



THE MADURA COLLEGE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University, Reaccredited (4th cycle) with “A” Grade by NAAC)

TPK Road, Madurai – 625 011, Tamil Nadu

www.maduracollege.edu.in

ACADEMIC COUNCIL

03.04.2024



ESTD : 1889

Learning Shines with Righteousness

BOOK 2 of 3

(Corrected Copy)

(Syllabi Pages : 748-1316)



THE MADURA COLLEGE (AUTONOMOUS)

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Ordinary Meeting of the Academic Council

Venue : Seminar Hall

Date : 03.04.2024

Time : 10.30 a.m.

Members are requested to bring with them this copy as well as the copy of the appendices.

R.Eswaran
Member Secretary

Dr. J. Suresh
Principal & Chairman



THE MADURA COLLEGE (AUTONOMOUS)

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ACADEMIC COUNCIL

Date: 13.03.2024

NOTICE

An ordinary meeting of the Academic Council will be held on **3rd April 2024** at **10:30 a.m.** at Seminar hall. Resolutions from Board of Studies and Private resolutions may be submitted to the Member Secretary, Academic Council (eswaran@maduracollege.edu.in) on or before 16.03.2024. The deadline for withdrawal of resolutions will be 19.03.2024 up to 3:00 p.m.

The agenda and resolutions to be discussed will be made available to the members sufficiently in advance.

Dr.R.Eswaran
Member Secretary

Dr.J.Suresh
Principal & Chairman



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ACADEMIC COUNCIL

MEMBERS IN THE ACADEMIC COUNCIL

Dr.J.Suresh

The Principal & Chairman

Dr.R.Eswaran

Member Secretary

EXTERNAL MEMBERS

Sri.S.Seetharaman,

President,

Madura College Board,

Madurai.

C.A.S.Natanagopal,

Secretary,

Madura College Board,

Madurai.

Sri.N.Anand Srinivasan,

Treasurer,

Madura College Board,

Madurai.

Dr.K.Perumal

Professor

Department of Computer Applications

School of Information Technology

Madurai Kamaraj University

Madurai – 625 021.

Dr.V.Ramarajapandian

Professor

Department of Modern Literature

School of Tamil Studies

Madurai Kamaraj University

Madurai – 625 021.

Dr.S.Saleema Rabiyyath.

Assistant Professor

Department of Journalism and Mass Communication

Directorate of Distance Education

Madurai Kamaraj University

Madurai – 625 021.

Dr.S.Vaidhya Subramanian,

Dean, (Member representing Education)

SASTRA University,

Tirumalai Samudiram,

Thanjavur – 613 401.

Sri.S.Sankaran,

(Member representing Profession)

Vice president – Madura College Board,

Madurai.

Sri.R.Sridharan,

(Member representing Profession)

Director – Madura College Board,

Madurai.

Sri.K.K.Raman,

(Member representing Industry)

President,

Sundaram Industries (TVS Rubber)

Madurai.

INTERNAL MEMBERS

Boards of Studies Chairmen	-	All Heads/Coordinators of the Department
Members of Academic Council	-	All Permanent Faculty Members
Special invitees	-	Nominated by Chairman
(Teachers on probation/Senior Faculties of SF stream)		



THE MADURA COLLEGE (AUTONOMOUS)

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ACADEMIC COUNCIL

AGENDA FOR THE MEETING ON 03.04.2024

1. Prayer
2. Welcome Address : The Chairman, Academic Council
3. Confirmation of the Minutes of the previous Academic Council Meeting held on 12.10.2023
4. Business brought forward by the Chairman
5. Resolutions of Boards of Studies from various Departments
6. Any other subjects brought forward by the Chairman
7. Observation & Remarks by the External Members
8. Vote of Thanks : Member Secretary
9. National Anthem

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I. CONFORMATION OF MINUTES OF THE PREVIOUS ACADEMIC COUNCIL MEETING HELD ON 12.10.2023.



THE MADURA COLLEGE

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MADURAI -625 011

MEETING OF THE ACADEMIC COUNCIL

Date : 12.10.2023 (Thursday)

Venue: Seminar Hall

Time : 10.30a.m.

MINUTES OF THE ACADEMIC COUNCIL MEETING

The ordinary meeting of the Academic Council was held in the Seminar Hall on Thursday, 12th October 2023 at 10.30 am.

Members Present

1) Dr. J. Suresh (Chairman, Academic Council)	35) Dr. R. Vennila
2) Dr. R. Eswaran (Member Secretary, Academic Council).	36) Dr. A. Karuppusamy
3) Sri. S. Seetharaman (Preseident, MCB)	37) Dr. S. Ramachandran
4) C.A.S. Natanagopal (Secretary, MCB)	38) Dr. S. Karthika
5) Dr. K. Perumal (University Nominee)	39) Prof. P. Jayalakshmi
6) Dr. V. Ramarajapandian (University Nominee)	40) Dr. S. Muthukumar
7) Dr. S. SaleemaRabiyath (University Nominee)	41) Dr. C. Thangapandi
8) Sri. S. Sankaran (Member representing Industry & Director, MCB)	42) Dr. R. Pandiselvi
9) Dr. S. Dhanasamy	43) Dr. K.M. Dharmalingam
10) Dr. A. Atheeswari	44) Dr. V. Ananthaswamy
11) Dr. G. Karunakaran	45) Dr. I. SahulHamid
12) Dr. V. Usha	46) Dr. U. Karthick Raja
13) Dr. M. Kannan	47) Dr. I. Padmavathi
14) Dr. D. Gandhimathi	48) Dr. S. Usha
15) Dr. S. Kannadasan	49) Dr. V. Sangeethasubha
16) Dr. Sheela P. Karthick	50) Dr. P. Vetriselvi
17) Dr. G. Sivasubramanian	51) Dr. R. Madhanagopal
18) Dr. A. Chandrabose	52) Dr. M. Venkateswaran
19) Dr. A. Vigneshkumar	53) Dr. A. Saberunnisa
20) Dr. S. Venkatesh	54) Dr. M. Rabert
21) Prof. B. Tamilselvi	55) Dr. M. Premarani
22) Prof. S. Murali	56) Prof. V. Meenakshisundaram
23) Prof. P. Manikandan	57) Prof. T. Vivekanandan
24) Dr. S. Theenathalayan	58) Prof. S. Sivaramakrishnan
25) Dr. P. Kannan	59) Dr. M. Kavitha
26) Dr. R. Gopi	60) Dr. G. Gowri
27) Dr. V. Sriman Narayanan	61) Dr. K. Neyvasagam
28) Dr. S. Karthikeyan	62) Dr. R. Vishnu Priya
29) Dr. S. Meenakshi	63) Dr. J. Sivasubramanian
30) Dr. A. Mayilmurugan	64) Dr. A. Xavier
31) Dr. S. Selvakumar	65) Dr. M. Karpagavalli
32) Dr. K. HemaMalini	66) Dr. P. Gajendran
33) Dr. Y. Natarajan	67) Dr. M. Malarvizhi
34) Dr. S. Chandrasekar	68) Prof. S. Vidhyasankar

69) Dr. S. Selvakumar	85) Dr. C. Selvakumar
70) Dr. P. Prasanna	86) Er. J. Rajendran
71) Dr. M. Boominathan	87) Prof. R. Umasankari
72) Dr. M. HasmathFarzana	88) Dr. T. SreeRamkumar
73) Dr. J. Shanmugapriya	89) Dr. K. Kathirvelpandian
74) Prof. S. Chella Pandian	90) Dr. N. Paneerselvam
75) Dr. P. Kannan	91) Dr. R. Karthikeyan
76) Dr. S. Karuppusamay	92) Prof. S. Selvaulaganathan
77) Dr. S. Gnaana Saraswathi	93) Dr. J. Premkumar
78) Prof. V. Meenakshisundaram	94) Prof. G. Sreedevi
79) Dr. M. Karpagajothi	95) Dr. R. Chitra
80) Dr. P. Jansirani	96) Dr. P. Pandi
81) Dr. N. Janakiraman	97) Prof. K. Rajasaravanakumar
82) Dr. S. Dinakaran	98) Prof. R. Suguna
83) Dr. L.D. Devasree	99) Dr. K. Rajeswari
84) Dr. B. Latha	100) Mr. M. Venkatraman

1. The meeting was called to order by Dr.J.Suresh, Principal and The Chairman of the Academic Council (*hereafter mentioned as The Chairman*). The meeting started with the college prayer. The Chairman welcomed Sri.S.Seetharaman, President, Madura College Board (MCB), CA.S.Natanagopal, Secretary, MCB, Sri.N.Anand Srinivasan, Treasurer, MCB, University nominees: Dr.K.Perumal, Dr.V.Ramarajapandian and Dr.S.SaleemaRabiyath, all Heads of the Departments (HoDs), Deans, Dr.N.Paneerselvam, Chief Coordinator (Self-Financing Stream), Controller of Examinations, Deputy Controller of Examinations, Assistant Controller of Examinations, Co-ordinators (SF stream) and all other members of the Academic Council.

2. The Chairman, in his welcome address, overviewed the milestones of achievements in the designing and implementation of Outcome Based Education (OBE), and also in the attainment calculation for Under-graduate (UG) & Post-graduate (PG) programmes. He narrated the stages of ceaseless updating of Curriculum based on Tamil Nadu State Council for Higher Education (TANSCH) model. And with delight, he announced that NAAC assessment has given high score (3.61 out of 4) for the Criterion-I (Curricular aspects) covering curriculum design and implementation. Furthermore, he also remembered the successful implementation of job-oriented courses and value-added courses under OBE. The chairman profusely thanked the Madura College Board for their support and encouragement. He also announced the forethought of the College Management's proposal to conduct the value added courses in collaboration with TVS Community College in the forthcoming years. He also correlated the vision & mission of the college with related planning in the curriculum and other aspects. The chairman concluded

by appreciating the support rendered by the faculty for the accomplishment. He also requested the faculty to carry the tradition and legacy of The Madura College forward.

3. The Minutes of the previous Academic Council meeting held on 20.07.2022 was confirmed and passed. The Chairman invited the Heads and Chairmen, Board of Studies (BoS) of all the Departments to present their resolutions one by one.

4. Resolutions No. **1.1. to 1.8.** were moved by **Dr.S.Dhanasamy**, Chairman, BoS of Tamil department and seconded by **Dr.A.Atheeswari**. Dr.S.Muthukumar, questioned the need of resolution 1.3. regarding the separate resolution for Part-I Tamil for B.A. Tamil students. Dr.A.Atheeswari explained that the Part-I Tamil also given for B.A. Tamil students too. After brief deliberations, Chairman (BoS) agreed to **withdraw resolution 1.3.**

Then, the motion was put to vote and CARRIED.

6. Resolutions No. **2.1.** and **2.2.** were moved by **Prof.S.Murali**, Chairman, BoS of Hindi department and seconded by **Dr.S.Dinakaran**. Dr.S.Muthukumar requested to remove the word “curriculum” in the resolution. Prof.S.Murali agreed to correct the resolution.

Then, the motion was put to vote and CARRIED.

7. Resolutions No. **3.1.** and **3.2.** were moved by **Prof.P.Manikandan**, Chairman, BoS of Sanskrit department and seconded by **Prof.S.Murali**. He also agreed to remove the word “curriculum” in the resolution.

Then, the motion was put to vote and CARRIED.

8. Resolutions No. **4.1. to 4.8.** were moved by **Dr.Sheela P.Karthick**, Chairperson, BoS of English department and seconded by **Dr.G.Sivasubramanian**. Dr.S.Muthukumar requested to mention B.Sc. Statistics in the tabular column in Page No. 197. He also suggested the department to mention one of the B.Com. courses as B.Com (Financial Marketing Analytics) instead of B.Com (Corporate Markets). He also advised the department to mention General English-I in the Table at page number 220. She agreed for the changes suggested by the member. In response to Resolution 4.8, The chairman questioned the need of resolution for changing the type of course. Dr.Sheela P.Karthick narrated the need of changing and highlighted benefits gain by the students.

Then, the motion was put to vote and CARRIED.

8. Resolutions No. **5.1. to 5.7.** were moved by **Dr.S.Theenathayalan**, Chairman, BoS of Economics department, and seconded by **Dr.P.Kannan**.

Prof.S.Chellapandian questioned the use of the term “revised curriculum” in the resolution. Dr.S.Theenathayalan explained that the department followed the standard format for resolutions supplied by the college. Dr.S.Muthukumar queried about the resolution 5.5 regarding the Skill Enhancement (SEC) offered by the department. He also suggested to include the word “M.A. Economics” in the resolution. Dr.S.Theenathayalan agreed to make changes in the resolution.

Then, the motion was put to vote and CARRIED.

9. Resolution Nos. **6.1. to 6.11.** were moved by **Dr.A.Mayil Murugan**, Chairman, BoS of Commerce department, and seconded by **Dr.S.Selvakumar**. Prof.S.Chellapandian requested to remove the word “curriculum” in the resolution as done by other departments. Dr.S.Muthukumar suggested to include the programme name in bracket for the SEC course, Fundamentals of Accounting software. Dr.S.Muthukumar also queried about resolution no.6.4, regarding programme approval from Madurai Kamaraj University. The chairman intervened and conveyed that since we received the approval from the University, the word “subject to Approval” may be removed in the resolution no.6.4. Dr.S.Muthukumar and Dr.A.Xavier queried about the usage of the term “Multidisciplinary course (MDC)” instead of Inter-disciplinary course (IDC) as used by other departments. Dr.A.Mayilmurugan replied that it was decided in the earlier meeting as the usage as MDC for commerce instead of IDC. Prof.S.Sivaramakrishnan opined that the word “curriculum” can be removed in the resolutions 6.9 and 6.10. Dr.Mayilmurugan requested the approval from the August body to include the quiz in the extended component of the table in page number 461. Then, the motion was put to vote and CARRIED.

9. Resolutions No.**7.1. to 7.12.** were moved by **Dr.S.Muthukumar**, Chairman, BoS of Mathematics department and seconded by **Dr.C.Thangapandi**. While presenting resolution 7.3, Dr.S.Dinakaran requested to clarify whether the resolution is for UG or PG. Dr.A.Xavier and Prof.S.Sivaramakrishnan clarified that Generic Elective courses are for I year and II year UG students and hence suggested to correct the resolution by adding the word ‘UG’ in the resolution. Prof.S.Sivaramakrishnan reiterated that Generic Elective courses cannot be offered for the students by the parent department as we decided to consider Generic Elective courses as equal with allied courses. Dr.S.Muthukumar agreed for the changes in the resolution. Then, the motion was put to vote and CARRIED.

10. Resolutions No.8.1 to 8.10. were moved **Dr.P.Vetriselvi**, Chairperson, BoS of Statistics department and seconded by **Dr.P.Madhanagopal**. Dr.S.Muthukumar pointed out the typographical error in Page number 1007 as the total number of credit was mentioned as 20 instead of 22. Further, he suggested to include the word “PG programmes” in the resolutions 8.4. & 8.5. Dr.P.Vetriselvi agreed to correct the resolutions. Dr.S.Muthukumar also suggested to extend the certificate courses by the department to UG students too. The chairperson also counseled that if the department wishes to extend the courses to UG students, the department can place it in the next BoS and pass the resolution in the ensuing Academic council meeting.

Then, the motion was put to vote and CARRIED.

11. Resolutions No. 9.1. to 9.6. were moved **Dr.M.Prema Rani**, Chairperson, BoS of Physics department, and seconded by **Prof.V.Meenakshi Sundaram**. She requested to correct the typographical errors in Page number 1096 and pleaded the August body for the nod for changing the credits as per standard pattern followed for science departments in the college. Dr.S.Muthukumar suggested to split up the table semester-wise in Page number 1151. He also requested to mention “PG programme” in resolutions 9.4.. Dr.M.Prema Rani agreed to correct the changes suggested by the members.

Then the motion was put to vote and CARRIED.

12. Resolutions No. 10.1. to 10.10. were moved by **Dr.A.Xavier**, Chairman, BoS of Chemistry department and seconded by **Dr.M.Karpagavalli**. Dr.S.Muthukumar requested clarification regarding ancillaries (General Electives) offered to various departments. Dr.A.Xavier reiterated that the pattern followed for clustering of ancillary departments is different for theory and practical. He added that B.Sc. maths students and Zoology students are clustered for the practical, and for theory Zoology is combined with Botany. While reading resolution 10.3., Prof.S.Sivaramakrishnan suggested not to mention the programme name in the resolution. Dr.K.Perumal, University nominee, also supported for mentioning the programme name in the resolution. While passing the resolution 10.5, members requested to remove the term “SF stream” in the resolution. Dr.A.Xavier agreed for the change in resolution. At the end, The chairman, Academic Council, requested the BoS chairmen not to read the page numbers while reading the resolutions.

Then, the motion was put to vote and CARRIED.

13. Resolutions Nos. **11.1. to 11.8.** were moved by **Prof.S.Chellapandian**, Chairman, BoS of Botany department and seconded by **Dr.P.Kannan**. Dr.S.Muthukumar requested to change the word “introduce” instead of “ratify” in the resolutions. The chairman suggested to remove the words, “question paper pattern” in the resolutions 11.1, 11.2 & 11.3. Prof.S.Chellapandian agreed and read all the resolutions by mentioning the changes suggested by the member and The chairman. Dr.S.Muthukumar questioned the need of passing of syllabi for Botany allied papers to be offered in 3rd and 4th semesters in the current meeting. The chairman, Academic Council, intervened and supported the stand of Botany department.

Then, the motion was put to vote and CARRIED.

14. Resolutions No. **12.1. to 12.4.** were moved by **Dr.S.Dinakaran**, Chairman, BoS of Zoology department and seconded by **Dr.L.D.Devasree**. The council unanimously agreed the resolutions.

Then the motion was put to vote and CARRIED.

Dr.S.Dinakaran requested The Chairman, to give one page printout containing resolutions to be read by the particular BoS chairman, which may be easier to carry instead of carrying the voluminous Academic council books containing more than 1900 pages. The chairman agreed to give.

15. Resolutions No. **13.1 to 13.4.** were moved by **Er.J.Rajendran**, Chairman, BoS of Computer Science department and seconded by **Prof.R.Umasankari**. He read the resolutions by mentioning the corrected word “ratify” in the resolutions. He also requested the members to read the course title (23U1DCCT1) as “Programming in C” instead of “C Programming”. Dr.S.Muthukumar questioned on passing the resolution 13.2. since the resolution passed already in the BoS of Mathematics Department. It went on larger deliberation. At the end, members suggested to withdraw the resolution. Er.J.Rajendran, with the approval of The chairman, Academic Council **withdrew the resolution 13.2.**

Then, the motion was put to vote and CARRIED.

16. Resolutions No. **14.1. to 14.6.** were moved by **Prof.K.Rajasaravanakumar**, Chairman, BoS of Information Technology department and seconded by **Dr.K.Rajeswari**. The motion was then thrown open for discussion. Dr.S.Muthukumar requested to mention UG programme and PG programme in the Resolutions 14.3. and 14.4. respectively. Prof.K.Rajasaravanakumar agreed to correct the changes suggested by the member.

Then, the motion was put to vote and CARRIED.

17. Resolutions No.15.1. to 15.6. were moved by **Dr.K.Rajeswari**, Chairperson, BoS of Microbiology department and seconded by **Prof.R.Suguna**. Dr.S.Mutkukumar queried about the department offering the course, Basic and Clinical Chemistry. Dr.K.Rajeswari replied that the paper was offered by the department itself. By indicating page number 1721, Dr.S.Mutkukumar requested to change the marks mentioned in the CIA and semester examinations as 25 and 75 respectively. Prof.S.Chellapandian requested to change the word “pass” in the resolution to “ratify”. Dr.K.Rajeswari agreed to correct the changes suggested by the members. Then, the motion was put to vote and CARRIED.

18. Resolutions No.16.1. to 16.4. were moved by **Prof.R.Suguna**, Chairperson, BoS of Biotechnology department and seconded by **Dr.K.Rajeswari**. Members unanimously agreed for passing the resolutions. Then the motion was put to vote and CARRIED.

19. Resolutions No.17.1. and 17.2. were moved by **Prof.S.Sivaramakrishnan**, Dean (Academics) and seconded by **Dr.I.Sahul Hamid**, Dean (Planning & Development). Then, the motion was put to vote and CARRIED. Dr.S. Gnaana Saraswathi queried about the preparation of question bank for the new courses introduced. The chairman, Academic Council replied that, question banks can be prepared as the basis of necessity. And regarding the supply of new question bank for the courses under TANSCHÉ, as decided in earlier meetings no question bank will be supplied for the courses passed.

The Chairman requested the University nominees to give their observations and remarks. Dr.K.Perumal expressed his views about the deliberations of the academic council as follows:

1. He congratulated all the members for the fruitful deliberations and felt very happy to be a part of it.
2. He also highlighted the difficulty in following TANSCHÉ pattern as it rejects the diversity in the content of syllabi.
3. He suggested to include the recent references and asked books to avoid which are decades old.
4. He recommended to introduce the Skill Based papers in line with core courses.
5. Also, he suggested to include computer science - oriented courses especially Artificial Intelligence in various domains.

Dr.V.Ramarajapandian expressed his views as follows:

1. He cherished the tradition of The Madura College by remembering the achievements made by The Madura College in the arena of academics.
2. He felt happy to be a part of the Academic council of this college.
3. He also suggested to include the recent developments in Part-I language & Part-V.

20. The Member secreatry, Dr.R.Eswaran proposed vote of thanks .

21. The Chairman, Academic Council, adjourned the Academic Council *sine die* and as a mark of completion of this academic exercise National Anthem was sung by all the participants.



Dr.R.Eswaran

Member Secretary



Dr.J.Suresh

Principal & Chairman

II. BUSINESS BROUGHT FORWARD BY THE CHAIRMAN

III. RESOLUTIONS BROUGHT FORWARD BY HEADS OF VARIOUS DEPARTMENTS

1) FROM THE BOARD OF STUDIES OF TAMIL DEPARTMENT

Dr.S.Dhanasamy, Chairman, Board of Studies in Tamil, shall move and **Dr.A.Atheeswari** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

- 1.1. Resolved to introduce the revised syllabus for II year B.A./B.Sc. and B.Com. (other than B.A. Tamil) Part-I Tamil for students who joined the programme from the academic year 2023-24 **(pp 1-11, 13)**.
- 1.2. Resolved to introduce the revised syllabus for II year B.A. Tamil, Part-I Tamil for students who joined the programme from the academic year 2023-24 **(pp 14-18, 46-50)**.
- 1.3. Resolved to introduce the revised curriculum, syllabus, programme structure for II year B.A. Tamil for students who joined the programme from the academic year 2023-24 **(pp 12, 19-42, 45, 51-75)**.
- 1.4. Resolved to introduce the revised Add On courses titled 'IDHAZHİYAL' and 'KAVITHAIK KALAI' to be offered during the III and IV Semester of B.A. Tamil for students who joined the programme from the academic year 2023-24 **(pp 13, 43-44, 76-78)**.
- 1.5. Resolved to introduce the revised Self Study course titled 'PUDHUMAIPITTHAN' of II B.A. Tamil for students who joined the programme from the academic year 2023-24 **(pp 13, 79-80)**.
- 1.6. Resolved to introduce the revised curriculum, syllabus, programme structure for II year M.A. Tamil for students who joined the programme from the academic year 2023-24 **(pp 81-153)**. The curriculum includes a Multi-disciplinary course titled TAMIL AZHAKIYAL offered jointly with the department of Economics and Botany **(pp 112-118)**.

**Resolutions 1.7. & 1.8. – withdrawn*

2) FROM THE BOARD OF STUDIES OF HINDI DEPARTMENT

Prof.S.Murali, Chairman, Board of Studies in Hindi, shall move and **Dr.S.Dinakaran** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

- 2.1. Resolved to pass the revised syllabus for Part-1 Language Hindi based on TANSCHÉ model curriculum for Second year B.A./ B.Sc./ B.Com. Programme for students who join the programme from the Academic year 2023-24 (**pp 154-165**).

3) FROM THE BOARD OF STUDIES OF SANSKRIT DEPARTMENT

Prof.P.Manikandan, Chairman, Board of Studies in Sanskrit, shall move and **Prof.S.Murali** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

- 3.1. Resolved to pass the revised syllabus for Part-1 Language Sanskrit based on TANSCHÉ model curriculum for Second year B.A./B.Sc./ B.Com. Programme for students who join the programme from the Academic year 2023-24. (**pp 166-180**).

4) FROM THE BOARD OF STUDIES OF ENGLISH DEPARTMENT

Dr.SheelaP.Karthick, Chairman, Board of Studies in English, shall move and **Dr.G.Sivasubramanian** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

- 4.1. Resolved to pass the syllabi for Part II English based on TANSCHÉ model curriculum for the second year (semester III & IV) B.A./B.Sc./ B.Com. programmes under outcome based education with Choice Based Credit System for students who joined the programmes from the Academic year 2023-2024 (**pp 181-196**).
- 4.2. Resolved to pass the revised curriculum, programme structure and syllabi based on the TANSCHÉ model curriculum, under outcome based education with choice based credit system for the second year (Semester III & IV) B.A. English programme for students who joined the programme from the Academic year 2023-24 (**pp 197-242**).
- 4.3. Resolved to pass the revised curriculum, programme structure and syllabi based on the TANSCHÉ model curriculum for the second year (semester III & IV) M.A. English programme for students who joined the programme from the Academic year 2023-24 (**pp 243-303**).The curriculum includes a Multi –Disciplinary Course on “Green Studies” offered jointly with the department of Tamil and Botany (**pp 264-269**).

- 4.4. Resolved to pass the syllabus for the Generic elective courses to be offered by the department of English to B.A. English programme for students who joined the programme from the Academic year 2023-24 (**pp 207-211, 229-232**).
- 4.5. Resolved to pass the syllabus for the Discipline specific elective courses to be offered to students of M.A.English programme who joined the programme from the Academic year 2023-24 (**pp 259-263, 289-293**).
- 4.6. Resolved to pass the syllabus for Skill Enhancement courses to be offered to the students of B.A.English programme who joined the programme from the Academic year 2023-24 (**pp 212-220, 233-240**).
- 4.7. Resolved to pass the syllabus for Skill Enhancement courses to be offered to the students of M.A.English programme who joined the programme from the Academic year 2023-24 (**pp 294-291**).
- 4.8. Resolved to pass the syllabus for Skill Enhancement course to be offered as NME to all PGprogrammes for students who joined the respective programmes from the Academic year 2023-24 (**pp 270-274**).

5) FROM THE BOARD OF STUDIES OF ECONOMICS DEPARTMENT

Dr.S.Theenathayalan, Chairman, Board of Studies in Economics, shall move and **Dr.P.Kannan** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

- 5.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for II - B.A. Economics Programme for students who have joined from the Academic year 2023-24 and onwards (**pp 304-368**).
- 5.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for II - M.A. Economics programme for Students who have joined from the Academic Year 2023-24 and onwards (**pp 369-433**). The curriculum includes a Multi-Disciplinary course offered jointly with the departments of Tamil, Commerce and Statistics (**pp 391-395**).
- 5.3. Resolved to pass the syllabi for the Generic Elective Courses (GEC) to be offered to the students of II – Year B.A. Economics and II – Year M.A. Economics programmes who have joined the respective programmes from the Academic year 2023-24 and onwards (**pp 322-326, 350-353, 386-390, 415-424**).

- 5.4. Resolved to pass the syllabi for Skill Enhancement Courses (SEC) to be offered for the II - Year B.A. Economics and II – Year M.A. Economics programmes for the students who have joined their respective programmes from the Academic Year 2023-24 and onwards **(pp 327-335, 354-358; 425-429)**.
- 5.5. Resolved to introduce a Non-Major Elective Course (NME) titled “Budget and Financial Administration” in the Third Semester for the students who have joined their respective programmes from the Academic Year 2023-24 and onwards **(pp 396-400)**.
- 5.6. Resolved to introduce two Add-on Courses namely Rural Development Studies and Labour Economics for the students of II – B.A. Economics who have joined from the Academic Year 2023-24 and onwards **(pp 359-362)**.
- 5.7. Resolved to introduce a Self Study Course entitled Energy Economics for the students of II – B.A. Economics who have joined from the Academic Year 2023-24 and onwards **(pp 363-364)**.
- 5.8. Resolved to introduce a Certificate Course entitled Economics for Competitive Examinations for the students of all Under Graduate Students (Open to all) who have joined from the Academic Year 2023-24 and onwards **(pp 365-366)**.
- 5.9. Resolved to introduce Internship, Project cum viva-voce and Extension Activity for the II – M.A. Economics students who have joined from the Academic Year 2023-24 and onwards as per TANSCHÉ guidelines **(pp 401-402, 413-414, 430-431)**.

6) FROM THE BOARD OF STUDIES OF COMMERCE DEPARTMENT

Dr.A.Mayilmurugan, Chairman, Board of Studies in Commerce, shall move and **Dr.S.Selvakumar** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 6.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for second year B.Com (General) Programme for students who joined the programme from the Academic year 2023-24 **(pp 434-436, 444, 448-657)**.
- 6.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for second year B.Com (Professional Accounting) Programme for students who joined the programme from the Academic year 2023-24 **(pp 437-438, 445, 448-657)**.

- 6.3. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for second year B.Com (Banking and Insurance) Programme for students who joined the programme from the Academic year 2023-24 (**pp 439-440, 446, 448-657**).
- 6.4. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for second year B.Com (Financial Marketing Analytics) Programme for students who joined the programme from the Academic year 2023-24 (**pp 441-442, 447, 448-657**).
- 6.5. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for second year M.Com. programme for Students who joined the programme from the Academic Year 2023-24 (**pp 443, 658-733**).
- 6.6. Resolved to pass Multi-Disciplinary Course on “Insurance, Actuarial Statistics and Economy” for II year M.Com students during III Semester for those who have joined from the Academic Year 2023-24. The course is offered with the departments of Economics and Statistics (**pp 688-693**).
- 6.7. Resolved to pass Non Major Elective (NME) course on “Marketing and Salesmanship” for PG students (other than Commerce) during III Semester for the students who have joined their respective programmes from the Academic Year 2023 -24 (**pp 694-698**).
- 6.8. Resolved to pass the revised syllabi for Generic elective courses ‘Financial Accounting’ and ‘Cost and Management Accounting’ based on TANSCHÉ model curriculum for second year B.Sc (IT) Programme during III Semester and IV Semester respectively for students who have joined the programme from the Academic year 2023-24 (**pp 734-743**).
- 6.9. Resolved to pass the revised syllabi for Skill Enhancement Course ‘Basic Accountancy’ based on TANSCHÉ model curriculum for second year B.A (Economics) Programme during IV Semester for students who joined the programme from the Academic year 2023-24 (**pp 744-747**).

7) FROM THE BOARD OF STUDIES OF MATHEMATICS DEPARTMENT

Dr.S.Muthukumar, Chairman, Board of Studies in Mathematics, shall move and **Dr.C.Thangapandi** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 7.1. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for II B.Sc. Mathematics students who joined the programme from the Academic year 2023-24 **(pp 748-785)**.
- 7.2. Resolved to pass the revised curriculum and syllabi based on TANSCHÉ model curriculum for II M.Sc. Mathematics Students who joined the programme from the Academic Year 2023-24 **(pp 786-864)**.
- 7.3. Resolved to pass the revised syllabus for the Generic Elective courses offered to the students of programme other than their programme of study and who joined their respective programmes from the Academic year 2023-24 **(pp 865-883)**.
- 7.4. Resolved to pass the revised syllabus for Skill Enhancement Courses offered to the students of II B.Sc. Mathematics students who joined the programmes from the Academic year 2023-24 **(pp 760-767, 776-783)**.
- 7.5. Resolved to pass the revised syllabus for Skill Enhancement courses in the third semester offered to the students of M.Sc. Mathematics who joined the programme from the Academic Year 2023-24 **(pp 849-852)**.
- 7.5. Resolved pass the revised syllabus for the NME courses offered to students of PG programmes in the third semester for students of programmes other than their programme of study who joined from the Academic Year 2023-24 **(pp 814-818)**.
- 7.6. Resolved to ratify the presentation of elaborate form of syllabus and the inclusion of section numbers in the textbook content for the paper “Computational Mathematics” 23U2MSED3 for the first year under graduate students in second semester **(pp 884-888)**.
- 7.7. Resolved to ratify the inclusion of one more elective paper in each of the core elective theory course namely “Fuzzy sets and its applications”, subject code 23P1MECT1(B) as core elective –I and one core elective theory course namely ”Object Oriented System Development”, subject code 23P1MECT2(B) and the respective practical paper namely “Practical in Object Oriented System Development”, subject code 23P1MECP1(B) as core elective –II in first semester **(pp 889-901)**.
- 7.8. Resolved to ratify the inclusion of one more elective paper in each of the core elective theory course namely “Mechanics” subject code 23P2MECT3(B) as core elective –III , “Numerical Analysis”, subject code 23P2MECT4(B) as core elective –IV and “Formal Languages”, subject code 23P2MECT5(B) as core elective –V in second semester **(pp 902-916)**.

- 7.9. Resolved to pass the syllabus for “Certificate Course entitled “Industrial Quality Techniques” to post graduate students of all programmes (pp 917-918).

8) FROM THE BOARD OF STUDIES OF STATISTICS DEPARTMENT

Dr.P.Vetriselvi, Chairman, Board of Studies in Statistics, shall move and **Dr.R.Madhanagopal** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 8.1. Resolved to pass the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year B.Sc. Statistics programme for students who join the programme from the Academic year 2023-24 onwards (pp 919-963).
- 8.2. Resolved to pass the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year M.Sc. Statistics programme for Students who join the programme from the Academic Year 2023-24 onwards (pp 966-1041).
- 8.4. Resolved to pass the syllabus for Skill Enhancement Courses (NME) to be offered to the students of programmes other than their programme of study and who join their respective programmes from the Academic Year 2023-24 onwards (pp 997-1001).
- 8.5. Resolved to pass the syllabus for Skill Enhancement Courses to be offered to the students of II B.Sc. Statistics and II M.Sc. Statistics Programme(s) who join these programmes from the Academic Year 2023-24 (pp 934-938, 952-955; 1031-1035).
- 8.6. Resolved to introduce the certificate course entitled “Official Statistics” to Under-graduate students from the Academic year 2023-2024 (pp 964-965).

**Resolution 8.3. – withdrawn*

9) FROM THE BOARD OF STUDIES OF PHYSICS DEPARTMENT

Dr.M.PremaRani, Chairman, Board of Studies in Physics, shall move and **Mr.V.Meenakshi Sundaram** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 9.1. Resolved to introduce the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year B.Sc. Physics Programme for students who joined the programme from the Academic year 2023-24 (pp 1042-1080).

- 9.2. Resolved to pass the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year M.Sc. programme for Students who joined the programme from the Academic Year 2023-24 (**pp 1081-1145**).
- 9.3. Resolved to pass the syllabus for the Discipline Specific Elective courses to be offered to the students of M.Sc. Physics and who joined the programme from the Academic year 2023-24 (**pp 1095-1105, 1126-1136**).
- 9.4. Resolved to pass the syllabus for Skill Enhancement Courses (NME) to be offered to the students of programmes other than their programme of study and who joined their respective programmes from the Academic Year 2023-24 (**pp 1111-1115**).
- 9.5. Resolved to pass the syllabus for Skill Enhancement Courses to be offered to the students of B.Sc. & M.Sc. Physics Programme(s) who join these programmes from the Academic Year 2023-24 (**pp 1052-1061, 1070-1079; 1137-1141**).
- 9.6. Resolved to pass Multi-Disciplinary Course “Material Science” for M.Sc. students those who have joined from the Academic Year 2023-24. The course is offered jointly with the departments of Mathematics and Chemistry (**pp 1106-1110**).

10) FROM THE BOARD OF STUDIES OF CHEMISTRY DEPARTMENT

Dr.A.Xavier, Chairman, Board of Studies in Chemistry, shall move and **Dr.P.S.Harikrishnan** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 10.1. Resolved to pass the curriculum and syllabus based on TANSCHÉ model curriculum for second year B.Sc., Chemistry Programme for students who joined the programme from the Academic year 2023-24 onwards (**pp 1146-1168, 1184-1203, 1217-1220, 1237-1241**).
- 10.2. Resolved to pass the curriculum and syllabus based on TANSCHÉ model curriculum for second year M.Sc., Chemistry programme for Students who joined the programme from the Academic Year 2023-24 onwards (**pp 1242-1316**).
- 10.3. Resolved to pass the syllabus for the Generic elective courses to be offered to the students of programmes other than their programme of study and who join their respective programmes from the Academic year 2023-24 onwards (**pp 1169-1183, 1204-1216, 1221-1236**).

- 10.4. Resolved to pass the syllabus for Skill Enhancement Courses (NME) to be offered to the all PG students who join their respective programmes from the Academic Year 2023-24 onwards (**pp 1276-1280**).
- 10.5. Resolved to pass the syllabus for Skill Enhancement Course (SEC) to be offered to students of second year B.Sc., Chemistry who joined the programme from the Academic year 2023-2024 onwards (**pp 1159-1168, 1194-1203**).
- 10.6. Resolve to ratify the change of course title as Foundation Course should be renamed as Introductory Chemistry (23U1CFCT1) for the first year B.Sc., students who have joined during the Academic Year 2023 – 24 onwards. pg. no. 1244

11) FROM THE BOARD OF STUDIES OF BOTANY DEPARTMENT

Prof.S.Chellapandian, Chairman, Board of Studies in Botany, shall move and **Dr.P.Kannan** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 11.1. Resolved to pass the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year B.Sc. Botany Programme for students who joined the programme from the Academic year 2023-24 (**pp 1317-1353**).
- 11.2. Resolved to pass the revised curriculum and syllabus based on TANSCHÉ model curriculum for second year M.Sc. Botany programme for students who joined the programme from the Academic Year 2023-24 (**pp 1354-1410**).
- 11.3. Resolved to pass the syllabus for the Generic elective courses to be offered to the second year Zoology major students from the Academic year 2023-24.
- 11.4. Resolved to pass the syllabus for Skill Enhancement Courses to be offered to the students of second year of B.Sc. Botany who joins the programme from the Academic Year 2023-24 (**pp 1330-1339, 1346-1353**).
- 11.5. Resolved to pass the syllabus for Skill Enhancement Courses (NME) to be offered to PG students who joined their respective programmes from the Academic Year 2023-24 (**pp 1382-1386**).

11.6. Resolved to pass the syllabus for Certificate course 'Flower arrangement' from the academic year 2024-25 to the students of all the UG and PG courses (**pp 1411-1414**).

12) FROM THE BOARD OF STUDIES OF ZOOLOGY DEPARTMENT

Dr.S.Dinakaran, Chairman, Board of Studies in Zoology, shall move and **Dr.L.D.Devasree** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

12.1. Resolved to ratify the syllabi for II semester of B.Sc. Zoology programme for students who joined the programme from the academic year 2023-2024 (**pp 1415-1416, 1419-1434**).

12.2. Resolved to ratify the syllabi for the Generic Elective courses offered to the II semester of B.Sc. Botany students who joined the programme from the Academic year 2023-24 (**pp 1418, 1435-1441**).

12.3. Resolved to pass the curriculum and syllabi based on TANSCHÉ model curriculum for III semester and IV semester of B.Sc. Zoology programme for students who joined the programme from the Academic year 2023-24 (**pp 1417-1418, 1442-1482**).

12.4. Resolved to pass the syllabus for Skill Enhancement Courses offered to the students of II B.Sc. Zoology who joined the programmes from the Academic year 2023-24 (**pp 1456-1460, 1470-1479**).

**Resolutions 12.5.& 12.6. - withdrawn*

13) FROM THE BOARD OF STUDIES OF COMPUTER SCIENCE DEPARTMENT

Er.J.Rajendran, Chairman, Board of Studies in Computer Science, shall move and **Prof.R.Uma Sankari** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

13.1. Resolved to pass and implement the Revised curriculum and syllabus based on the TANSCHÉ model curriculum for Semester III and Semester IV of II B.Sc. Computer Science Programme for students who joined the programme from the Academic year 2023-24 (**pp 1483-1529**).

13.2. Resolved to pass the syllabus for the Generic elective courses based on the TANSCHÉ model curriculum to be offered in the III and IV semesters to the students of II B.Sc. Computer Science programme who joined the programme from the Academic year 2023-24 (**pp 1492-1495, 1514-1518**).

13.3. Resolved to pass the syllabus for Skill Enhancement Courses to be offered in the III and IV semesters to the students of II year B.Sc. Computer Science Programme who joined the programme from the Academic year 2023-24 (**pp 1496-1505, 1519-1528**).

14) FROM THE BOARD OF STUDIES OF INFORMATION TECHNOLOGY DEPARTMENT

Prof.K.RajaSaravanaKumar, Chairman, Board of Studies in Information Technology, shall move and **Dr.K.Rajeswari** shall second the following resolutions, passed in the Board of Studies meeting held on 13.02.2024.

14.1. Resolved to pass the revised Curriculum and Syllabi based on TANSCHÉ Model Curriculum for Second Year B.Sc. Information Technology students who joined the Programme from the Academic year 2023-24 (**pp 1530-1577, 1582-1585**).

14.2. Resolved to pass the revised Curriculum and Syllabi based on TANSCHÉ Model Curriculum for Second Year M.Sc. Computer Science Students who joined the Programme from the Academic Year 2023-24 (**pp 1586-1662**).

14.3. Resolved to pass the Syllabi for Skill Enhancement Courses to be offered to the Second year B.Sc. Information Technology students who joined the Programme from the Academic Year 2023-24 (**pp 1546-1554, 1564-1573**).

14.4. Resolved to pass the Syllabus for Multi Disciplinary Course to be offered to the Second Year M.Sc. Computer Science students who joined the Programme from the Academic Year 2023-24. This Course is offered jointly with the Departments of Mathematics and Physics (**pp 1615-1619**).

14.5. Resolved to pass the Syllabus for Skill Enhancement Course (NME) titled “Basic Excel Techniques” to be offered to the students of Second year PG Programmes other than their Programme of study and who joined their respective Programmes from the Academic Year 2023-24 (**pp 1620-1625**).

14.6. Resolved to pass the Syllabus for Professional Competency Skill Course titled “Quantitative Aptitude” to be offered to the Second Year M.Sc. Computer Science students who joined the Programme from the Academic Year 2023-24 (**pp 1650-1654**).

- 14.7. Resolved to pass the Syllabi for Add-On Courses titled “Multimedia Tools” and “R Programming” to be offered during Third and Fourth Semester of B.Sc. Information Technology for students who joined the Programme from the Academic Year 2023-24 (pp 1574-1577).
- 14.8. Resolved to pass the Syllabus for Add-On Course titled “Values and Ethics in Research” to be offered in the Second Year to M.Sc. Computer Science students who joined the Programme from the Academic Year 2023-24 (pp 1657-1659).
- 14.9. Resolved to pass the Syllabi for Certificate Courses titled “Web Designing Tools” and “PC Hardware & Troubleshooting” to be offered to the students who joined from the Academic Year 2023-24 (pp 1578-1581).
- 14.10. Resolved to pass the Syllabus for Self Study Course titled “Quantitative Aptitude” to be offered to the Second Year B.Sc. Information Technology students who joined the Programme from the Academic Year 2023-24 (pp 1582-1583).

15) FROM THE BOARD OF STUDIES OF MICROBIOLOGY DEPARTMENT

Dr.K.Rajeswari, Chairman, Board of Studies in Microbiology, shall move and **Prof.R.Suguna** shall second the following resolutions, passed in the Board of studies meeting held on 13.02.2024.

- 15.1. Resolved to pass the revised syllabus based on TANSCHÉ model curriculum for second year B.Sc Microbiology Programme for students who join the programme from the Academic year 2023-24 (pp 1663-1707, 1724-1731).
- 15.2. Resolved to pass the revised syllabus based on TANSCHÉ model curriculum for second year M.Sc Microbiology programme for students who join the programme from the Academic Year 2023-24 (pp 1732-1819).
- 15.3. Resolved to pass the syllabus for the Generic elective courses to be offered to the students of programmes II year B.Sc., Biotechnology who join their respective programmes from the Academic year 2023-24 (pp 1666, 1708-1723).
- 15.4. Resolved to pass the syllabus for add-on courses titled “Biostatistics and Bioinformatics”, “Introduction to Medical Coding” semester III, IV respectively and self-study course titled ‘Bioenergy’ for B.Sc., Microbiology programme for students who join the programme from the Academic Year 2023-24 (pp 1724-1728).

15.5. Resolved to pass the syllabus for Skill Enhancement Courses as NME to be offered to the PG students of programmes other than their programme of study who join their respective programmes from the Academic Year 2023-24 (**pp 1768-1772**).

15.6. Resolved to pass the syllabus for Multi-disciplinary course (MDC) for III semester of second year M.Sc Microbiology programme for students who join the programme from the Academic Year 2023-24. The course is offered jointly with the departments of Mathematics and Computer Science (**pp 1762-1767**).

Resolution 15.7. - withdrawn

16) FROM THE BOARD OF STUDIES OF BIOTECHNOLOGY DEPARTMENT

Prof.R.Suguna, Chairman, Board of Studies of Biotechnology, shall move and **Dr.K.Rajeswari** shall second the following resolutions passed in the Board of Studies meeting held on 13.02.2024.

16.1. Resolved to ratify the programme structure for B.Sc. Biotechnology Programme for II semester from the Academic year 2023-24 (**pp 1820-1824**).

16.1. Resolved to pass the programme structure for B.Sc. Biotechnology Programme for II Year from the Academic year 2023-24 (**pp 1820-1824**).

16.2. Resolved to ratify the syllabi for B.Sc. Biotechnology II semester for the students who joined the programme from the Academic year 2023-24 (**pp 1825-1841**).

16.3. Resolved to ratify the syllabi for Generic Elective Biotechnology offered to I B.Sc. Microbiology II semester for the students who joined the programme from the Academic year 2023-24 (**pp 1875-1888**).

16.4. Resolved to pass the curriculum and syllabi for Second year B.Sc. Biotechnology Programme for students who joined the programme from the Academic year 2023-24 (**pp 1842-1874, 1889-1893**).

16.5. Resolved to pass the syllabi for Add-on courses titled “Forensic Biotechnology” and “Herbal Medicine” offered to Second year B.Sc. Biotechnology Programme for students who joined the programme from the Academic year 2023-24 (**pp 1889-1890**).

16.6. Resolved to pass the syllabus for Self-study course titled “Good Laboratory Practices” offered to Second year B.Sc. Biotechnology Programme for students who joined the programme from the Academic year 2023-24 (**P 1891**).

17) FROM THE BOARD OF STUDIES IN NATIONAL CADET CORPS (NCC)

Dr.S.V.Karthikeyan, Chairman, Board of studies in NCC, shall move and **Dr.K.Kathirvelpandian**, shall second the following resolutions passed in the meeting of the Board of studies in NCC held on 13.02.2024.

17.1. Resolved to pass the revised syllabus for Part-V NCC in the fourth semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1899-1902**).

17.2. Resolved to ratify the revised syllabus for Part-V NCC in the second semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1894-1898**).

18) FROM THE BOARD OF STUDIES IN NATIONAL SERVICE SCHEME (NSS)

Dr.Y.Natarajan, Chairman, Board of studies in NSS, shall move and **Dr.M.Kannan**, shall second the following resolutions passed in the meeting of the Board of studies in NSS held on 13.02.2024.

18.1. Resolved to pass the revised syllabus for Part-V NSS in the fourth semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1907-1910**).

18.2. Resolved to ratify the revised syllabus for Part-V NSS in the second semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1903-1906**).

19) FROM THE BOARD OF STUDIES IN YOUTH RED CROSS (YRC)

Dr.S.Selvakumar, Chairman, Board of studies in YRC, shall move and **Dr.S.Krithika**, shall second the following resolutions passed in the meeting of the Board of studies in YRC held on 13.02.2024.

19.1. Resolved to pass the revised syllabus for Part-V YRC in the fourth semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1915-1918**).

19.2. Resolved to ratify the revised syllabus for Part-V YRC in the second semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1911-1914**).

20) FROM THE BOARD OF STUDIES IN PHYSICAL EDUCATION

Dr.K.Kathirvelpandian, Chairman, Board of studies in Physical Education, shall move and **Dr.S.V.Karthikeyan**, shall second the following resolution passed in the meeting of the Board of studies in Physical Education held on 13.02.2024.

20.1. Resolved to pass the revised syllabus for Part-V Physical education in the fourth semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1923-1926**).

20.2. Resolved to ratify the revised syllabus for Part-V Physical education in the second semester for students who joined their respective programmes from the academic year 2023-24 and onwards (**pp 1919-1922**).

21) FROM DEAN (ACADEMICS)

Prof.S.Sivaramakrishnan, Dean (Academics), shall move and **Dr.I. Sahul Hamid**, Dean (Planning and Development) shall second the following resolution:

21.1. Resolved to offer Add-on courses passed by the respective Board of Studies during semesters 3 and 5 for students who joined all UG programmes offered by the institution from the academic year 2023-2024.

22) FROM THE MEMBER – PRIVATE RESOLUTION

Prof.S.Chellapandi, Head, Department of Botany, shall move and **Dr.S.Dinakaran**, Head, Department of Zoology shall second the following resolution:

22.1. Resolved to adopt the existing syllabus for “Environmental science and Gender Awareness” course (Regulation 2020) for students who joined all UG programmes offered by the institution from the academic year 2023-2024. The end semester examination would held at the end of fourth semester.

ADDENDUM

Dr.S.V.Karthikeyan, Associate NCC officer, shall move and **Dr.K.Kathirvelpandian**, Physical Director shall second the following resolution:

- 22.2. Resolved to permit NCC cadets of our college to avail 35 days of leave on-duty (OD) to attend camps like RDC, TSC and special camps like Mountaineering, Trekking, attachment camps, EBSB, CATC, etc. and however excluding this OD leave, the minimum attendance requirement to avoid repeating the course remains same.

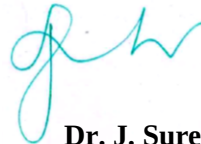
Prof.S.Sivaramakrishnan, Dean (Academics), shall move and **Dr.I.Sahul Hamid**, Dean (Planning and Development) shall second the following resolution:

- 22.3. Resolved to award two extra credits to students who successfully complete a community project listed under Nan Muthalvan scheme from the academic year 2023-24.

IV. Any Other Subject



Dr. R. Eswaran
Member Secretary



Dr. J. Suresh
Principal & Chairman



DEPARTMENT OF MATHEMATICS

Revised Curriculum

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCHE)
(Choice Based Credit system with Outcome Based Education)**

Academic Year 2023-2024 onwards

III and IV semesters (B.Sc. Mathematics)

Allied Courses

III and IV semesters (M.Sc. Mathematics)

The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics
Programme Structure for B.Sc., Mathematics

SEMESTER - I

Part	Course Description	Course Code	Hours per week	Credit
I	Language - I Tamil / Hindi / Sanskrit	23U1TLAN1/23U1HLAN1/23U1SLAN1	6	3
II	Language - II English	23U1NENG1	6	3
III	Algebra & Trigonometry	23U1MCCT1	4	4
	Differential Calculus	23U1MCCT2	4	4
	Chemistry for Physical Science-I	23U1CGET1	4	4
	Chemistry Practical for Physical Science-I	23U1CGEP1	2	1
IV	Fourier Series	23U1MSED1	2	2
	Bridge Mathematics	23U1MFCT1	2	2
	Total		30	23

SEMESTER - II

Part	Course Description	Course Code	Hours per week	Credit
I	Language - I Tamil / Hindi / Sanskrit	23U2TLAN2/23U2HLAN2/23U2SLAN2	6	3
II	Language - II English	23U2NENG2	6	3
III	Analytical Geometry	23U2MCCT3	4	4
	Integral Calculus	23U2MCCT4	4	4
	Chemistry for Physical Science-II	23U2CGET2	4	4
	Chemistry Practical for Physical Science-II	23U1CGEP2	2	1
IV	Transform Techniques	23U2MSED2	2	2
	Computational Mathematics	23U2MSED3	2	2
	Total		30	23

SEMESTER – III

Part	Course Description	Course Code	Hours per week	Credit
I	Language - I Tamil / Hindi / Sanskrit	23U3TLAN3/23U3HLAN3/23U3SLAN3	6	3
II	Language - II English	23U3NENG3	6	3
III	Vector Calculus and Applications	23U3MCCT5	4	4
	Differential Equations and Applications	23U3MCCT6	3	3
	Ancillary Physics – I	23U3PGET1	4	4
	Ancillary Physics Practical – I	23U3PGEP1	2	1
IV	Discrete Mathematics	23U3MSED4	2	2
	Mathematics for Competitive Examinations	23U3MSED5	2	2
	EVS-I	23U3EVST1	1	-
	Total		30	22

SEMESTER - IV

Part	Course Description	Course Code	Hours per week	Credit
I	Language - I Tamil / Hindi / Sanskrit	23U4TLAN4/23U4HLAN4/23U4SLAN4	6	3
II	Language - II English	23U4NENG4	6	3
III	Elements of Mathematical Analysis	23U4MCCT7	4	4
	Industrial Statistics	23U4MCCT8	3	3
	Ancillary Physics – II	23U4PGET2	4	4
	Ancillary Physics Practical – II	23U4PGEP2	2	1
IV	Combinatorics	23U4MSED6	2	2
	Reasoning and Aptitude	23U4MSED7	2	2
	EVS-II	23U4EVST2	1	2
	Total		30	24

DEPARTMENT OF MATHEMATICS				CLASS : II B.Sc. Mathematics				
Sem.	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
III	Major Core	23U3MCCT5	VECTOR CALCULUS AND APPLICATIONS	4	4	25	75	100
Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented		

Course Objectives:

The objectives of the course is

- To impart knowledge on differentiation of vectors and on differential operators and functions.
- To enhance skills on evaluating line, surface and volume integrals.
- To analyze physical applications of derivatives of vectors.

Unit	Description	Hours	K-level	CLO(s)
I	Vector Algebra: Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors - Derivative of a product of a scalar and a vector point function - Derivative of a scalar product and vector product.	12	K2	1
II	Vector Products: The vector operator 'del', The gradient of a scalar point function - Divergence of a vector - Curl of a vector - solenoidal and irrotational vectors– simple applications	12	K3	2
III	Vector Products (continued): Laplacian operator, Vector identities - Line integral - simple problems.	12	K3	3
IV	Applications of vector algebra: Surface integral - Volume integral– Simple Applications.	12	K3	4
V	Applications of vector algebra (continued): Green's Theorem in two dimensions [Statement only] - Gauss divergence Theorem [Statement only] - Stoke's Theorem [Statement only],– Simple verification and applications.	12	K4	5

Book for Study:

Vector Calculus by J.N. Sharma and A.R. Vasishtha , 41st Edition 2018,Krishna Prakashan Media Private Limited, Meerut -250001

Unit I - Chapter 1 (Sections 1 – 9, 11)

Unit II - Chapter 2 (Sections 1 – 4, 8, 9)

Unit III –Chapter 2(Sections 10, 11), Chapter 3(Sections 1, 2)

Unit IV – Chapter 3 (Sections 3, 4)

Unit V - Chapter 3(Sections 5, 6, 7, 9)

Books for Reference:

1. J.C. Susan, Vector Calculus, (4th Edition) Pearson Education, Boston, 2012.
2. A. Gorguis, Vector Calculus for College Students, Xilbius Corporation, 2014.
3. J.E. Marsden and A. Tromba, Vector Calculus, (5th edition) W.H. Freeman, New York, 1988.J.L. Kelly, General Topology, Van No strand, Reinhold Co., New York

- Advanced Engineering Mathematics, Erwin Kreyszig, Professor of Mathematics, Ohio State Columbus, Ohio, University, John Wiley & Sons, Inc.
- Analytical Geometry 3D and Vector Calculus, by S.Arumugam, A. Thangapandi Isaac and A. Somusundram, Latest Edition Yes Dee Publishing Pvt. Ltd.

Web Resources:

- <https://www.lehman.edu/faculty/anchordoqui/VC-3.pdf>
- <http://www.math.ox.ac.uk/study-here/undergraduate-study/practice-problems>
- http://www.freebookcentre.net/SpecialCat/Free-Mathematics-Books_Download.html

Rationale for Nature of the course:

Vector Calculus have wide application in various science disciplines. It provides a framework for modeling systems in which there is change, and a way to make predictions using such models. Calculus provides the foundation to physics, engineering, and many higher math courses. It is also important to chemistry, biology, astronomy, business, economics and statistics.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This subject is generally taught as a traditional lecture course, with recurring problem sets serving as an important learning tool. In class, problems will be discussed and students will work together to find solutions.

Pedagogy:

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designers:

- Dr. V. Ananthaswamy, Associate Professor, Research Centre & PG Department of Mathematics.
- Prof.V.Vijayalakshmi, Assistant Professor – S.F, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors.	4	Lecture, Quiz, Test
	Derivative of a product of a scalar and a vector point function -	4	
	Derivative of a scalar product and vector product.	4	
II	The vector operator 'del', The gradient of a scalar point function - Divergence of a vector.	4	Lecture, Quiz, Test
	Curl of a vector and simple problems.	4	
	Solenoidal and irrotational vectors [properties statement only] – simple applications.	4	
III	Laplacian operator, Vector identities.	4	PPT, Lecture, Quiz, GD, Test
	Line integral - simple problems	4	
	Line integral - simple problems	4	
IV	Surface integral– Simple Applications	6	PPT, Lecture, Quiz, Test
	Volume integral– Simple Applications.	6	

V	Gauss divergence Theorem [Statement only]–Verification and simple applications.	4	Assignments and Seminar, Quiz
	Stoke's Theorem in two dimensions [Statement only] - Verification and simple applications.	4	
	Green's Theorem [Statement only] - Verification and simple applications.	4	
	Total hours	60	

Course learning Outcomes

At the end of the course, the students will be able to

CLOs	Description	K- level
CLO 1	Find the derivative of vector and sum of vectors, product of scalar and vector point function and to Determine derivatives of scalar and vector products	K2
CLO 2	Apply the operator 'del' and solve problems on solenoidal and irrotational vectors	K3
CLO 3	Evaluate line integrals	K3
CLO 4	Evaluate surface integrals and volume integrals	K3
CLO 5	Verify vector integral theorems(Two Dimension)	K4

Mapping of CLOs with PSOs

CLOs	PSO -1	PSO -2	PSO -3
CLO -1	3	2	1
CLO -2	2	2	1
CLO -3	1	1	1
CLO -4	2	1	1
CLO -5	2	2	1

Mapping of CLOs with POs

CLOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	3	2	2	1	-	2
CLO -2	2	2	-	1	2	1
CLO -3	1	1	1	2	-	2
CLO -4	2	1	2	-	1	1
CLO -5	2	3	-	1	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Summative Examination – Blue Print

S.No.	CLOs	K–Level	SectionA		SectionB		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		ShortAnswer			
			No. of questions	K-Level	No. of questions	K-Level		
1	CLO1	K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO2	K3	2	K1& K2	1	K1	2(K2& K2)	1(K3)
3	CLO3	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
4	CLO4	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
5	CLO5	K4	2	K1& K2	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers.

K2 –Basic understanding of facts and stating main ideas with general answers.

K3 – Application oriented-Solving Problems.

K4- Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.67%
K2	5	6	10	10	31	25.84	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II B.Sc., Mathematics				
Sem.	Course Type	Course code	Course Title	Credits	Contact Hours/ Week	CIA	Ext	Total
III	Major Core	23U3MCCT6	DIFFERENTIAL EQUATIONS AND APPLICATIONS	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To know the knowledge about the methods of solving Ordinary and Partial Differential Equations.
- To introduce the various methods to find the solution of ordinary and partial differential equations.
- To understand the technique of how the differential equations can be used as a powerful tool in solving problems in science.

Unit	Description	Hours	K-level	CLO(s)
I	Differential equations of first order: Differential equations - Definition and examples - order and degree of differential equations - Types of differential equations - Linear and non-linear differential equations- Solving first order and higher degree equations: Equations solvable for p - Equations solvable for x - Equations solvable for y - Clairaut's form.	9	K2	1
II	Linear equations of higher order: Second order linear differential equations with constant coefficients - Method of finding complementary functions – Method of finding particular integral for functions of the form e^{mx} , $\sin mx$ or $\cos mx$, x^m ($m \in \mathbb{Z}^+$), $e^{ax}V(x)$, $x^m \cos ax$ or $x^m \sin ax$, $e^{mx} \sin bx$ or $e^{mx} \cos bx$.	9	K3	2
III	Linear equations of higher order (continued): Simultaneous differential equations with constant coefficients - Linear differential equations with variable coefficients- Euler's Homogeneous equations -Legendre's linear equations - Method of variation of parameters.	9	K3	3
IV	Partial differential equations: Partial differential equations - Definition and examples - Formation of partial differential equations by elimination of arbitrary constants - By elimination of arbitrary functions -Solutions by direct integrals - Types of solution of partial differential equations - Solving Lagrange's differential equations $Pp+Qq=R$ by method of grouping and method of multipliers.	9	K3	4

V	Partial differential equations (continued): First order non-linear partial differential equations – Standard form $f(p,q) = 0, z = px + qy + f(p,q), f(x,p) = f(y,q),$ $f(x,p,q) = 0, f(y,p,q) = 0, f(z,p,q) = 0$	9	K4	5

Book for Study:

S.Arumugam, A. Thangapandi Issac and A. Somasundaram, Differential Equations and Applications, 2020 Edition, Yes Dee Publishing Pvt. Ltd.

Unit 1 : Chapter 1 (1.1-1.3 & 1.6, 1.8)

Unit II : Chapter 2 (2.1 – 2.4)

Unit III : Chapter 2 (2.5 - 2.7)

Unit IV : Chapter 4 (4.1 - 4.4)

Unit V : Chapter 4 (4.5 only)

Books for Reference:

1. S. Narayanan and T. K. Manicavachagam Pillai, Differential Equations and its Applications, 2003, S. Viswanathan Printers.
2. P. Kandasamy and K. Thilagavathi, Mathematics for B.Sc., Vol.III, 2004, S. Chand and Co., New Delhi.
3. M. K. Venkataraman and Mrs.Manorama Sridhar, Differential Equations and Laplace Transforms, 2004, The National Publishing Company.
4. D.A. Murray, Introductory course in Differential Equations, Orient and Longman
5. H.T. H. Piaggio, Elementary Treaties on Differential Equations and their applications, C.B.S Publisher & Distributors, Delhi,1985.
6. Sundrapandian, V. Ordinary and Partial Differential Equations, Tata McGraw Hill Education Pvt.Ltd. New Delhi, 2013

Web Resources:

1. <http://www.khanacademy.org/math/differential-equations>
2. http://mathinsight.org/ordinary_differential_equation_introduction
3. <http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
4. <https://sam.nitk.ac.in/courses/MA713/First%20Order%20Partial%20Differential%20Equations.pdf>

Rationale for Nature of the course

Differential equations have wide application in various science disciplines. It is practically important for science students able to model physical and chemical problems using mathematical equations so that the behavior of the systems concerned can be studied.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This subject is generally taught as a traditional lecture course, with recurring problem sets serving as an important learning tool. In class, problems will be discussed and students will work together to find solutions.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designers:

1. Dr. V. Ananthaswamy, Associate Professor, Research Centre & PG Department of Mathematics.
2. Prof.V.Vijayalakshmi, Assistant Professor – S.F, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Definition and examples, order and degree of differential equations, Types of differential equations.	3	Lecture, Quiz, Test
	Linear and non-linear differential equations- Solving first order and higher degree equations.	3	
	Equations solvable for p, Equations solvable for x, Equations solvable for y and Clairaut's form.	3	
II	Second order linear differential equations with constant coefficients, Method of finding complementary functions.	3	Lecture, Quiz, Test
	Method of finding complementary functions e^{mx} , $\sin mx$ or $\cos mx$, x^m ($m \in \mathbb{Z}^+$), $e^{ax}V(x)$, $x^m \cos ax$ or $x^m \sin ax$, $e^{mx} \sin bxx^m$ or $e^{mx} \cos bxx^m$	3	
	Method of finding particular integral for functions of the form e^{mx} , $\sin mx$ or $\cos mx$, x^m ($m \in \mathbb{Z}^+$), $e^{ax}V(x)$, $x^m \cos ax$ or $x^m \sin ax$, $e^{mx} \sin bxx^m$ or $e^{mx} \cos bxx^m$	3	
III	Simultaneous differential equations with constant coefficients, Linear differential equations with variable coefficients	3	PPT, Lecture, Quiz, GD, Test
	Euler's Homogeneous equations, Legendre's linear equations.	3	
	Method of variation of parameters.	3	
IV	Partial differential equations - Definition and examples - Formation of partial differential equations by elimination of arbitrary constants - By elimination of arbitrary functions -	3	PPT, Lecture, Quiz, Test
	Solutions by direct integrals - Types of solution of partial differential equations.	3	
	Solving Lagrange's differential equations $Pp+Qq=R$ by method of grouping and method of multipliers.	3	
V	First order non-linear partial differential equations – Standard form $f(p,q) = 0$	3	Assignments and Seminar, Quiz
	$z = px + qy + f(p,q)$, $f(x, p) = f(y, q)$	3	
	$f(x, p, q) = 0$, $f(y, p, q) = 0$, $f(z, p, q) = 0$	3	
	Total hours	45	

Course learning Outcomes

At the end of the course, the students will be able to

CLOs	Description	K-level
CLO 1	Determine solutions of homogeneous equations, non-homogeneous equations of degree one in two variables, solve Bernoulli's equations and exact differential equations.	K2
CLO 2	Find the solutions of equations of first order but not of higher degree and to Determine particular integrals of algebraic, exponential, trigonometric functions and their products.	K3
CLO 3	Find solutions of simultaneous linear differential equations, linear equations of second order and to find solutions using the method of variations of parameters.	K3
CLO 4	Form a PDE by eliminating arbitrary constants and arbitrary functions. Find complete, singular and general integrals, to solve Lagrange's equations.	K3
CLO 5	Explain standard forms and Solve Differential equations.	K4

Mapping of CLOs with PSOs

CLOs	PSO -1	PSO -2	PSO -3
CLO -1	1	2	1
CLO -2	3	2	1
CLO -3	2	3	1
CLO -4	1	2	1
CLO -5	1	2	1

Mapping of CLOs with POs

CLOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	1	1	1	2	1	-
CLO -2	1	1	1	1	1	2
CLO -3	2	1	2	1	1	-
CLO -4	2	1	2	2	2	1
CLO -5	3	1	1	2	2	1

Advance application– 3

Intermediate level–2

Basic level–1

Summative Examination – Blue Print

S.No.	CLOs	K–Level	SectionA		SectionB		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		ShortAnswer			
			No. of questions	K-Level	No. of questions	K- Level		
1	CLO1	K2	2	K1&K2	1	K1	2(K1& K1)	1(K2)
2	CLO2	K3	2	K1&K2	1	K1	2(K2& K2)	1(K3)
3	CLO3	K3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO4	K3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
5	CLO5	K4	2	K1&K2	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers.

K2 –Basic understanding off acts and stating main ideas with general answers.

K3 –Applicationoriented-SolvingProblems.

K4- Examining, analyzing, presentation and make inferences with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.67%
K2	5	6	10	10	31	25.84	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II B.Sc. Mathematics				
Sem.	Course Type	Course code	Course Title	Credits	Contact Hours/ Week	CIA	Ext	Total
III	SEC4	23U3MSED4	DISCRETE MATHEMATICS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To impart fundamental concepts of sets, relations, functions, mathematical logic and proof techniques.
- To understand the type of relations and their properties.
- To learn the notions of propositional logic and predicate logic.

Unit	Description	Hours	K-level	CLO
I	Relations: Introduction – Product sets – Relations – Pictorial representations of relations – Composition of relations	6	K2	CLO1
II	Relations (continued) : Types of Relations – Closure properties – Equivalence relations – Partial ordering relations – n -ary Relations	6	K3	CLO2
III	Functions and Algorithms : Introduction – Functions – One-to-one, and invertible function – Mathematical functions, exponential and logarithmic Function – Sequences, indexed classes of sets – Recursively defined functions – Cardinality	6	K3	CLO3
IV	Logic and Propositional Calculus : Introduction – Propositions and compound propositions – Basic logical operations – Propositions and truth tables – Tautologies and contradictions	6	K3	CLO4
V	Logic and Propositional Calculus (Continued) : Logical equivalence – Algebra of proposition – Conditional and biconditional statements – Arguments – Logical implication – Propositional functions, quantifiers – Negation of quantified Statements.	6	K4	CLO5

Book for study:

1. Discrete Mathematics, Seymour Lipschutz, Marc Lipson, 2nd Edition – Tata McGraw Hill Publishing company Ltd, New Delhi
Unit 1: chapter 2: 2.1 - 2.5
Unit 2: chapter 2: 2.6 – 2.10
Unit 3: chapter 3: 3.1 – 3.7
Unit 4: chapter 4: 4.1 – 4.5

Unit 5: chapter 4: 4.6 – 4.12

Books for Reference:

1. M.K.Venkatraman, N.Sridharan and N.Chandrasekaran, Discrete Mathematics, National Publishing Company (2007).
2. Trembly and Manohar, Discrete Mathematical structures with application to computer science, Tata McGraw Hill, New Delhi (1997).
3. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 7th edition, Tata McGraw Hill, 2012.

Web Resources

1. https://www.tutorialspoint.com/discrete_mathematics/index.html
2. <https://www.javatpoint.com/propositional-logic-in-discrete-mathematics>
3. <https://sites.millersville.edu/bikenaga/math-proof/truth-tables/truth-tables.html>

Rationale for Nature of the course

Discrete mathematics is the study of mathematical structures involving discrete elements that are used in algebra and arithmetic. It deals with countable objects that are widely used in almost all fields of computer science such as programming language, data structures, algorithmic, cryptography, operating systems, networking, etc.

Activities having a direct bearing on Skill development / Employability Entrepreneurship

Problem-solving sessions endeavor to help students grasp the essential concepts of discrete mathematics. It will enable them to have a good understanding of elementary algebra and arithmetic.

Pedagogy

Lecture, chalk and talk, quiz, PPT, problem solving, group discussion, seminar and assignment.

Course Designer(s):

1. Dr. I. Padmavathi, Assistant Professor, PG and Research Department of Mathematics.
2. Dr.S.Vallirani, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Introduction, product set and relations	2	6 Lecture, Chalk and Talk, Problem solving, Test
	Pictorial representation and composition of relations	4	
II	Types of relations, closure properties	3	6 Lecture, Problem solving, Quiz, Test
	Equivalence relations, partial ordering relations and n -ary relations	3	
III	Functions, one-one, onto, invertible function	1	6 PPT, Group discussion, seminar, Quiz, Test
	Mathematical function, exponential, logarithmic functions	3	
	Sequences, Indexed classes of sets, recursively defined function, cardinality	2	
IV	Introduction, propositions and compound propositions, basic logical operations	2	6 Lecture, Problem Solving, Quiz, Test
	Propositions and truth tables, tautologies and contradiction	4	

V	Logical equivalence, algebra of propositions,	1	6	Lecture, Chalk and Talk, PPT, Quiz, Assignment
	conditional and biconditional statements, arguments, logical implications	3		
	Propositional functions, Quantifiers, Negation of Quantified statement	2		
Total Hours		30		

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Determine the product set, relation, pictorial representation of relation and composition of relation	K2
CLO2	Understand the type of relation and learn to categorize their types	K3
CLO3	Recognize equivalence relations and to categorize types of functions	K3
CLO4	Apply the validity of a formula using mathematical logic	K3
CLO5	Analyze the idea of proposition and statements	K4

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	2	3	1
CLO2	3	3	-
CLO3	2	2	1
CLO4	1	3	2
CLO5	2	3	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	2	1	1
CLO2	2	2	3	3	1	2
CLO3	1	1	2	3	1	1
CLO4	3	3	3	3	2	1
CLO5	2	2	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO1	K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
2	CLO2	K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
3	CLO3	K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO4	K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
5	CLO5	K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc. Mathematics				
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	SEC5	23U3MSED5	MATHEMATICS FOR COMPETITIVE EXAMINATIONS	2	2	25	75	100

Nature of course	Skill oriented		Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To understand fundamental formulae and learn fast solving techniques of quantitative aptitude to crack competitive examinations.
- To enhance the skill of arithmetical ability.
- To enrich logical thinking and reasoning.

Unit	Description	Hours	K-level	CLO
I	Profit and Loss : Introduction on cost price, selling price, gain, loss – gain percentage – loss percentage – find SP from given CP and gain% or loss% - find CP from given SP and gain% or loss% - problems	6	K3	CLO1
II	Time and Work : Important facts and Formulae – days and hours Calculation – problems	6	K2	CLO2
III	Calendar and Clock : Calendar: Odd days – Leap year – Ordinary year – Counting of odd days – Day of the week related to odd days – solved examples – Clocks: Important facts – Too fast and too slow –problems.	6	K3	CLO3
IV	Permutations and Combinations : Factorial notation – Permutations – Combinations –problems	6	K3	CLO4
V	Probability : Experiment – Random experiment – Sample space – Event – Probability of occurrence of an event – Results on probability – problems.	6	K4	CLO5

Book for study:

1. R. S. Aggarwal, Quantitative Aptitude for competitive examinations (Fully Solved), 2017 Revised Edition, S. Chand & Company Ltd.

Unit 1: chapter: 12

Unit 2: chapter: 17

Unit 3: chapter: 27, 28

Unit 4: chapter: 30

Unit 5: chapter: 31

Books for Reference:

1. G. K. Ranganath, C. S. Sampangiram and Y. Rajaram, A text book of business Mathematics, 2008, Himalaya Publishing House.
2. R.V. Praveen, Quantitative Aptitude and Reasoning by, 2nd revised edition, 2013, Prentice – Hall of India Pvt. Ltd.
3. Shyam Saraf and Abhilasha Swarup, Quantitative Aptitude and Reasoning, 2019, Cengage India Private Limited.

Web Resources

1. <https://www.math-shortcut-tricks.com>
2. <https://www.examsbook.com/quantitative-aptitude-shortcut-trick-and-methods>
3. <https://www.edudose.com/reasoning/calendar-clock-test-short-tricks/>

Rationale for Nature of the course

The course enhances logical reasoning skills by requiring students to understand and apply mathematical principles and patterns. It helps develop critical problem-solving skills, which are invaluable in both academic and professional settings. The ability to analyze and solve quantitative problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Provide students with a variety of practical problems and organize group discussions where students can collaborate to solve challenging problems. This encourages teamwork, fosters peer learning, and allows students to crack competitive examinations.

Pedagogy

Lecture, Chalk and Talk, Problem solving, Quiz, PPT, Group discussion, Tutorial and Assignment.

Course Designer(s):

1. Dr. I. Padmavathi, Assistant Professor, PG and Research Department of Mathematics.
2. Prof. N. Sriviveka Saratha, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Description	Hours		Mode
I	Introduction on cost price, selling price, gain, loss – gain percentage – loss percentage	2	6	Lecture, Chalk And Talk, Problem Solving, Quiz, Test
	find SP from given CP and gain% or loss%	2		
	find CP from given SP and gain% or loss% - Solved related problems	2		
II	Time and work - Important facts and Formulae – some examples	2	6	Chalk and Talk Lecture, Problem Solving, Quiz, Test
	Calculating days and hours – Related problems.	4		
III	Calendar: Odd days – Leap year – Ordinary year – Counting of odd days – Day of the week related to odd days – solved examples	3	6	PPT, Lecture, Quiz, Tutorial, Test
	Clocks: Important facts – Too fast and too slow – related problems.	3		
IV	Introduction to Factorial notation – Permutations – Combinations – some examples	2	6	Lecture, Tutorial Problem Solving, Quiz, Test
	Solved problems on permutation and combination	4		
V	Basic concepts on Experiment, Random experiment, Sample space, Event and related problems.	3	6	Lecture, Chalk and Talk, Quiz, Seminar, Assignment
	Probability of occurrence of an event – Results on probability – some related problems	3		
Total Hours		30		

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Solve problems on profit/loss	K3
CLO2	Understand the concepts of time and distance	K2
CLO3	Apply the concepts of calendar and clock	K3
CLO4	Acquire knowledge on permutations and combinations	K3
CLO5	Analyze the concepts in probability such as events, occurrence of events, and sample space.	K4

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	2	3	1
CLO2	2	3	1
CLO3	2	3	1
CLO4	2	3	1
CLO5	2	3	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	1	1	-	-
CLO2	3	1	-	-	-	1
CLO3	3	2	1	-	1	2
CLO4	3	-	2	1	1	2
CLO5	3	2	2	-	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Blue Print for Summative Examinations

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	K3	2	K1& K2	1	K2	2(K2& K2)	1(K3)
2	CLO2	K2	2	K1& K2	1	K1	2(K1 & K1)	1(K2)
3	CLO3	K3	2	K1& K2	1	K2	2(K3 & K3)	1(K3)
4	CLO4	K3	2	K1& K2	1	K1	2(K3 & K3)	1(K3)
5	CLO5	K4	2	K1& K2	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.66	41.67%
K4	-	-	10	10	20	16.66	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: II B.Sc., Mathematics				
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
IV	CORE	23U4MCCT7	ELEMENTS OF MATHEMATICAL ANALYSIS	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- Identify and characterize sets and functions and understand, test and analyze the convergence and divergence of sequences, series.
- Understand metric spaces with suitable examples.

Unit	Description	Hours	K-level	CLO
I	Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- real numbers- least upper bounds.	12	K2	CLO1
II	Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence – convergent sequences– divergent sequences- bounded sequences.	12	K3	CLO2
III	Sequences of Real Numbers (continued): Operations on convergent sequences – operations on divergent sequences – Cauchy sequences.	12	K3	CLO3
IV	Series of Real Numbers: Convergence and divergence – series with non –negative terms-alternating series.	12	K4	CLO4
V	Limits and Metric Spaces: Limit of a function on a real line - Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces: Function continuous at a point on there a line-Function continuous on a metric space.	12	K3	CLO5

Book for study:

- Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020).

Chapters:

Unit I: Chapter 1(1.1-1.4, 1.6-1.7) (Excluded 1.5)

Unit II: Chapter 2(2.1-2.5)

Unit III: Chapter 2(2.7, 2.8, 2.10) (Excluded 2.9)

Unit IV: Chapter 3(3.1-3.3)

Unit V: Chapter 4(4.1-4.3), Chapter 5(5.1, 5.3)

Books for Reference:

1. Ethan D. Bloch, The Real Numbers and Real Analysis, Springer, 2011.
2. G.M. The fundamentals of Mathematical Analysis, vol I. Pergamon Press, New York, 1965.
3. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
4. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.

Web Resources

1. https://www.math.ucdavis.edu/~hunter/intro_analysis_pdf/ch1.pdf
2. <https://www.geneseo.edu/~aguilar/public/notes/Real-Analysis-HTML/ch3-sequences.html>
3. <https://www.csusm.edu/mathlab/documents/seriesconvergediverge.pdf>
4. <https://www.geneseo.edu/~aguilar/public/notes/Real-Analysis-HTML/ch9-metric-spaces.html>

Rationale for Nature of the course

Analysis is the branch of mathematics dealing with continuous functions, limits, and related theories such as differentiation, integration, measure, infinite sequences, series, and analytic functions. These theories are usually studied in the context of real and complex numbers and functions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students do solve problems, create subject knowledge by quiz activities, taking seminar and through discussion among themselves students can develop their skills.

Pedagogy

Lecture, Chalk and Talk, Quiz, PPT, Tutorial, Assignment

Course Designer(s):

1. Dr. V. Sangeethasubha, Assistant Professor, PG and Research Department of Mathematics.
2. Prof. S.Krishna Jayanthi, Assistant Professor, Department of mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Sets and Functions: Sets and elements- Operations on sets	4	12 Lecture, Chalk and Talk Problem Solving, Quiz, Test
	Functions- real valued functions	3	
	Countability- real numbers- least upper bounds.	5	
II	Sequences of Real Numbers: Definition of a sequence and subsequence-limit of a sequence	6	12 Lecture, Problem Solving, Chalk and Talk, Quiz, Seminar, Test
	convergent sequences–divergent sequences-bounded sequences	6	
III	Sequences of Real Numbers(Continued):Operations on convergent sequences – operations on divergent sequences	7	12 PPT, Lecture, Quiz, Tutorial Problem Solving, Test
	Cauchy sequences	5	

IV	Series of Real Numbers: Convergence and divergence	6	12	Lecture, Tutorial, Problem Solving, Quiz, Seminar, Test
	Series with non –negative terms-alternating series	6		
V	Limits and Metric Spaces: Limit of a function on a real line	3	12	Lecture, Chalk and Talk, PPT, Problem Solving, Quiz, Assignment
	Metric spaces - Limits in metric spaces – Continuous Functions on Metric Spaces	4		
	Function continuous at a point on there a line-Function continuous on a metric space.	5		
Total Hours		60		

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Recall the concepts of sets and functions, real valued function and countability and the LUB axiom	K2
CLO2	Understand the concepts of Sequence and Subsequence of real numbers and to find the limit of sequence to test for convergent, divergent and bounded sequences	K3
CLO3	Explain the operations on convergent and divergent sequences and to Explain the concepts of limit superior and limit inferior and the notion of Cauchy sequences	K3
CLO4	Examine the series of real numbers and the alternating series and their convergence and divergence, the conditional convergence and absolute convergence and solve problems on convergence of the sequences	K4
CLO5	Understand about the metric spaces and functions continuous on a Metric space	K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	3	1	1
CLO2	1	2	1
CLO3	3	2	2
CLO4	2	1	1
CLO5	3	2	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	3	2	-
CLO2	3	2	2	2	1	-
CLO3	1	2	3	1	2	-
CLO4	3	3	3	3	2	-
CLO5	2	3	2	3	1	-

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO1	K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO2	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
3	CLO3	K3	2	K1& K2	1	K1	2(K2& K2)	1(K3)
4	CLO4	K4	2	K1& K2	1	K2	2(K4& K4)	1(K4)
5	CLO5	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II B.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	CORE	23U4MCCT8	INDUSTRIAL STATISTICS	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objectives of the course is

- To learn the basic concepts about axiomatic and mathematical approach to find probability of events.
- To understand the notion of distribution functions of discrete and continuous random variables.
- To acquire knowledge of Mathematical expectation and its variants.

Unit	Description	Hours	K-level	CLO
I	Probability: Introduction-Sample Spaces-Events-The Probability of event-Some rules of Probability- Conditional Probability- independent events-Bayes theorem.	9	K3	CLO 1
II	Probability Distributions and Probability Densities: Random variables- Probability Distributions- Continuous Random Variables- Probability Density Functions- Multivariate Distributions- Marginal Distributions – Conditional Distributions.	9	K3	CLO 2
III	Mathematical Expectations: Introduction- The Expected value of a random variable- Moments- Chebyshev's theorem- Moment- Generating Functions- Product Moments - Moments-of linear combinations of random variables- Conditional Expectations.	9	K3	CLO 3
IV	Special Probability Distributions: Introduction- The Discrete Uniform Distribution- The Bernoulli Distribution- The Binomial Distribution- The Negative Binomial and Geometric Distributions- The Poisson Distribution	9	K4	CLO 4
V	Special Probability Densities: Introduction- The Uniform Distribution- The Gamma, Exponential and Chi-square Distributions-The Beta Distribution- The Normal Distribution.	9	K3	CLO 5

Book for study:

Irwin Miller, Marylees Miller, John E. Freund's Mathematical Statistics with Applications, Seventh Edition, Pearson Education Inc.

UNIT I – Chapter -.2

UNIT II - Chapter -3,

UNIT III - Chapter -4,

UNIT IV - Chapter -5 (5.1-5.5, 5.7)

UNIT V - Chapter - 6 (6.1-6.5)

Books for Reference:

1. P R Vittal, Mathematical Statistics, Margham Publications, Chennai, 2002.
2. Kandasamy, P.K.Thilagavathi and K.Gunavathi, Probability, Statistics, and Queueing Theory –(2007) S.Chand and Co. New Delhi.
3. S. C. Gupta, V .K Kapoor Fundamentals Of Mathematical Statistics-2002 Sultan Chand & Sons, New Delhi – Eleventh thoroughly revised edition.
4. Veerarajan T. Fundamentals Of Mathematical Statistics, Yesdee Publishing Private Ltd. 2017.
5. Arumugam and Thangapandi Issac- Statistics, New Gamma Publishing House, 2016.

Web Resources

1. <http://www.ocw.mit.edu>
2. <https://www.khanacademy.org>
3. <http://onlinestatbook.com/2/introduction/descriptive.html>
4. <https://www.statistichowto.datasciencecentral.com/probability-and-statistics/descriptive-statistics/>

Rationale for Nature of the course

This course imparts theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance. Theoretical knowledge explains the why factor at the back of any situation and technique of working.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem solving, hands on training with statistical software tools, using sessions to help students in grasping the essential concepts of statistics.

Pedagogy

Chalk and Talk, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

1. Dr. U.Karthik Raja, Assistant Professor, Department of mathematics.
2. Prof. S.Meenakshi Selvarajan, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction-Sample spaces-Events-The probability of event-Some axioms of probability- Conditional probability	6	Lecture, Quiz, Problem
	Independent events-Bayes theorem.	3	Solving, Test
II	Random variables- Probability distributions- Continuous random variables	3	Chalk and Talk, Group
	Probability density functions- Multivariate Distributions- Marginal Distributions – Conditional Distributions.	6	Discussion, Quiz, Test
III	Introduction- The expected value of a random variable-Moments- Chebyshev's theorem- Moment generating functions	5	Lecture, Quiz Problem
	Product Moments-Moments-of linear combinations of random variables- Conditional Expectations.	4	Solving, Quiz, Test
IV	Introduction- The discrete uniform Distribution- The Bernoulli Distribution-The Binomial Distribution-	5	Lecture, Tutorial, Quiz, Test
	The Negative Binomial and Geometric Distributions- The Poisson Distribution	4	
V	Introduction- The Uniform Distribution	2	Lecture, Tutorial, Quiz, Seminar, Assignment
	The Gamma, Exponential and Chi-square Distributions- The beta Distribution- The Normal Distribution.	7	
	Total	45	

Course Learning Outcomes

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Learn about Probability, Conditional probability, Bayes's theorem	K3
CLO-2	Understand the concepts of discrete and continuous type random variables, distribution/density functions and find variants (joint, marginal, conditional probability distribution/density functions).	K3
CLO-3	Apply techniques to find Expectation and its variants	K3
CLO-4	Analyze various types of discrete distributions	K4
CLO-5	Examine various continuous distributions	K3

Mapping of CLOs with PSOs

CLO	PO1	PO2	PO3
CLO1	3	2	1
CLO2	3	2	1
CLO3	3	2	1
CLO4	3	2	1
CLO5	3	2	1

Mapping of CLOs with POs

CLO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	3	2	3	2	1
CLO-2	3	3	2	3	2	1
CLO-3	3	3	3	3	2	1
CLO-4	3	3	3	3	2	1
CLO-5	3	3	2	3	2	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S.No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	K2	2	K1 & K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	K3	2	K1 & K2	1	K1	2(K2& K2)	1(K3)
4	CLO 4	K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II B.Sc. Mathematics				
Sem.	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
IV	SEC 6	23U4MSED6	COMBINATORICS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To introduce the basics of counting principles in variety of applications
- To emphasis the importance of arrangements and combinations for counting
- To solve problems under prescribed constraints with the help of arrangements satisfying the given requirements
- To solve problems with the help of Inclusion and Exclusion

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	Permutation and Combinations: Introduction – Basic tools – The Rules of Sum and Product – Permutations –Combinations – Pigeon hole Principle	6	K2	1
II	Inclusion and Exclusion Principle: The principle of Inclusion and Exclusion - Combinatorial Number Theory	6	K3	2
III	Rook and Hit Polynomials: The Permanent of a Matrix - Rook Polynomials and Hit Polynomials	6	K3	3
IV	Generating Functions: Generating Functions – Partitions of a positive integer	6	K3	4
V	Recurrence Relations: Recurrence Relations - Algebraic solution of Linear Recurrence relations with constant co-efficient - Solution of Recurrence relations using Generating Functions	6	K4	5

Book for Study:

V.K. Balakrishnan Combinatorics including concepts of Graph Theory Schaum's Outlines Series McGraw – Hill, INC.

Unit I-Chapter 1(1.1, 1.2, 1.3-Pages 1-21)

Unit II -Chapter 2(2.3, Combinatorial Number Theory -Pages 59 To 67)

Unit III-Chapter 2(Pages 73 To 83)

Unit IV -Chapter 3 (3.1, 3.2)

Unit V- Chapter 3 (3.3, 3.4, 3.5)

Books for Reference:

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 7th edition, Tata McGraw Hill, 2012.
2. M.K.Venkatraman, N.Sridharan and N.Chandrasekaran, Discrete Mathematics, National Publishing Company (2007).

Web Resources:

1. https://www.tutorialspoint.com/discrete_mathematics/index.htm
2. <https://web.cs.hacettepe.edu.tr/~bbm205/Lectures/Lecture4.pdf>
3. <https://inspirehep.net/files/cbc9090d658b474ed002b765b8761889>

Rationale for Nature of the course:

Combinatorics is the study of mathematical structures which are essential in the sense that they assume only distinct, separate values, rather than in a range of values. It deals with countable objects that are widely used in field of computer science such as programming language, data structures, algorithmic, etc.

Activities having direct bearing on Skill development/ Employability Entrepreneurship:

This subject is generally taught as a traditional lecture course, with recurring problem sets serving as an important learning tool. In class, problems will be discussed and students will work together to find solutions.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

1. Dr. R. Pandiselvi, Associate Professor, PG and Research Department of Mathematics.
2. Prof. S.Meenakshi, Assistant Professor, Department of Mathematics.

Course schedule

Unit	Description	Hours		Mode
I	Introduction, sum and product rules	2	6	Lecture, Chalk and Talk, Problem Solving, Quiz, Test
	Explanations using Pictorial representation	4		
II	About Inclusion and Exclusion Principles	3	6	Lecture, Problem Solving, Chalk and Talk, Quiz, Test
	Combinatorial Number Theory	3		
III	Permanent Matrix	1	6	PPT, Lecture, Quiz Tutorial Problem Solving , Quiz, Test
	Rook Polynomial	3		
	Hit Polynomial	2		

IV	Generating Functions	2	6	Lecture, Tutorial, Seminar, Problem Solving, Quiz, Test
	Partitions of a Positive Number	4		
V	Recurrence Relations, Algebraic solution of Linear Recurrence relation with constant co-efficient	2	6	Lecture, PPT, Quiz, Seminar, Assignment
	Solution of Recurrence relations using Generating Functions	4		
	Total Hours		30	

Course learning Outcomes

At the end of the course, the students will be able to

CLO	Description	K- level
CLO 1	Determine the rules of Sum and product, representation of Pigeon hole Principle.	K2
CLO 2	Understand the principle of Inclusion and Exclusion learn combinatorial number theory.	K3
CLO 3	Study about Rook and Hit Polynomials.	K3
CLO 4	Understand about Generating functions.	K3
CLO 5	Study about Recurrence Relation and the types of Solutions of Recurrence relation and Generating Functions.	K4

Mapping of CLOs with PSOs

CLO	PSO -1	PSO -2	PSO -3
CLO -1	3	3	1
CLO -2	2	3	2
CLO -3	2	1	1
CLO -4	1	3	-
CLO -5	2	3	1

Mapping of CLOs with POs

CLO	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	2	3	3	2	1	1
CLO -2	2	2	3	3	1	2
CLO -3	1	1	2	3	1	1
CLO -4	3	3	3	3	2	1
CLO -5	2	2	3	3	2	3

Advance application– 3

Intermediate level–2

Basic level–1

Summative - Blue – Print – Model

S.No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K Level		
1	CLO 1	K2	2	K1 & K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	K3	2	K1 & K2	1	K1	2(K3 & K3)	1(K3)
5	CLO 5	K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	30	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

DEPARTMET OF MATHEMATICS				CLASS: II B.Sc., Mathematics				
Sem.	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
IV	SEC7	23U4MSED7	REASONING AND APTITUDE	2	2	25	75	100

Nature of Course	Skill oriented		Employability	✓	Entrepreneurship oriented	

Objectives:

The objectives of the course is

- To enrich and enhance the knowledge of students in both Verbal & Non-Verbal Reasoning.
- To enable students to analyze and solve complex problems without relying upon or being limited by language skills.
- To provide the students with an overview of Aptitude view in mathematics

Unit	Description	Hours	K-level	CLO
I	Verbal Reasoning: Series Completion – Classification – Coding & Decoding – Blood Relation – Alphabet test.	6	K2	CLO1
II	Logical Reasoning: Logical Venn Diagram – Logical Sequence of words.	6	K3	CLO2
III	Non-Verbal Reasoning: Series – Analogy – Classification – Analytical Reasoning – Mirror Images – Water Images.	6	K4	CLO3
IV	Arithmetical Ability: H.C.F. and L.C.M. of Numbers – Average – Percentage – Profit and Loss.	6	K3	CLO4
V	Arithmetical Ability (continued): Time and Distance – Simple Interest – Compound Interest – Odd Man Out and Series.	6	K3	CLO5

Books for study

1. R.S. Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, S. Chand & Company Limited, Reprint 2012.
Unit I: Part I - Section I (1, 3 – 5, 10)
Unit II: Part I - Section I (9, 14)
Unit III: Part II - Section I (1 - 6)
2. R.S. Aggarwal, Quantitative Aptitude, S. Chand & Company limited, revised edition (2020).
Unit IV: Section I (2, 6, 11, 12)
Unit V: Section I (18, 22, 23, 35)

Books for Reference:

1. B.S. Sijwali & InduSijwali, A New Approach to Reasoning – Verbal, Non-Verbal & Analytical, Arihant Publication, revised edition (2023).
2. Jaikishan & Premkishan, How to Crack Test of Reasoning in all competitive examination, Arihant Publication, revised edition
3. R.V. Praveen, Quantitative Aptitude and Reasoning by, Prentice – Hall of India Pvt. Ltd. 2nd revised edition, 2013,
4. Shyam Saraf and Abhilasha Swarup, Quantitative Aptitude and Reasoning, 1st Edition (2019)

5. Prof. Abhilasha Khanaa, Arvind Sharma, Quantitative Aptitude and Arithmetic for Competitive Exam. Sura college of Competition (2015)

Web Resources

1. <https://learnfrenzy.com/reasoning>
2. <https://www.indiabix.com/non-verbal-reasoning/questions-and-answers/>
3. <https://studymild.com/non-verbal-reasoning/>
4. <https://affairscloud.com/aptitude-questions-profit-and-loss-set-23.html>
5. <https://www.bankexamstoday.com/2015/07/simple-interest-and-compound-interest.html>

Rationale for Nature of the course

Verbal reasoning uses language to draw conclusions. It relies on verbal cues and interpretive thought processes to interpret data and come to conclusions. It involves the use of logic and patterns to interpret data. Non-Verbal reasoning involves the entire amount of reasoning skills that are not verbal in nature and can be classified as abstract reasoning, numerical reasoning, spatial reasoning etc. Aptitude is a skill that involves solving numerical problems using mathematical concepts and logical reasoning.

Activities having direct bearing on skill development/Employability Entrepreneurship

Provide students with a variety of practical problems and organize group discussions where students can collaborate to solve challenging problems. This encourages teamwork, fosters peer learning, and allows students to crack competitive examinations.

Pedagogy

Lecture, Seminar, Quiz, Group Discussion, Assignment, PPT, LMS (CANVAS)

Course Designer(s):

1. Prof. G.K.LAKSHMI, Assistant Professor, Department of Mathematics.
2. Dr. S.USHA, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Series Completion, Classification	2	PPT, Chalk and Talk, Quiz, Test
	Coding & Decoding, Blood Relation	2	
	Alphabet test	2	
II	Logical Venn Diagram	2	PPT, GD, Quiz, Test
	Logical Sequence of words	2	
III	Series, Analogy	2	PPT, Chalk and Talk, Quiz, Test
	Classification, Analytical Reasoning	2	
	Mirror Images, Water Images	2	
IV	H.C.F. and L.C.M. of Numbers	2	PPT, Chalk and Talk, Quiz, Test
	Average, Percentage	2	
	Profit and Loss	2	
V	Time and Distance	2	Assignments, Seminar and GD, Quiz
	Simple Interest, Compound Interest	2	
	Odd Man Out and Series	2	
Total Hours		30	

Course Learning Outcomes

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Classify and Solve series completion, classification, coding & decoding, blood relation, alphabet test.	K2
CLO2	Understand the basic concepts of logical reasoning.	K3
CLO3	Acquire satisfactory competency in use of non-verbal reasoning.	K4
CLO4	To solve different types of questions based on H.C.F. and L.C.M. of Numbers average, percentage, profit and loss.	K3
CLO5	Solve questions related to Time and distance, simple interest, compound Interest, odd Man Out and Series.	K3

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	1	1	2
CLO2	2	2	1
CLO3	2	1	-
CLO4	2	2	-
CLO5	2	1	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	1	1	1	1	1
CLO2	2	2	1	2	2	1
CLO3	2	1	1	2	2	1
CLO4	1	1	2	1	1	1
CLO5	1	1	1	1	1	1

Advance application-3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model

S. No.	CLOs	K– Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K-Level	No. of questions	K-Level		
1	CLO1	K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO2	K3	2	K1& K2	1	K2	2(K2& K2)	1(K3)
3	CLO3	K4	2	K1& K2	1	K2	2(K4& K4)	1(K4)
4	CLO4	K3	2	K1& K2	1	K1	2(K3& K3)	1(K3)
5	CLO5	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%



The Madura College (Autonomous), Madurai – 625 011

Department of Mathematics

COURSES OFFERED TO UG BY THE DEPARTMENT OF MATHEMATICS

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/ New
					Empl	Ent	Skill	Local	National	Global	
I	23U1MCCT1	Algebra & Trigonometry	4	4			Yes		Yes		20.45% No change
	23U1MCCT2	Differential Calculus	4	4			Yes			Yes	60%
	23U1MGET1 (P)	Allied Mathematics - I (PHYSICS)	6	5			Yes		Yes		17%
	23U1MGET1 (D)	Numerical Methods (Computer Science)					Yes			Yes	No change
	23U1MSD1	Fourier Series	2	2			Yes			Yes	No change
	23U1MFCT1	Bridge Mathematics	2	2			Yes		Yes		New
II	23U2MCCT3	Analytical Geometry	4	4			Yes		Yes		65%
	23U2MCCT4	Integral Calculus	4	4			Yes			Yes	12% No change
	23U2MGET2(P)	Allied Mathematics – II (PHYSICS)	6	5			Yes		Yes		15%
	23U2MGET2(D)	Graph Theory and its Applications (Computer Science)					Yes				85.17%

	23U2MSED2	Transform Techniques	2	2			Yes			Yes	41.66%
	23U2MSED3	Computational Mathematics	2	2			Yes			Yes	New
III	23U3MCCT5	Vector Calculus and Applications	4	4			Yes			Yes	17%
	23U3MCCT6	Differential Equations and Applications	3	3			Yes			Yes	No change
	23U3MGET1(C)	Allied Mathematics – I (Chemistry)	6	5			Yes		Yes		No change
	23U3MGET1(S)	Numerical Methods (Statistics)					Yes			Yes	100% New
	23U3MSED4	Discrete Mathematics	2	2			Yes			Yes	65%
	23U3MSED5	Mathematics for Competitive Examinations	2	2	Yes				Yes		60%
IV	23U4MCCT7	Elements of Mathematical Analysis	4	4			Yes			Yes	No change
	23U4MCCT8	Industrial Statistics	3	3			Yes			Yes	40%
	23U4MGET2(C)	Allied Mathematics – II (Chemistry)	6	5			Yes		Yes		No change
	23U4MGET2(S)	Real Analysis (Statistics)					Yes			Yes	100% New
	23U4MSED6	Combinatorics	2	2			Yes			Yes	100% New
	23U4MSED7	Reasoning and Aptitude	2	2	Yes					Yes	100% New

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development



The Madura College (Autonomous), Madurai – 625 011
Department of Mathematics
Programme Structure for M.Sc., Mathematics

Semester	Course Code	Title of the Course	Hours	Credits
I	23P1MCCT1	ALGEBRAIC STRUCTURES	6	5
	23P1MCCT2	REAL ANALYSIS - I	6	5
	23P1MCCT3	ORDINARY DIFFERENTIAL EQUATIONS	6	4
	23P1MECT1(A)	NUMBER THEORY AND CRYPTOGRAPHY	5	3
	23P1MECT1(B)	FUZZY SETS AND ITS APPLICATIONS		
	23P1MECT2(A)	PROGRAMMING IN PYTHON	3	2
	23P1MECT2(B)	OBJECT ORIENTED SYSTEM DEVELOPMENT		
	23P1MECP1(A)	PRACTICAL IN PYTHON	2	1
	23P1MECP1(B)	PRACTICAL IN OBJECT ORIENTED SYSTEM DEVELOPMENT		
	23P1MSD1	MATHEMATICAL DOCUMENTATION USING LATEX	2	2
	Total		30	22
II	23P2MCCT4	ADVANCED ALGEBRA	6	5
	23P2MCCT5	REAL ANALYSIS - II	6	5
	23P2MCCT6	PARTIAL DIFFERENTIAL EQUATIONS	6	4
	23P2MECT3(A)	MATHEMATICAL STATISTICS	5	3
	23P2MECT3(B)	MECHANICS		
	23P2MECT4(A)	ADVANCED LINEAR PROGRAMMING	3	2
	23P2MECT4(B)	NUMERICAL ANALYSIS		
	23P2MECT5(A)	NONLINEAR PROGRAMMING	2	1
	23P2MECT5(B)	FORMAL LANGUAGES AND AUTOMATA		
	23P2MSEN1	NME	2	2
	Total		30	22
III	23P3MCCT7	COMPLEX ANALYSIS	6	5
	23P3MCCT8	PROBABILITY THEORY	6	5
	23P3MCCT9	TOPOLOGY	6	4
	23P3MCCT10	GRAPH THEORY	5	3
	23P3MMDC	MDC- STOCHASTIC PROCESSES, STATISTICAL MECHANICS AND POINT GROUPS OF MOLECULES	5	3

		MDC- STOCHASTIC PROCESSES, STATISTICAL MECHANICS BIOLOGICAL MACROMOLECULES		
	23P3MSEN2	NME	2	2
	23P3MINTR	INTERNSHIP/ INDUSTRIAL ACTIVITY	-	2
	Total		30	24
IV	23P4MCCT11	FUNCTIONAL ANALYSIS	6	5
	23P4MCCT12	DIFFERENTIAL GEOMETRY	6	4
	23P4MPROV	PROJECT WITH VIVA VOCE	8	8
	23P4MECT6(A)	PROGRAMMING WITH JAVA	4	2
	23P4MECT6(B)	DATA STRUCTURES USING C AND C++		
	23P4MECP2(A)	PRACTICAL IN JAVA	2	1
	23P4MECP2(B)	PRACTICAL IN DATA STRUCTURES USING C AND C++		
	23P4MSED2	MATHEMATICS FOR CSIR-UGC NET /GATE/ SET COMPETITIVE EXAMINATIONS	4	2
	23P4MEXTN	EXTENSION ACTIVITY	-	1
	Total		30	23

DEPARTMET OF MATHEMATICS				CLASS: II M.Sc Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core	23P3MCCT7	COMPLEX ANALYSIS	5	6	25	75	100

Nature of Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Objectives:

The objective of the course is:

- To explain the fundamental concepts of complex analysis and their role in modern Mathematics and applied contexts.
- To apply the techniques in complex theory to evaluate definite integrals and infinite series.
- To examine the conformality of arcs, analyticity of a function, local properties of an analytic function and different forms of Cauchy's theorem.
- To decide when and where a given function is analytic and be able to find its series and product development.
- To develop power series expansions and partial fractions and factorization.

Unit	Description	Hours	K-level	CLO
I	Cauchy's Integral Formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives. Local Properties of analytical Functions - Removable Singularities-Taylor's Theorem – Zeros and poles – The local Mapping – The Maximum Principle.	18	K2	CLO1
II	The general form of Cauchy's Theorem: Chains and cycles-Simple Continuity - Homology - Cauchy's Theorem - Locally exact differentials - Multiply connected regions - Residue theorem - The argument principle.	18	K3	CLO2
III	Evaluation of Definite Integrals and Harmonic Functions: Evaluation of definite integrals - Definition of Harmonic function and basic properties - Mean value property - Poisson formula.	18	K3	CLO3
IV	Harmonic Functions and Power Series Expansions: Schwarz theorem - Weierstrass theorem – Taylor's Series – Laurent series.	18	K4	CLO4
V	Partial Fractions and Entire Functions: Partial fractions - Infinite products – Canonical products – Gamma Function - Jensen's formula.	18	K4	CLO5

Book for study:

1. Lars V. Ahlfors, *Complex Analysis*, (3rd edition) McGraw Hill Co., New York, 1979
UNIT-I Chapter 4: Sections 2(2.1 to 2.3), 3(3.1 to 3.4)
UNIT-II Chapter 4: Sections 4(4.1 to 4.7), 5(5.1 and 5.2)
UNIT-III Chapter 4: Sections 5(5.3), 6 (6.1 to 6.3)
UNIT-IV Chapter 4: Sections 6(6.4), Chapter 5: Sections 1.1 to 1.3
UNIT-V Chapter 5: Sections 2(2.1 to 2.4), 3(3.1)

Books for Reference:

1. H.A. Presfly, *Introduction to complex Analysis*, Clarendon Press, oxford, 1990.
2. J.B. Conway, *Functions of one complex variables* Springer - Verlag, International student Edition, Naroser Publishing Co.1978
3. E. Hille, *Analytic function Thorey* (2 vols.), Gonm & Co, 1959.
4. M.Heins, *Complex function Theory*, Academic Press, New York, 1968.
5. S.Ponnusamy, Herb Silverman, *Complex Variables with Applications*, Birkhauser,2011.
6. V.Karunakaran, *Complex Analysis*, Second Edition, Alpha Science,2002

Web Resources

1. <http://mathforum.org>,
2. <http://ocw.mit.edu/ocwwweb/Mathematics>,
3. <http://www.opensource.org>,

Rationale for Nature of the course

This course aims to provide an introduction to the theories for functions of a complex variable. It begins with the exploration of the algebraic, geometric and topological structures of the complex number field. The concepts of analyticity, Cauchy Riemann relations and harmonic functions are then introduced. Students will be equipped with the understanding of the fundamental concepts of complex variable theory. In particular, students will acquire the skill of contour integration to evaluate complicated real integrals via residue calculus.

Activities having direct bearing on skill development/Employability Entrepreneurship

The essential ideas of complex analysis are covered in this course, along with their importance in contemporary mathematics, real-world situations, and the application of complex theory methods to the evaluation of definite integrals and infinite series

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, and Seminar, Interaction and Tutorial sessions.

Course Designer(s):

1. Dr. K.M. DHARMALINGAM, Associate Professor, Department of Mathematics.
2. Prof.G.K.LAKSHMI, Assistant Professor, Department of Mathematics.

Course Schedule

Units	Topics	Hrs	Mode
I	The Index of a point with respect to a closed curve	1	Chalk and Talk, Quiz, Test.
	The Integral formula	2	
	Higher derivatives, Local Properties of analytical Functions:	4	
	Removable Singularities, Taylors's Theorem	4	
	Zeros and poles	4	
	The local Mapping , The Maximum Principle	3	
II	Chains and cycles, Simple Continuity	3	Chalk and Talk, Quiz, Test.
	Homology	2	
	Cauchy's Theorem	4	
	Locally exact differentials- Multiply connected regions	4	
	Residue theorem , The argument principle	5	
III	Evaluation of definite integrals	5	Chalk and Talk, Seminar, Quiz, Test
	Definition of Harmonic function and basic properties	4	
	Mean value property	4	
	Poisson formula	5	
IV	Schwarz theorem	5	Chalk and Talk& Seminar, Quiz, Test.
	Weierstrass theorem	5	
	Taylor's Series	4	
	Laurent series	4	
V	Partial fractions	5	Chalk and Talk, Quiz, Assignment
	Infinite products, Canonical products	5	
	Gamma Function	4	
	Jensen's formula	4	
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcome	Knowledge Level
CLO1	Understand and evaluate local properties of analytical functions and definite integrals.	K2
CLO2	Describe the concept of definite integrals and harmonic functions.	K3
CLO3	Apply the concept of the general form of Cauchy's theorem.	K3
CLO4	Evaluate Taylor and Laurent series.	K4
CLO5	Analyze the infinite products, canonical products and Jensen's formula.	K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	-
CLO2	2	1	3	1	-
CLO3	3	2	3	1	1
CLO4	1	2	3	2	1
CLO5	3	1	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	2	1	3
CLO2	3	2	1	2	1	3
CLO3	3	2	1	2	1	2
CLO4	3	2	1	2	1	1
CLO5	3	2	1	2	1	1

Advance application-3;**Intermediate level-2;****Basic level-1**

Summative - Blue – Print – Model

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMET OF MATHEMATICS				CLASS: II M.Sc Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Major Core	23P3MCCT8	PROBABILITY THEORY	5	6	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objectives of the course is:

- To introduce axiomatic approach to probability theory.
- To analyze some statistical characteristics, discrete and continuous distribution functions and their properties, characteristic function and basic limit theorems of probability.
- To acquire a knowledge of Bernoulli, Binomial, Poisson and Normal distributions.

Course content:

Unit	Description	Hours	K-level	CLOs
I	Random Events and Random Variables: Random events – Probability axioms – Combinatorial formulae – conditional probability – Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Functions of random variables.	18	K2	CLO 1
II	Parameters of the Distribution: Expectation- Moments – The Chebyshev Inequality – Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.	18	K3	CLO 2
III	Characteristic functions : Properties of characteristic functions – Characteristic functions and moments – semi invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.	18	K3	CLO 3
IV	Some Probability distributions: One point , two point , Binomial – Polya – Hyper geometric – Poisson distributions – Uniform – normal gamma – Beta – Cauchy and Laplace distributions.	18	K4	CLO 4

V	Limit Theorems : Stochastic convergence – Bernoulli law of large numbers – Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers .	18	K4	CLO 5

Book for Study:

1. M. Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons, New York, 1963.
Unit I : Chapter 1: Sections 1.1 to 1.7, Chapter 2 : Sections 2.1 to 2.9
Unit II: Chapter 3 : Sections 3.1 to 3.8
Unit III: Chapter 4 : Sections 4.1 to 4.7
Unit IV: Chapter 5 : Section 5.1 to 5.10
Unit V : Chapter 6 : Sections 6.1 to 6.4, 6.6, 6.7..

Books for Reference:

1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972
2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974.
3. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd., New Delhi, 1988(3rd Print).
4. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999.

Web Resources:

1. <http://mathforum.org>, <http://ocw.mit.edu/ocwwweb/Mathematics>,
2. <http://www.opensource.org>, <http://www.probability.net>
3. https://www.usb.ac.ir/FileStaff/7344_2018-12-2-10-44-10.pdf

Rationale for Nature of the course:

Probability is a mathematical term for the likelihood that something will occur. It is the ability to understand and estimate the likelihood of any different combination of outcomes. This course, namely Probability Theory, has applications in various fields. This course will enable the students to acquire skills by which they can model certain real-life problems.

Activities having direct bearing on Skill development/ Employability Entrepreneurship:

During class hours, students can handle more difficulties involved in the problems can be discussed and resolved.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

1. Dr. R. Pandiselvi, Associate Professor, PG and Research Department of Mathematics.
2. Dr. M. Revathi, Assistant Professor, Department of Mathematics(S.F)

Course schedule

Unit	Description	Hours	Mode
I	Probability axioms, Combinatorial formulae	3	Lecture, Chalk and Talk, Problem Solving, Quiz, Test.
	conditional probability	3	
	Bayes Theorem Independent events.	3	
	Random Variables Distribution Function.	2	
	Joint Distribution, Marginal Distribution, Conditional Distribution	4	
	Independent random variables, Functions of random variables.	3	
II	Expectation, Moments.	3	Lecture, Chalk and Talk, Problem Solving, Quiz, Test.
	The Chebyshev Inequality, Absolute moments.	6	
	Order parameters.	2	
	Moments of random vectors	4	
	Regression of the first and second types.	3	
III	Properties of characteristic functions.	3	PPT, Tutorial Problem Solving, Lecture, PPT, Quiz, Test
	Characteristic functions and moments, function of multidimensional random vectors	3	
	Probability generating functions.	3	
	Semi invariants.	2	
	characteristic function of the sum of the independent random variables	4	
	Determination of distribution function by the Characteristic function.	3	
IV	One point, two point, Binomial.	3	Lecture, Tutorial Problem Solving, Test, Quiz.
	Polya, Hypergeometric distributions	3	
	Poisson (discrete) distribution	3	
	Uniform, normal gamma, Beta distributions	4	
	Cauchy and Laplace (continuous) distributions.	5	
V	Stochastic Convergence-Bernoulli law of large numbers	3	Assignment, Problem Solving, Quiz, Seminar.
	Convergence of Sequence of distribution functions-Levy-	4	
	Cramer Theorems	2	
	De Moivre, Laplace Theorem.	2	
	Poisson, Chebyshev theorems	4	
	Khintchine Weak law of large numbers	3	
	Total Hours	90	

Course learning Outcomes:

At the end of the course, the students will be able to,

CLO s	Description	K- level
CLO 1	Define and illustrate the concept of – Combinatorial formulae – conditional probability and the basic definitions of Distribution Function, Marginal Distribution, Independent random variables and their axioms for defining probability theory.	K2
CLO 2	Understand Expectation- Moments and also to evaluate absolute moments, regression of the first and second types	K3
CLO 3	Identify Semi-invariants – characteristic function of the sum of the independent random variables	K3
CLO 4	Analyze One point, two point, Binomial and to characterize Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.	K4
CLO 5	Analyze Kolmogorov inequality and Kolmogorov strong law of large numbers.	K4

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	1
CLO2	2	1	3	1	2
CLO3	3	2	3	1	1
CLO4	1	2	3	2	1
CLO5	3	1	2	3	1

Mapping of CLOs with POs

CLO #	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	2	1	3
CLO2	3	2	1	2	1	3
CLO3	3	2	1	2	1	2
CLO4	3	2	1	2	1	1
CLO5	3	2	1	2	1	1

Advance application– 3

Intermediate level–2

Basic level–1

SUMMATIVE ASSESSMENT-BLUEPRINT

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
3	CLO 3	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/week	CIA	External	Total
III	Major Core	23P3MCCT 9	Topology	4	6	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objectives of the course is

- To impart knowledge on topological spaces and their properties such as compactness, connectedness, metrizable, countability & separation axioms etc.,
- To demonstrate construction of new topological spaces out of given ones by means of operations like union, intersection and finite & infinite Cartesian product.
- To analyze the structure of topological spaces applying continuous functions and homeomorphisms.

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	TOPOLOGICAL SPACES: Topological spaces – Basis for a topology – The order topology – The product topology on $X \times Y$ – The subspace topology – Closed sets and limit points.	18	K3	CLO1
II	CONTINUOUS FUNCTIONS: Continuous functions and properties– the product topology – The metric topology.	18	K3	CLO2
III	CONNECTEDNESS: Connected spaces- connected subspaces of the Real line – Components and local connectedness.	18	K3	CLO3
IV	COMPACTNESS: Compact spaces – compact subspaces of the Real line – Limit Point Compactness – Local Compactness.	18	K4	CLO4
V	COUNTABILITY AND SEPARATION AXIOMS: The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization Theorem – The Tietz extension theorem.	18	K4	CLO5

Book for Study:

1. Topology (Second Edition), James R.Munkres, Prentice – Hall of India, Private Ltd, New Delhi (2014).

Unit –I: Chapter 2 - Sections 12 to 17

Unit –II: Chapter 2 - Sections 18 to 21

Unit –III: Chapter 3 - Sections 23 to 25

Unit –IV: Chapter 3 - Sections 26 to 29

Unit –V: Chapter 4 - Sections 30 and 35

Books for Reference:

1. Introduction to Topology and Modern Analysis, G.F.Simmons, TataMcGraw-Hill Edition, New Delhi (2004).
2. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
3. J.L. Kelly, General Topology, Van Nostrand, Reinhold Co., New York
4. S.Willard, General Topology, Addison - Wesley, Mass., 1970 Introduction to Topology (3rd Edition), Bert Mendelson, Dover Publications, New York (1990).

Web Resources:

1. <https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm>
2. <https://www.topologywithouttears.net/topbook.pdf>
3. <https://www.math.colostate.edu/~renzo/teaching/Topology10/Notes.pdf>
4. <https://freevideolectures.com/course/3528/topology>

Rationale for Nature of the course:

This course on topology provides the students a knowledge of fundamental concepts and methods in topology. The course shall enable the students to acquire skill of applying basic topology to formulate and solve problems of a topological nature in mathematics and other fields where topological issues arise.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

This course is usually taught as a conventional lecture course with regular problem sets making up a key part of the course. Classes shall be spent discussing problems and having students participation in solving them.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

Dr.I. SAHUL HAMID Associate Professor, Department of Mathematics

Course learning Outcomes:

At the end of the course, the students will be able to,

CLO #	Description	K-level
CLO 1	Illustrate the concept of topological spaces and the basic definitions of open sets, neighbourhood, interior, exterior, closure and their axioms for defining topological space.	K3
CLO 2	Recognize continuity, homeomorphism and topological properties and also to recognize metrizable spaces.	K3
CLO 3	Identify connected topological spaces, to construct new connected spaces out of given ones and to find out connected subspaces of the real line.	K3
CLO 4	Analyze compactness of a topological space and to characterize compact subspaces of the real line.	K4
CLO 5	Develop qualitative tools to characterize second countable, Hausdorff and develop tools to identify when two are equivalent (homeomorphic).	K4

Mapping of CLOs with PSOs

#	PSO -1	PSO -2	PSO -3	PSO -4	PSO -5
CLO -1	1	-	2	-	-
CLO -2	-	1	2	-	-
CLO -3	2	1	2	-	-
CLO -4	-	3	3	-	-
CLO -5	3	2	-	-	-

Mapping with CLOs with POs

#	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	-	-	2	1	3	-
CLO -2	-	1	2	2	3	-
CLO -3	-	1	2	2	3	2
CLO -4	-	2	3	2	3	2
CLO -5	-	2	3	2	3	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Schedule

UNIT	Topics to be covered	Hours	Pedagogy
I	Topological spaces – introduction – definition and Examples - Types of Topological Spaces	3	Chalk and talk, PPT, Interaction, e-Quiz, Group Discussion, Test
	Basis and subbasis for a topology – topology generated by bases and subbases	3	
	The order topology	2	
	The product topology on $X \times Y$ - The subspace topology	4	
	Closed sets and limits points	4	
	Tutorial	2	
II	Continuous functions – definition and examples	2	Chalk and talk, PPT, Interaction, seminar, Group Discussion, Test
	Characterization theorems for continuous functions	2	
	Homeomorphisms and constructing continuous functions	3	
	Definition of Box topology and product topology	2	
	Comparison of Box topology and product topology and related theorems	3	
	Metric topology: Metrizable space – standard bounded metric, Euclidean metric and square metric	3	
	Sequence lemma-Uniform limit theorem	2	
	Tutorial	1	
III	Connected topological spaces – definition and example – construction of new connected spaces from the given ones	6	Chalk and talk, PPT, Interaction, Group Discussion, Quiz and Test
	Connected subspaces of the real line	6	
	Components and Local connectedness	4	
	Tutorial	2	
IV	Compact topological spaces – definition and examples - properties	4	Chalk and talk, PPT, Interaction, Seminar, test
	Finite product of compact topological spaces – tube Lemma – finite intersection property	3	
	Compact subspaces of the real line – Extreme value theorem – Lebesgue number Lemma –Uniform continuity theorem	5	
	Limit Point Compactness	3	
	Locally compactness	2	
	Tutorial	1	

V	The countability axioms - First and Second countable spaces	3	Chalk and talk, PPT, Interaction e-Quiz, and Assignment
	Lindeloff and Separable Spaces	1	
	The separation axioms – Hausdroff, Regular and Norma spaces	3	
	Properties of Normal spaces	4	
	The Urysohn lemma – Completely regular spaces	2	
	The Urysohn Metrization Theorem	2	
	Tietze Extension Theorem	2	
	Tutorial	1	
Total Hours		90	

Summative Examination – Blue Print

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	K3	2	K2 / K3	1	K1	2 (K1/K1)	1 (K3)
2	CLO 2	K4	2	K2 / K3	1	K2	2 (K3/K3)	1 (K4)
3	CLO 3	K4	2	K3 / K4	1	K2	2 (K4/K4)	1 (K3)
4	CLO 4	K4	2	K3 / K4	1	K3	2 (K4/K4)	1 (K4)
5	CLO 5	K2	2	K1 / K1	1	K1	2 (K2/K2)	1 (K2)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	External	Total
III	Major Core	23P3MCCT10	GRAPH THEORY AND APPLICATIONS	3	5	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objective of the course is

- To impart knowledge on graph theoretical terminologies such as degree sequence, isomorphism of graphs, operations of graphs, matrix representation of graphs, connectedness, distance, connectivity, Eulerian graphs, Hamiltonian graphs, planar graphs and graph colorings.
- To demonstrate construction of a minimum spanning tree in a connected weighted graph using Kruskal and Prim algorithms.
- To determine whether or not a given graph is Eulerian /Hamiltonian/planar.
- To inculcate proof techniques available in the topics of graph theory such as connectedness, distance, algorithms, transversability, connectivity, independence, covering, matching, planarity and colorings,

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	Title Trees, Cut Edges and Bonds, Cut Vertices, Cayley's Formula –Applications: The Connector Problem – Connectivity, Blocks – Applications: Construction of Reliable Communication Networks.	15	K3	CLO1
II	Euler Tours, Hamiltonian Cycles –Applications: The Chinese Postman Problem, The Travelling Salesman Problem.	15	K3	CLO2
III	Matching's, Matching's and Coverings in Bipartite Graphs, Perfect Matching – Applications: The Personnel Assignment Problem.	15	K3	CLO3
IV	Chromatic Number, Brook's Theorem, Chromatic Polynomials, Girth and Chromatic Number – Applications: A Storage Problem.	15	K4	CLO4
V	Directed Graphs, Directed Paths, Directed Cycles – Applications: A Job Sequencing Problem, Designing as Efficient Computer Drum.	15	K4	CLO5

Book for Study:

1. J.A Bondy and U.S.R Murty, Graph Theory with Applications, North Holland, 1976.
Unit – I : Chapter 2 : Sections 2.1-2.5 and Chapter 3: Sections 3.1-3.3

Unit – II: Chapter 4: Sections 4.1-4.4
Unit – III: Chapter 5: Sections 5.1-5.4
Unit –IV: Chapter 8: Sections 8.1, 8.2, 8.4, 8.5, 8.6
Unit –V: Chapter 10: Sections 10.1-10.6

Books for Reference:

1. Frank Harry, Graph Theory, Addison - Wesley, Reading Mass, 1969.
2. R.Balakrishnan and K.Ranganathan, A Textbook of Graph Theory (second edition), Springer, New York, 2012.
3. J.A.Bondy and U.S.R.Murty, Graph Theory with Applications, Macmillan Co., London, 1976.
4. Robin J. Wilson, Introduction To Graph Theory (5th Edition), Pearson publications, 2010.
5. D.B.West, Introduction to Graph Theory, Prentice - Hall of India, 2001.

Web Resources:

1. <https://d3gt.com/>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-6-graph-theory-and-coloring/>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-7-matching-problems/>
4. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-8-graph-theory-ii-minimum-spanning-trees/>
5. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/lecture-10-graph-theory-iii/>
6. <http://mit.usiu.ac.ke/high-school/courses/combinatorics-the-fine-art-of-counting/lecture-notes/>
7. https://www.brianheinold.net/graph_theory/graph_theory_book.html

Rationale for Nature of the course:

This course, namely Graph Theory, has applications in various fields. Graph theory has been serving as an elegant tool to easily approach/solve several problems/concepts in other fields ranging from Science to Sociology. This course will enable the students to acquire skills by which they can model certain real-life problems as graph theoretical terms and can make inferences.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Modelling of certain real-life problems like Scheduling problem, Traffic signal problem, Marriage problem and so on as graph structure and solving them using graph theoretic tools.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:**Dr.I.SAHUL HAMID**, Associate Professor, Department of Mathematics**Course learning Outcomes**

At the end of the course, students will be able to

CLOs	Description	K-level
CLO 1	Recognize isomorphic graphs, bipartite graphs & graphical sequences, to find the union, sum & product of two graphs, to determine the radius, diameter, center & adjacency matrix of a graph.	K3
CLO 2	Prove properties of trees, to identify the cut-vertices & bridges of a given graph, to construct the Prufer code for the given tree and vice-versa, to apply Kruskal's and Prim's algorithms for finding a minimum spanning tree in a given tree.	K3
CLO 3	Find vertex & edge connectivity of a graph, to recognize Eulerien graphs and certain families of Hamiltonian graphs, to find a maximum matching in a graph, to verify Hall's condition for a given bipartite graph.	K3
CLO 4	Verify whether or not a graph has a 1-factor applying Tutte's theorem, to find the four independence & covering parameters for a graph and also to establish relationship among them, to derive properties of planar graphs, to apply Kuatowski's theorem for determning a given is a planar graph or not.	K4
CLO 5	Find chromatic number and chromatic index of a graph, to obtain a vertex coloring of a graph using greedy algorithm, to construct the Myceilskian graph.	K4

Mapping of CLOs with PSOs

CLOs	PSO -1	PSO -2	PSO -3	PSO -4	PSO -5
CLO 1	1	-	2	2	-
CLO 2	-	1	2	-	2
CLO 3	-	3	1	-	-
CLO 4	1	2		2	2
CLO 5	-	2	3	-	-

Mapping of CLOs with POs

CLOs	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO 1	-	-	2	1	3	-
CLO 2	-	1	2	2	3	-
CLO 3	-	1	-	2	-	2
CLO 4	-	2	3	2	3	2
CLO 5	-	2	-	2	-	2

*Advance application– 3**Intermediate level–2**Basic level–1*

Course Schedule

UNIT	Topics to be covered	Hour(s)	Pedagogy
I	Definition and examples of Graph, degree of a vertex, regular graphs	2	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion & Test
	subgraphs, isomorphism and automorphism of graphs, adjacency and incidence matrices, operations of graphs	3	
	degree sequence- graphical sequence-Havel-Hakimi theorem	3	
	connectedness of graphs	3	
	distance, eccentricity, radius, diameter, center, periphery bipartite graphs	4	
II	Definition and examples of trees - properties of trees	3	Chalk and talk, PPT, Interaction, quiz, Group Discussion and Test
	spanning tree - Prufer codes - Cayley's formula	3	
	cut-vertices , separable graphs, blocks	5	
	bridges	1	
	minimum spanning tree problem - Kruskal's algorithm - Prim's algorithm	3	
III	Connectivity - k-connected graphs	1	Chalk and talk, PPT, Interaction, Seminar and Test
	edge connectivity	3	
	Eulerian graphs - definition and examples - characterization of Eulerian graphs	3	
	Hamiltonian graphs - Ore's theorem - Dirac's theorem	2	
	Closure of a graph	3	
	Matchings - maximum matching - marriage problem - Hall's marriage theorem - system of representatives	3	
IV	1-factors - Tutte's theorem - Petersen's theorem	4	Chalk and talk, PPT, Interaction, e-Quiz and test
	vertex and edge covering - independence - Gallai theorem - Konig-Egervary theorem	3	
	Planar graphs - planar embedding - Euler's formula	2	
	An upper bound for the size of a planar graph	1	
	regular polyhedra	2	
	maximal planar graphs - statement of kuratowski's theorem	3	
V	vertex coloring - chromatic number - applications of vertex coloring - greedy coloring algorithm	4	Chalk and talk, Interaction, Quiz and Assignment
	bounds for chromatic number - Brook's theorem	4	
	triangle-free graphs with large chromatic number - Mycielskian construction	2	
	edge-coloring, chromatic index of a graph, its applications	2	
	Vizing's theorem	3	
	Total Hours	75	

Summative Examination – Blue Print

Units	CLOs	K-Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	K3	2	K2 / K3	1	K1	2 (K1/K1)	1 (K3)
2	CLO 2	K4	2	K2 / K3	1	K2	2 (K3/K3)	1 (K4)
3	CLO 3	K4	2	K1 / K4	1	K2	2 (K4/K4)	1 (K3)
4	CLO 4	K4	2	K3 / K4	1	K1	2 (K4/K4)	1 (K4)
5	CLO 5	K4	2	K1 / K3	1	K3	2 (K2/K2)	1 (K2)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	MDC	23P3MMDC	Stochastic Processes, Statistical Mechanics and point groups of Molecules	3	5	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objectives of the course is to

- Acquire knowledge on the underlying concepts of stochastic processes.
- Familiarize with Markov chain and system.
- Obtain in-depth understanding of birth and death process.
- Develop the acquaintance with applications of Markov process.

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	Stochastic Processes -Specification of stochastic processes – Stationary processes –Second order process – Covariance function – Gaussian Processes – Martingales-Types of Martingale: Martingale Convergence Theorem(Statement only) - Markov Chains: Definitions and Examples.	15	K2	CLO 1
II	Markov Chains: Higher transition probabilities- Generalization of independent Bernoulli trials - Classification of States and Chains – Determination of Higher transition probabilities – Stability of Markov system-Ergodic Theorem – Graph theoretic approach – Statement of Solberg theorem with example.	15	K2	CLO2
III	Markov process with discrete state space -Poisson process - Poisson process and related distributions –Generalizations of Poisson process –Pure Birth process – Yule- Furry Process – Time dependent Poisson Process- Birth and death process – Linear growth process.	15	K2	CLO3
IV	Statistical Mechanics(Physics) Phase space - Volume of phase space - Ensembles – Micro canonical, canonical and grand canonical ensembles - Microstates and macrostates - General statistical distribution law – Most probable distribution - Statistical weight or a priori probability - Bose-Einstein Statistics.	15	K2	CLO4

V	Point Groups of Molecules(Chemistry) Symmetry elements: symmetry operations – group theory- Abelian group-point groups-determination of point group- Group multiplication table –(C_{2v} , C_{3v} , D_{2h}) Matrix representation of symmetry operations-Mulliken symbols-reducible and irreducible representations; Symbols and rules of irreducible representations-reduction formula-direct product representation; Great orthogonality theorem; character table-construction of character tables C_{2v}	15	K2	CLO5

Books for Study:

- Medhi.J, “**Stochastic Processes**”, New Age International, Cochin, 2nd edition 2017.
Unit I - Chapter 2(Sections 2.1 - 2.4) & **Chapter 3**(Sections 3.1)
Unit II - Chapter 3(Sections 3.2 - 3.7)
Unit III - Chapter 4(Sections 4.1 - 4.4)
- Statistical mechanics – S.L.Gupta & V. Kumar –PragatiPrakashan educational publishers (twenty fifth edition) 2012.
Unit IV - Chapters: 1.1, 1.3, 2.1, 2.4, 2.5, 2.6, 5.8, 6.2
- Ramakrishnan, V and Gopinathan, M. S, Group theory in Chemistry, Vishal Publications, 1988.
UNIT V- Relevant topics

Books for Reference:

- Leo Breiman., Probability and Stochastic Processes, Houghton Mifflin, 2008
- Athanasios Papoulis., Probability Random Variable & Stochastic Process, McGraw Hill, International, II Edition, 2004.
- Brijlal & Subrahmanyam, Heat Thermodynamics and Statistical Physics, S. Chand & Company Pvt.Ltd. Reprint (2016).

Web Resources:

- <https://www.coursera.org/learn/stochasticprocesses>
- <https://nptel.ac.in/courses/111/102/111102014/>
- <https://www.mphysicstutorial.com/2020/11/ensembles-in-statistical-mechanics.html>
- <https://uou.ac.in/sites/default/files/slm/MSCPH-504.pdf>

Rationale for Nature of the course:

The purpose of this course is to equip students with theoretical knowledge and practical skills, which are necessary for the analysis of stochastic dynamical systems in economics, engineering and other fields. More precisely, the objectives are study of the basic concepts of the theory of stochastic processes; introduction of the most important types of stochastic processes; study of various properties and characteristics of processes; study of the methods for describing and analyzing complex stochastic models. The course provides a necessary theoretical basis for studying other courses in stochastic, such as financial mathematics, quantitative finance, stochastic modelling.

Activities having direct bearing on Skill development/ Employability /Entrepreneurship:

Students are able to work on challenging problems in class. In the classroom, extra challenges in the tasks can be explored and worked.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

1. Dr. C.Thangapandi, Department of Mathematics, The Madura College, Madurai.
2. Dr. M.Revathi, Department of Mathematics, The Madura College, Madurai.

Course schedule

Unit	Topics	Hours	Mode
I	Stochastic Processes -Specification of stochastic processes – Stationary processes –Second order process.	5	PPT, Chalk and Talk, Quiz.
	Covariance function – Gaussian Processes – Martingales-Types of Martingale.	5	
	Martingale Convergence Theorem(Statement only) - Markov Chains: Definitions and Examples.	5	
II	Markov Chains: Higher transition probabilities- Generalization of independent Bernoulli trials.	4	PPT, Chalk and Talk, and GD, Quiz
	Classification of States and Chains – Determination of Higher transition probabilities.	5	
	Stability of Markov system-Ergodic Theorem – Graph theoretic approach – Statement of Solberg theorem with example.	6	
III	Markov process with discrete state space - Poisson process - Poisson process and related distributions.	5	PPT, Chalk and Talk, Assignments, Quiz
	Generalizations of Poisson process – Pure Birth process – Yule-Furry Process.	5	
	Time dependent Poisson Process- Birth and death process –Linear growth process.	5	
IV	Phase space - Volume of phase space- Ensembles - Microcanonical, canonical and grand canonical ensembles- Microstates and macrostates.	4	PPT, Chalk and Talk, Assignments, Test, Quiz.
	General statistical distribution law – Most probable distribution	5	
	Statistical weight or a priori probability- Bose-Einstein Statistics.	6	
V	symmetry operations – group theory- Abelian group-point groups-determination of point group- Group multiplication table-(C_{2v} , C_{3v} , D_{2h}) Matrix representation of symmetry operations.	5	Assignments, Seminar and GD, Quiz, Test.
	Mulliken symbols-reducible and irreducible representations; Symbols and rules of irreducible representations	5	

	Reduction formula and direct product representation; Great orthogonality theorem; character table-construction of character tables C_{2v} .	5	
	Total Hours	75	

Course learning Outcomes

At the end of the course, the students will be able to,

CLOs	Description	K- level
CLO 1	Correlate the concepts of stochastic processes with illustrations	K2
CLO 2	Illustrate Markov chain and its applications	K2
CLO 3	Compare the conceptualization of pure birth and death process	K2
CLO 4	Infer the basic concepts of statistical mechanics and apply them to derive the distribution law of particles mechanics	K2
CLO 5	Study the structure of atoms and molecules with reference to point groups.	K2

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	3
CLO2	2	1	3	1	3
CLO3	3	2	3	1	3
CLO4	1	2	3	2	3
CLO5	3	1	2	3	3

Mapping of CLOs with POs

CLOs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	2	1	3
CLO2	3	2	1	2	1	3
CLO3	3	2	1	2	1	2
CLO4	3	2	1	2	1	1
CLO5	3	2	1	2	1	1

Advance application-3;

Intermediate level-2;

Basic level-1

SUMMATIVE ASSESSMENT-BLUEPRINT

S.No	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short Answers		(Either/or Choice)		
			No of Questions	K - Level	No of Questions	K - Level	
1	CLO1	K2	1	K1	1	K2& K2	1(K2)
2	CLO2	K2	1	K1	1	K2& K2	1(K2)
3	CLO3	K2	1	K1	1	K2& K2	1(K2)
4	CLO4	K2	1	K1	1	K2& K2	1(K2)
5	CLO5	K2	1	K1	1	K2& K2	1(K2)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

Distribution of section wise marks with K levels

K Levels	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	-	10	7.69	8%
K2	-	70	50	120	92.31	92%
Total Marks	10	70	50	130	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II M.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	SEC1	23P3MSEN2	NME - Business Statistics	2	2	25	75	100

Nature of the course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	

Objectives:

The objective of the course is:

- To explain the important concepts of statistics and mathematical data concept.
- To formulate the visualization of frequency distribution.
- To describe the relationship between two different variables in terms of positive and negative correlation, describe how strongly correlated two different variables are based on the proximity to a line of best fit on a scatter graph or a scatter graph without a line of best fit.

Course content:

Unit	Description	Hours	K-level	CLOs
I	Correlation: Introduction – Definitions – Types of correlation – Karl Pearson’s coefficient of correlation – Rank coefficient of correlation – Problems.	6	K2	CLO 1
II	Regression: Introduction – Definitions – Line of regression of x on y and y on x Difference between correlation and regression – Problems.	6	K2	CLO 2
III	Index Numbers: Introduction – Definitions – Types of index number – Laspeyre’s method – Paasche’s method, Dorbish and Bowley’s method – Fisher’s ideal method – Marshall Edgeworth method – Problems.	6	K2	CLO 3
IV	Index Numbers (continued): Quantity index numbers – Value index numbers – Time reversal test – Factor reversal test – Consumer price index – Family Budget method – Problems.	6	K2	CLO 4
V	Time series: Introduction – Definitions – Measurements of secular trend – Semi average method –Moving average method – Method of Least squares – Measurement of Seasonal variation – Method of simple average - Problems.	6	K2	CLO 5

Book for study:

1. **Statistics Theory and Practice** R.S.N. Pillai and Bagavathi S. chand and company Reprint 2018.
Chapters 12, 13, 14, 15 (Relevant Topics only)

Books for Reference:

1. Gupta S.C and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi
2. Goon A.M. Gupta. A.K. and Das Gupta, B (1987). Fundamental of Statistics, vol.2 World Press Pvt. Ltd., Kolkatta
3. G.U.Yule and M.G. Kendall (1956). An introduction to the theory of Statistics, Charles Griffin.
4. M.R. Spiegel (1961). Theory and problems of Statistics, Schaum's outline series.
5. Anderson, T.W. and Sclove SL. (1978). An introduction to statistical analysis of data, Houghton Mifflin & co.

Web Resources

1. <https://geographyfieldwork.com/Spearman'sRank.htm#:~:text=Spearman's%20Rank%20correlation%20coefficient%20is%20a%20technique%20which%20can%20be,between%201%20and%20minus%201.&text=Create%20a%20table%20from%20your,Rank%20the%20two%20data%20sets>.
2. <https://www.geeksforgeeks.org/laspeyres-paasches-and-fishers-methods-of-calculating-index-number/>
3. https://www.brainkart.com/article/Measurements-of-Trends--Methods-of-measuring-Seasonal-Variations-By-Simple-Averages_39019/

Rationale for Nature of the course

Statistics is the part of mathematical science which pertains to the collection, classification, tabulation, analysis, interpretation and presentation of data. Some of the eminent researchers consider Statistics to be a separate mathematical science rather than a branch of mathematics.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students have the ability to work on challenging issues during class hours. The challenges can be discussed and further difficulties can be worked through in class.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

1. Dr. C. Thangapandi, Associate Professor, Department of Mathematics.
2. Prof. N. Sriviveka Saratha, Assistant Professor, Department of Mathematics(SF).

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction – Definitions – Types of correlation.	2	Lecture,
	Karl Pearson's coefficient of correlation – Problems.	2	Tutorial, Quiz,
	Rank coefficient of correlation – Problems.	2	Test
Unit II	Introduction – Definitions and examples.	2	Lecture ,PPT, Problem solving, Quiz, Test.
	Line of regression of x on y and y on x and problems.	2	
	Difference between correlation and regression – problems.	2	
Unit III	Introduction – Definitions – Types of index number and simple problems.	2	Lecture, Problem solving, Quiz, Test.
	Laspeyre's method – Paasche's method, Derbish and Bowley's method – Problems.	2	
	Fisher's ideal method – Marshall – Edge worths method – Problems.	2	
Unit IV	Quantity index numbers – Value index numbers — Problems.	2	Problem solving Lecture, Quiz Tutorial, Test
	Time reversal test – Factor reversal test – simple problems.	2	
	Consumer price index – Family Budget method – Problems.	2	
Unit V	Introduction – Definitions – Measurements of secular trend — Problems.	2	Seminar, Lecture, Quiz Lecture, Assignment.
	semi average method –moving average method – Simple problems.	2	
	Method of Least square – Measurement of Seasonal variation – Method of simple average problems.	2	
	Total	30	

Course Learning Outcomes:

After completion of the course the students will be able to,

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the types of correlation, Karl Pearson's coefficient of correlation, Rank coefficient of correlation and Problems.	K2
CLO-2	Find line of regression of x on y and y on x and difference between correlation and regression, problems.	K2
CLO-3	Understand index numbers, Laspeyre's method, Paasche's method, Dorbish and Bowley's method, Fisher's ideal method, Marshall, Edgeworth method and Problems.	K2
CLO-4	Understand value index numbers, Time reversal test, Factor reversal test, Consumer price index, Family Budget method and Problems.	K2
CLO-5	Solve problem by using moving average method, Method of Least squares, Measurement of Seasonal variation, Method of simple average and Problems.	K2

Mapping of CLOs with PSOs

CLOs	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	1	2
CLO-2	3	3	2	1	2
CLO-3	3	3	2	2	2
CLO-4	3	3	2	2	2
CLO-5	3	3	2	3	2

Mapping of CLOs with POs

CLOs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	1	1	1	1
CLO4	3	2	1	1	1	1
CLO5	3	2	1	1	1	1

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue Print – Model

S. No.	CLOs	K – Level	Section A	Section B	Section C
			Short Answers	(Either/OR Choice)	(Open Choice)
1	CLO1	K2	1(K1)	2(K2 &K2)	1(K1)
2	CLO2	K2	1(K1)	2(K2 &K2)	1(K1)
3	CLO3	K2	1(K1)	2(K2 &K2)	1(K1)
4	CLO4	K2	1(K1)	2(K2 &K2)	1(K1)
5	CLO5	K2	1(K1)	2(K2 &K2)	1(K1)
No. of Questions to be asked			5	10	5
No. of Questions to be answered			5	5	3
Marks for each question			2	7	10
Total Marks for each Section			10	35	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	—	70	-	70	53.85	54%
Total marks	10	70	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS :II M.Sc MATHEMATICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
III	Internship	23P3MINTR	Internship	2	-	-	-	-

Nature of the course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	✓

Course Objectives:

The objective of the course is:

- To motivate students to take up internship in research institutions / industry.
- To develop the employability of students.
- To promote entrepreneurial tendencies among students.
- During the second semester vacation, students shall undertake internship for a minimum period of two weeks and submit a report and certificate from the company / industry / institution offering internship.

At the end of the internship, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in mission critical projects in real-time	K4
CLO 2	Develop into a critical thinker and solve every day problems in the industry.	K5
CLO 3	Learn and analyze problems faced by the industry and workforce at large.	K4
CLO 4	Survey the job market / understand entrepreneurial opportunities / research opportunities available to them.	K2
CLO 5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with PSOs

CLOs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation schema for Internship

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMET OF MATHEMATICS				CLASS: II M.Sc Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core	23P4MCCT11	FUNCTIONAL ANALYSIS	5	6	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Objectives:

The objective of the course is:

- To Provide the students with an overview of functional analysis.
- To understand the concepts of analyzing the basic structure of Banach spaces, Hilbert spaces and fundamental theorems of functional analysis.
- To acquire the knowledge of operator theory and Banach algebras leading to the spectral theory of operators.

Course content

Unit	Description	Hours	K-level	CLO
I	Banach Spaces: The definition and some examples - Continuous linear transformations – The Hahn-Banach Theorem.	18	K4	CLO1
II	Banach Spaces (continued): The natural imbedding of $\mathbf{N}$ in $\mathbf{N}^{**}$ - The open mapping theorem – The conjugate of an operator.	18	K3	CLO2
III	Hilbert Spaces: The definition and some simple properties – Orthogonal complements – Orthonormal sets.	18	K5	CLO3
IV	Hilbert Spaces (continued): The Conjugate space $\mathbf{H}^*$ - The adjoint of an operator – Self-adjoint operators- Normal and unitary operators.	18	K3	CLO4
V	Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator – The spectral theorem.	18	K5	CLO5

Book for study:

1. Simmons.G.F., Introduction to Topology and Modern Analysis, Tata McGraw Hill, New Delhi.
Unit I - Chapter 9: Sections (46, 47, 48)
Unit II - Chapter 9: Sections (49, 50, 51)
Unit III - Chapter 10: Sections (52, 53, 54)
Unit IV - Chapter 10: Sections (55, 56, 57, 58)
Unit V - Chapter 11: Sections (60, 61, 62)

Books for Reference:

1. D.Somasundaram, A First Course in Functional Analysis, Narosa Book Distributors Private Ltd., 2008.
2. S.C.Bose, Introduction to Functional Analysis, MacMillan Publishers India, New Delhi, 2000.
3. Balmohan Visnu Limaye, Functional Analysis, New Age International, New Delhi, 2012.
4. W.Rudin, Functional Analysis, Mc Graw Hill Education (India) Private Limited, New Delhi, 1973
5. B.V. Limaye, Functional Analysis, New Age International, 1996.
6. M.Thamban Nair, Functional Analysis, A First Course, Prentice Hall of India, New Delhi, 2002.

Web Resources

1. <http://mathforum.org>,
2. <http://ocw.mit.edu/ocwwweb/Mathematics>,
3. <http://www.opensource.org>,

Rationale for Nature of the course

Functional analysis is a branch of mathematical analysis, the core of which is formed by the study of vector spaces endowed with some kind of limit-related structure (e.g. inner product, norm, topology, etc.) and the linear functions defined on these spaces and respecting these structures in a suitable sense. The historical roots of functional analysis lie in the study of spaces of functions and the formulation of properties of transformations of functions such as the Fourier transform as transformations defining continuous, unitary etc. operators between function spaces. This point of view turned out to be particularly useful for the study of differential and integral equations. These course Functional analyses are used to identify the environmental context in which aberrant behaviour is likely and unlikely to occur.

Activities having direct bearing on skill development/Employability Entrepreneurship

This course leads to acquire the knowledge of operator theory, Banach algebras and also to understand some concepts like Hilbert Spaces, The Spectral Theorem, Theory of Operators.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, and Seminar, Interaction and Tutorial sessions.

Course Designer(s):

1. Dr. C.THANGAPANDI, Associate Professor, Department of Mathematics.
2. Prof.G.K.LAKSHMI, Assistant Professor, Department of Mathematics.

Course Schedule

Units	Topics	Hrs	Mode
I	Banach Spaces: The definition and some examples	6	Chalk and Talk, Quiz, Test
	continuous linear transformations	6	
	The Hahn-Banach Theorem	6	
II	Banach Spaces: The natural imbedding of $\mathbf{N}$ in $\mathbf{N}^{**}$	6	Chalk and Talk, Quiz, Test
	The open mapping theorem	6	
	The conjugate of an operator	6	
III	Hilbert Spaces: The definition and some simple properties	6	Chalk and Talk, Quiz, Test
	Orthogonal complements	6	
	Orthonormal sets	6	
IV	Hilbert Spaces: The Conjugate space $\mathbf{H}^*$	4	Chalk and Talk & Seminar, Quiz, Test, Group Discussion
	The adjoint of an operator	5	
	Self-adjoint operators	4	
	Normal and unitary operators	5	
V	Finite-Dimensional Spectral Theory: Matrices	6	Chalk and Talk, Assignment, Quiz
	Determinants and the spectrum of an operator	6	
	The spectral theorem	6	
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the students will be able to,

CLO	Course Learning Outcome	Knowledge Level
CLO1	Acquire the fundamentals of normed, Banach & Hilbert Spaces	K4
CLO2	Recall the results in Banach Spaces & Hilbert Spaces	K3
CLO3	Prove standard theorems such as Hahn-Banach theorem, Open mapping theorem, closed graph theorem, Uniform boundedness theorem and spectral theorem	K5
CLO4	Analyze the behaviour of linear operators on normed spaces	K3
CLO5	Elucidate the operators and find the spectrum of operators	K5

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	1	1	2
CLO2	3	2	1	1	1
CLO3	3	2	1	2	2
CLO4	3	2	1	1	2
CLO5	3	2	1	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	3	2	3	3
CLO2	2	1	3	1	3	3
CLO3	3	2	3	1	3	3
CLO4	1	2	3	2	3	3
CLO5	3	1	2	3	3	3

Advance application-3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. Of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	K 4	2	K2 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	K 3	2	K3 & K3	1	K2	2(K4& K4)	1(K4)
3	CLO 3	K 5	2	K3 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	K 3	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
5	CLO 5	K 5	2	K4 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2		20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMET OF MATHEMATICS				CLASS: II M.Sc Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Major Core	23P4MCCT12	DIFFERENTIAL GEOMETRY	4	6	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Objectives:

The objective of the course is

- To provide the students with an overview of Differential Geometry.
- To understand the concepts of analyzing the geometrical properties of surfaces, and of systems of curves on a surface.
- To acquire knowledge of curvatures and developable.

Course Content:

Unit	Description	Hours	K-level	CLO
I	Space curves: Definition of a space curve – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface- involutes and evolutes.	18	K4	CLO1
II	Intrinsic properties of a surface: Definition of a surface – curves on a surface – Surface of revolution – Helicoids – Metric- Direction coefficients – families of curves.	18	K3	CLO2
III	Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvature- Gauss- Bonnet Theorem.	18	K5	CLO3
IV	Non-intrinsic properties of a surface: The second fundamental form- Principle curvature – Lines of curvature – Developable - Developable associated with space curves and with curves on surface.	18	K3	CLO4
V	Differential Geometry of Surfaces: Compact surfaces whose points are umbilics - Hilbert's lemma – Compact surface of constant curvature.	18	K5	CLO5

Book for study:

- T.J. Willmore, *An Introduction to Differential Geometry*, Oxford University Press, (17th Impression)
New Delhi 2002. (Indian Print)
UNIT-I Chapter 1: Sections 1 to 7

UNIT-II Chapter 2: Sections 1 to 7

UNIT-III Chapter 2: Sections 10 to 16

UNIT-IV Chapter 3: Sections 1 to 6

UNIT-V Chapter 4: Sections 1 to 4

Books for Reference:

1. Struik, D.T. *Lectures on Classical Differential Geometry*, Addison – Wesley, Mass. 1950.
2. Kobayashi. S. and Nomizu. K. *Foundations of Differential Geometry*, Interscience Publishers, 1963.
3. Wilhelm Klingenberg: *A course in Differential Geometry*, Graduate Texts in Mathematics, Springer-Verlag 1978.
4. J.A. Thorpe *Elementary topics in Differential Geometry*, Under-graduate Texts in Mathematics, Springer - Verlag 1979.
5. Mittal S.Chand Agarwal D.C., "*Differential Geometry*", Thirty Ninth Edition, Krishna Prakashan Media (p) Ltd, Meerut, Uttar Pradesh, 2013.

Web Resources

1. <http://mathforum.org>,
2. <http://ocw.mit.edu/ocwweb/Mathematics>,
3. <http://www.opensource.org>,

Rationale for Nature of the course

Differential geometry is a mathematical discipline that studies the geometry of smooth shapes and smooth spaces, otherwise known as smooth manifolds, using the techniques of differential calculus, integral calculus, linear algebra and multi linear algebra. The field has its origins in the study of spherical geometry as far back as antiquity, as it relates to astronomy and the geodesy of the Earth, and later in the study of hyperbolic geometry. These courses divulge theoretical knowledge & Problem Solving Skills to the students and are shaped to help the students to deliberating the best techniques in a given theory. Theoretical learning provides the guidance to the mind.

Activities having direct bearing on skill development/Employability Entrepreneurship

This course helps to understand the concepts of analyzing the geometrical properties of surface, systems of curves on a surface and to know about curvatures, developable, minimal and ruled surfaces.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, and Seminar, Interaction and Tutorial sessions.

Course Designer(s):

1. Dr. K.M. DHARMALINGAM, Associate Professor, Department of Mathematics.
2. Prof. S.Krishnajayanthi, Assistant Professor, Department of Mathematics.

Course Schedule

Units	Topics	Hrs	Mode
I	Definition of a space curve	1	Chalk and Talk, Quiz, Test
	Arc length	2	
	Tangent, Normal and Binormal	4	
	Curvature and Torsion	4	
	Contact between curves and surfaces	4	
	Tangent surface, Involutives and evolutes	3	
II	Definition of a surface, curves on a surface.	3	Chalk and Talk, Quiz, Test.
	Surface of revolution	4	
	Helicoids	3	
	Metric- Direction Coefficients	4	
	Families of curves	4	
III	Geodesics – Canonical geodesics equations	3	Chalk and Talk, Quiz, Test
	Normal property of geodesics	4	
	Existence theorems	3	
	Geodesic parallels, Geodesic curvature	4	
	Gauss-Bonnet theorem	4	
IV	The second fundamental form	4	Chalk and Talk, Seminar ,Quiz, Test
	Principle curvature , Lines of curvature	4	
	Developable	3	
	Developable associated with space curves and with curves on surface.	7	
V	Compact surfaces whose points are umbilics	6	Chalk and Talk, Quiz Seminar, Assignment
	Hilbert's lemma	6	
	Compact surface of constant curvature	6	
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the students will be able to,

CLO	Course Learning Outcome	Knowledge Level
CLO1	Explain space curves, Curves between surfaces, metrics on a surface, fundamental form of a surface and Geodesics.	K4
CLO2	Evaluate the concepts of Helicoids and space curves with related example.	K3
CLO3	Compose problems on geodesics.	K5
CLO4	Recognize applicability of developable.	K3
CLO5	Construct and analyze the problems on curvature and surfaces	K5

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	1	3	2	3
CLO2	2	1	3	1	3
CLO3	3	2	3	1	3
CLO4	1	2	3	2	3
CLO5	3	1	2	3	3

Mapping of CLOs with POs

CLOs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	2	1	1
CLO2	3	2	1	2	1	2
CLO3	3	2	1	2	1	-
CLO4	3	2	1	2	1	1
CLO5	3	2	1	2	1	2

Advance application-3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model

Units	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	K4	2	K2 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	K3	2	K3 & K3	1	K2	2(K4 & K4)	1(K4)
3	CLO 3	K5	2	K3 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	K3	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
5	CLO 5	K5	2	K4 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2		20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc MATHEMATICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Project	23P4MPROV	Project & Viva-voce	8	8	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	✓

Course Objectives:

The objective of the course is:

- To motivate students to take up research projects in their field of interest.
- To promote scientific temper and systematic approach to problem solving and research methodology.
- To promote research writing aptitude among students.

During the fourth semester, students shall undertake a project work and submit the project report.

Course Learning Outcomes:

At the end of the project, the students will be able to,

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K5
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3,

Intermediate level –2 ,

Basic level–1

Internal& External Valuation for Project

Internal	External
25 marks	75 Mark
Guide Evaluation: • 10 Marks for Students ability and interest • 10 Marks for Regularity and Punctuality • 5 Marks for Quality of the work and Presentation	Dept Evaluation: 25 (Min (No.) 50 % of faculty must be present) • 15 Marks for Presentation using ICT tools. • 10 Marks for Quality and Publications / Presentation in Seminar/ conferences External Evaluation: 50 • 20 Marks for the Report • 30 Marks for Presentation, Quality of work and Viva voce.

DEPARTMENT OF MATHEMATICS					CLASS: II M.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23P4MECT6(A)	PROGRAMMING WITH JAVA	2	4	25	75	100

Nature of the course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of the course is :

- To impart knowledge about the basic concepts of OOPS and overview & evaluation of Java.
- To use the concepts of Classes, Inheritance, Packages and Interfaces.
- To learn exception handling, multithreading and string handling concepts in Java.
- To inculcate knowledge about I/O concepts in Java.
- To understand applet and event handling programming with HTML and to explore the Java swing and Java Bean.

Course content:

Unit	Description	Hours	K-level	CLOs
I	Java evolution: Java history – java features – java and internet – Web browsers - java environment. Overview of java language: java program structure – java statements – Implementry java program – java virtual machine – command line arguments.	12	K2	CLO1
II	Java fundamentals: Constants, variables and data types – operations and expressions – decision making and branching – decision making and looping.	12	K3	CLO2
III	Classes, objects and methods: Defining a class, adding variables – adding methods – constructors – method overloading. inheritance – overriding methods, arrays, strings and vectors – creating arrays – strings – vectors – wrapper classes.	12	K4	CLO3
IV	Interfaces: Defining interfaces – external interfaces – implementing interfaces, packages: creating packages – using a package – adding a class to a package. Multithreaded programming – creating threads – extending the thread – stopping and blocking a thread – life cycle of a thread.	12	K4	CLO4

V	Applet programming : Applet life cycle – creating an executable applet – applet tag – running the applet – more about applet tag – passing parameters to applets – graphics programming – the graphics class – lines and rectangles – circle and ellipses drawing arc polygons.	12	K5	CLO5

Book for study:

Programming with JAVA – A primer - E. Balagurusamy, 6th edition 2019, Tata McGraw – Hill Publication.

Unit-I : Chapter - 2(2.1, 2.2, 2.4, 2.6, 2.9), Chapter - 3(3.5, 3.7-3.11)

Unit-II : Chapter - 4(4.2-4.4), Chapter - 5(5.2-5.9), Chapter - 6(6.2-6.8), Chapter - 7(7.2-7.4)

Unit-III : Chapter - 8(8.2-8.8, 8.11, 8.12), Chapter - 9(9.2-9.7)

Unit-IV : Chapter - 10(10.2-10.4), Chapter - 11(11.5-11.8), Chapter - 12(12.2-12.5)

Unit-V : Chapter - 14(14.5-14.12), Chapter - 15(15.2-15.6).

Books for Reference:

1. JAVA 2: The complete reference by Patrick Naughton, Herbert Scheldt, 3rd edition, Osborne Publishing (1997).
2. Programming with JAVA 2 by C. Xavier, 2nd Reprint 2003, Scitech Publication.
3. Programming With JAVA by John R. Hubbard, Second Edition 1999, Tata McGraw Hill Publications.
4. Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education.

Web Resources

1. www.javatpoint.com
2. <https://www.edureka.co/blog/java-tutorial/>
3. <https://beginnersbook.com/java-tutorial-for-beginners-with-examples>

Rationale for Nature of the course

This course aims at facilitating the student to understand the basic internet programming concepts and the programming concepts of JAVA towards developing Java based applications and hands on practices by applying the concepts for implementing internet applications. And to enable the students practice the concepts of java programming language and develop solutions for real world problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem solving session, group discussion, practical session.

Pedagogy

Lecture, Power point Presentation, Group Discussion, Quiz, Seminar, Tutorial.

Course Designer(s):

1. Dr. S.MUTHUKUMAR, Head, Department of Mathematics.
2. Prof. S.MEENAKSHI, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction of Java history – java features – java and internet – Web browsers - java environment.	4	Lecture, PPT, Quiz, Test
	Overview of java language, java program structure – java statements	4	
	Implementry java program – java virtual machine – command line arguments.	4	
II	Definition of Constants, variables and data types and related programs.	4	Lecture, PPT, Quiz, Test
	Introduction of operations and expressions and applications	4	
	Decision making and branching – decision making and looping.	4	
III	Introduction of Defining a class, adding variables – adding methods – constructors.	4	Lecture, PPT, Quiz, Test , Tutorial
	Method overloading inheritance – overriding methods, arrays, strings and vectors	4	
	Creating arrays – strings – vectors – wrapper classes.	4	
IV	Defining interfaces – external interfaces – implementing interfaces, packages.	4	Lecture, PPT, Quiz, Test, Seminar
	Creating packages – using a package – adding a class to a package. Multithreaded programming –	4	
	Creating threads – extending the thread – stopping and blocking a thread –life cycle of a thread.	4	
V	Introduction of applet life cycle – creating an executable applet – applet tag.	4	PPT, Lecture, Assignment, Group Discussion, Quiz
	Running the applet – more about applet tag – passing parameters to applets	4	
	Graphics programming – the graphics class – lines and rectangles – circle and ellipses drawing arc polygons.	4	
Total Hours		60	

Course Learning Outcomes:

At the end of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Discuss the basic oops concept, evaluation and implementation overview of java.	K2
CLO2	Design the applications using classes, inheritance, packages and interface.	K3
CLO3	Use the exception handling, multithreading and string handling concepts in various applications.	K4
CLO4	Analyze the concept of I/O in Java.	K4
CLO5	Able to perform applet programming designing HTML, Java Swing and Java Bean based programs.	K5

Mapping of CLOs with PSOs

CLOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	3	1
CLO2	3	2	3	3	1
CLO3	3	2	3	3	1
CLO4	3	2	3	3	1
CLO5	3	2	3	3	1

Mapping of CLOs with POs

CLOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	3	2	3	3
CLO-2	2	1	3	1	3	3
CLO-3	3	2	3	1	3	3
CLO-4	1	2	3	2	3	3
CLO-5	3	1	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO 3	K4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	K5	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					II M.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23P4MECT6(B)	DATA STRUCTURES USING C & C++	2	4	25	75	100

Nature of the Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objective of the course is

- To develop algorithms for manipulating stacks, queues, linked lists, hash tables, trees and graphs.
- To use critical thinking and problem-solving skills in analyzing information gathered through different media and from a variety of sources.
- To familiarize the student with the issues of Time complexity and examine various algorithms from this perspective.
- To identify the problem and analyse it in terms of its significant parts and the information needed to solve it.
- To formulate and evaluate possible solutions to problems, and select and defend the chosen solutions.

Unit	Description	Hours	K-level	CLOs
I	Stack & its Operations: The Stack – Definition and example, representing stack in C, Infix, Prefix, and Postfix notations.	12	K2	CLO1
II	Recursion & Queue Operations: Recursion – recursive definition and process of Fibonacci sequence, Binary search and Tower of Hanoi problem- Factorial functions-Queues– The Queue and its sequential representation.	12	K3	CLO2
III	Linked Structures: Linked List, List in C, other List Structures-Circular List-Stack as Circular List-Queue as Circular List-Primitive operations on Circular List – Header Notes – Simulation Process - Doubly linked list.	12	K3	CLO3
IV	Trees & Operations: Trees – Binary Trees, Binary Tree representations, Huffman algorithm, Representing List as Binary Trees, Trees and their applications – Threaded binary trees – Traversal using a father Filed –	12	K4	CLO4

	C representations of Trees – Tree transversal general expressions as Trees.			
V	Methods of Sorting and Searching: Sorting – Exchange Sorts, Selection and Tree Sorting, Insertion Sorts, Merge and Radix Sorts, Searching – Sequential searching – Indexed sequential search – Interpolation search – Bubble Sort – Quick Sort – Efficiency of Quick Sort – The Cook – Kim Algorithm.	12	K4	CLO5

Books for study:

1. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum by “Data Structures using C and C++”, 2nd Edition 2000, PHI.
Unit I - Chapter 2 (2.1, 2.2, 2.3)
Unit II - 3 (3.1, 3.2, 3.3)&4.1
Unit III – 4(4.2, 4.3, 4.4, 4.5)
Unit IV - 5 (5.1, 5.2, 5.3, 5.4, 5.5)
Unit V - 6 (6.2, 6.3, 6.4, 6.5) (Relevant headings only)

Books for References:

1. P. RadhaGanesan “C and Data structures”, Scitech Publication (2000).
2. Robert L. Kruse, Bruce P. Leung and Clovis L by “Data structures and program design in C” Tondo, Reprint Edition 1998, PHI.

Web resources:

1. http://www.tutorialspoint.com/data_structures_algorithms/
2. <http://www.geeksforgeeks.org/binary-tree-data-structure>
3. <https://www.cpp.edu/~ftang/courses/CS241/notes/trees.htm>
4. <https://www.geeksforgeeks.org/difference-between-searching-and-sorting-algorithms/>
5. <https://www.geeksforgeeks.org/data-structures/?ref=shm>

Rationale and activities having direct bearing on Nature of the Course

Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by a pointer a bit string, representing a memory address, that can be itself stored in memory and manipulated by the program. The implementation of a data structure usually requires writing a set of procedures that create and manipulate instances of that structure. The efficiency of a data structure cannot be analyzed separately from those operations. This observation motivates the theoretical concept of an abstract data type.

Activities having direct bearing on Skill Development /Employability/Entrepreneurship

The capacity to solve problems, analyze information, demonstrate professional competence, communicate professionally, and possess transferable skills.

Pedagogy:

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction.

Course Designer(s):

1. Dr.S.MUTHUKUMAR, Head, Department of Mathematics.
2. Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

Course Schedule

Unit	Description	Hours	Mode
I	The Stack – Definition and example, representing stack in C,	12	Chalk and talk, PPT, Interaction, Quiz and Group Discussion & Test
	Concept of Infix, Prefix, and Postfix notations and related ideas.		
II	Recursion – recursive definition and process of Fibonacci sequence, Binary search and Tower of Hanoi problem-	12	Chalk and talk, PPT, Interaction, Quiz and Group Discussion & Test
	Definition of Factorial functions- definition of Queues– The Queue and its sequential representation and related concepts.		
III	Concept of Linked List, List in C, other List Structures- definition of Circular List-Stack as Circular List- concept of Queue as Circular List .	12	Chalk and talk, PPT, Interaction, Quiz & Test
	Detailed explanation of Primitive operations on Circular List – Header notes and Simulation Process – concept of Doubly linked list.		
IV	Definition of trees – Binary Trees, Binary Tree representations, Huffman algorithm, Representing List as Binary Trees, Trees and their applications.	12	Chalk and talk, PPT, Interaction ,Quiz and Test
	Concept of threaded binary trees and Traversal using a father Filed – C representations of Trees – Tree transversal general expressions as Trees and related concepts.		
V	Definition of Sorting and Exchange Sorts, Selection and Tree Sorting, Insertion Sorts, Merge and Radix Sorts, concept of Searching and sequential searching , related ideas.	12	Chalk and talk ,Interaction, Assignment, and quiz, seminar
	Concept of indexed sequential search , definition of interpolation search , bubble Sort , Quick Sort and efficiency of Quick Sort –explanation of the Cook – Kim Algorithm .		
Total Hours		60	

Course learning Outcomes:

At the end of the course, students will be able to,

CLOs	Description	K- level
CLO 1	Understand the stack operation and its applications	K2
CLO 2	Illustrate the concept of recursive functions and outline queue operations and its applications	K3
CLO 3	Demonstrate the various representation of the linked list	K3
CLO 4	Categorize binary trees and explain tree traversal and its uses	K4
CLO 5	Discriminate various methods of searching and sorting	K4

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Summative Examination – Blue Print

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	K2	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	K4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II M.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective Practical	23P4MECP2(A)	PRACTICAL IN JAVA	1	2	25	75	100

Nature of the Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The objective of the course is:

- Familiar with the main features of the Java language.
- Able to write a Java programs to solve a well specified problem.
- Able to debug and test Java programs.

S.No.	LIST OF PROGRAMS
1	Program to find out the area of the triangle.
2	Use a command line argument to find out the biggest of three integers.
3	Create a java program to display student name, roll no. and marks of three subjects where the information is obtained at runtime.
4	Develop a Java program to display all prime numbers between two limits.
5	Develop a Java program to solve a quadratic equation.
6	Develop a Java program to generate sequence of numbers with the following format.
7	Generate Fibonacci sequence using a constructor.
8	Develop a Java program with the idea of multiple constructors to find the area of a triangle.
9	Use a Java program to find the area of a circle, a triangle, a square and a rectangle. Use method overloading if possible.
10	Develop a Java program that performs string sorting.
11	Develop a Java program with inheritance to display the area of a triangle and display the altitude of a triangle. Assume that the sides are input.
12	Create a Java program that will implement the usage of more than one package.
13	Create an applet program that demonstrates passing a parameter to the applet program.
14	Develop a Java program using exception handling to find the slope of the line between two points.
15	Develop a Java program using applet draw the circle, rectangle, square, ellipse & lines.
16	Develop a Java Program using applet to draw the smiley.

Book for Study:

Programming with JAVA – A primer by E. Balagurusamy, 6th edition, 2019, Tata McGraw – Hill Publication.

Books for Reference:

1. JAVA 2: The complete reference by Patrick Naughton, Herbert Scheldt, 3rd edition, Osborne Publishing(1997).
2. Programming with JAVA 2 by C. Xavier, 2nd Reprint 2003, Scitech Publication.
3. Programming With JAVA by John R.Hubbard, Second Edition 1999,Tata McGraw Hill Publications.
4. Core Java Volume-I Fundamentals, Eight Edition, Horstmann& Cornell, Pearson Education.

Web Resources

1. www.javatpoint.com
2. <https://www.edureka.co/blog/java-tutorial/>
3. <https://beginnersbook.com/java-tutorial-for-beginners-with-examples>

Pedagogy

Demonstration and practical session, Program Writing.

Course Designer(s):

1. Dr. S.MUTHUKUMAR, Head, Department of Mathematics.
2. Prof. S.MEENAKSHI, Assistant Professor, Department of Mathematics (SF).

Course learning outcomes :

At the end of the course, students will be able to

CLO	Description	K- Level
CLO 1	Able to understand concepts of Object Oriented Programming & Java Programming constructs.	Upto K2
CLO 2	Able to identify basic concepts of Java such as operators, classes, objects, inheritance, packages and Enumeration	Upto K3
CLO 3	Apply the concept of exception handling and Input/output Operations.	Upto K4
CLO 4	Able to design the application of Java and Java applet	Upto K4
CLO 5	Analyze the concepts of Event Handling, Abstract windows toolkit, Java Bean and Java Swing.	Upto K5

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	3	1
CLO2	3	2	3	3	1
CLO3	3	2	3	3	1
CLO4	3	2	3	3	1
CLO5	3	2	3	3	1

Mapping of CLOs with POs

CLO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	3	2	3	3
CLO-2	2	1	3	1	3	3
CLO-3	3	2	3	1	3	3
CLO-4	1	2	3	2	3	3
CLO-5	3	1	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF MATHEMATICS				II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
IV	Elective	23P4MECP2(B)	PRACTICAL IN DATA STRUCTURES USING C & C++	1	2	25	75	100

Nature of the Course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	

Objectives:

The objective of the course is

- To get the detailed knowledge of basic data structures and importance of data structures in computer programs.
- Distinguish the key difference between various data structures.
- Recognize the problem, properties, to develop an algorithm and determine the use of appropriate data structures in different real world applications.
- To strengthen the ability to identify and apply the suitable data structure for the given real world problem.
- To gain knowledge in practical applications of data structures.

S. No.	List of Programs
1.	Array Implementation of Stack.
2.	Structure Implementation of Stack.
3.	Checking the proper pairing of delimiters.
4.	Evaluation of postfix expression.
5.	Structure implementation of queue.
6.	Array implementation of queue.
7.	Tower of Hanoi problem (Recursive).
8.	Creation and display of linked list.
9.	Link list implementation of queues.
10.	Insertion of link list.
11.	Deletion in link list.
12.	Sorting of nodes.
13.	Binary tree using array implementation.
14.	Insertion in a binary tree.
15.	Deletion in a binary tree.

Book for Study:

1. Data Structures using C and C++ by YedidyahLangsam, Moshe J. Augenstein, Aaron M. Tenenbaum, 2nd Edition 2000, PHI.

Books for Reference:

1. G A V PAI ” Data Structures and Algorithms-Concepts , Techniques and Applications”- TATA MCGRAW HILL, 6th Reprint -2011.
2. Ellis Horowitz & Sartaj Shani “Data and File Structures”- Galgotia Publication 2014.
2. Jean Paul Tremblay, Paul G. Sorenson “An Introduction to Data Structures with Applications”- Second dition, Tata Mcgraw Hill 1984.

Web resources:

1. http://www.tutorialspoint.com/data_structures_algorithms/
2. <http://www.geeksforgeeks.org/binary-tree-data-structure>
3. <https://www.cpp.edu/~ftang/courses/CS241/notes/trees.htm>
4. <https://www.geeksforgeeks.org/difference-between-searching-and-sorting-algorithms/>
5. <https://www.geeksforgeeks.org/data-structures/?ref=shm>

Rationale and activities having direct bearing on Nature of the Course

To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms. In addition, another objective of the course is to develop effective software development practice, emphasizing such principles as decomposition, procedural abstraction, and software reuse.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The capacity to solve problems, analyze information, demonstrate professional competence, communicate professionally, and possess transferable skills.

Pedagogy:

Practical session, PPT, Group discussion, Interaction.

Course Designer(s):

1. Dr.S.MUTHUKUMAR, Head, Department of Mathematics.
2. Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

Course Learning Outcomes (CLO)

At the end of the course, students will be able to,

CLOs	Description	K- level
CLO 1	Understand the various operations using data structures program	K2
CLO 2	Design and implement abstract data types such as linked list, stack, queues and trees to solve particular problem	K3
CLO 3	Carryout different methodology to create, edit and display the linked list.	K3
CLO 4	Identify the concepts various methods of create, edit and display the binary trees and give focus on tree traversals and its applications	K4
CLO 5	Relate the fundamental algorithms for sorting and searching in various real time applications.	K4

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	External	Total
IV	SEC	23P4MSED2	Mathematics for CSIR-UGC NET /GATE/ SET competitive Examinations	2	4	25	75	100

Nature of the Course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	

Course Objectives:

The objectives of the course is

- To facilitate the students to crack national level examinations like CSIR-UGC NET/GATE/IIT-JAM/NBHM/TIFR/SLET etc.
- To prepare students for facing competitive examinations like UPSC / TNPSC

Course content:

Unit	Description	Hours	K-level	CLOs
I	Algebra: Groups, cyclic groups, cayley's theorem, sylow's theorem, rings, ideals, UFD, PID, polynomial ring and fields.	12	K4	CLO1
II	Linear Algebra: Vector space, subspace, linear transformations, matrices, inner product space and orthonormal basis.	12	K4	CLO2
III	Real Analysis: Countability, real number system, sequences, series, metric spaces, compactness, connectedness, continuity, sequences & series of functions, Riemann integral.	12	K4	CLO3
IV	Topology: Basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.	12	K4	CLO4
V	Complex Analysis: Complex numbers, power series, analytic functions, complex integration.	12	K4	CLO5

Book for Study:

- CSIR-UGC NET Mathematics (UNIT-1, UNIT-2 & UNIT-3), DR.A.P.Singh, First edition, Infostudy publications,

Books for Reference:

1. Advanced CSIR-NET/JRF/Mathematics By Dr.Gajendra Purohit, Invincible publishers.
2. CSIR-NET/JRF Mathematics Previous Years Solved Papers Volume -1 Pure Mathematics, 5th Edition, by Rajendra Dubey, Kittu Rani publications pvt. Ltd.

Web Resources:

1. <https://pkalika.in/2019/10/14/study-material/>
2. <https://toppersnotes.com/csir-net-toppers-handwritten-notes-mathematical-science-samples/>
3. <https://www.examrace.com/CSIR/CSIR-Free-Study-Material/CSIR-Mathematical-Sciences/>

Rationale for Nature of the Course:

This course will help the students to develop their skill of solving multiple choice questions in higher mathematics.

Activities having direct bearing on Skill development / Employability / Entrepreneurship:

Problems of previous year question papers of CSIR-UGC NET examinations will be discussed which will enable the students to apply mathematical knowledge in solving multiple choice questions usually asked in competitive examinations involving higher mathematics.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

Dr.I.SAHUL HAMID Associate Professor, Department of Mathematics

Course learning Outcomes

At the end of the course, students will be able to

CLO s	Description	K- level
CLO 1	Apply the concepts in algebra to solve problems	K3
CLO 2	Apply the concepts in linear algebra to solve problems	K4
CLO 3	Apply the concepts in real analysis to solve problems	K4
CLO 4	Apply the concepts in topology to solve problems	K4
CLO 5	Apply the concepts in complex analysis to solve problems	K4

Mapping of CLOs with PSOs

#	PSO -1	PSO -2	PSO -3	PSO -4	PSO -5
CLO -1	1	-	3	-	-
CLO -2	-	1	2	-	-
CLO -3	2	2	1	-	-
CLO -4	3	2	-	-	-
CLO -5	-	2	3	-	-

Mapping of CLOs with POs

#	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6
CLO -1	-	-	2	1	3	-
CLO -2	-	1	2	2	3	-
CLO -3	-	1	2	2	3	2
CLO -4	-	2	3	2	3	2
CLO -5	1	2	3	2	3	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Schedule

UNIT	Topics to be covered	Hour(s)	Pedagogy
I	Recalling of the concepts in algebra and illustrating related theorems	3	Chalk and talk, PPT, Interaction, e-Quiz, Group Discussion, Test
	Solving problems in algebra from previous question papers of NET examinations	7	
	Tutorial	2	
II	Recalling of the concepts in algebra and illustrating related theorems	3	Chalk and talk, PPT, Interaction, Group Discussion, Seminar, and Test
	Solving problems in algebra from previous question papers of NET examinations	7	
	Tutorial	2	
III	Recalling of the concepts in algebra and illustrating related theorems	3	Chalk and talk, PPT, Interaction, Seminar, Test
	Solving problems in algebra from previous question papers of NET examinations	7	
	Tutorial	2	
IV	Recalling of the concepts in algebra and illustrating related theorems	3	Chalk and talk, PPT, Interaction e-Quiz, Test
	Solving problems in algebra from previous question papers of NET examinations	7	
	Tutorial	2	
V	Recalling of the concepts in algebra and illustrating related theorems	3	Chalk and talk and Interaction, Quiz and Assignment
	Solving problems in algebra from previous question papers of NET examinations	7	
	Tutorial	2	
	Total Hours	60	

Summative Examination – Blue Print

Units	CLOs	K- Level	Section A		Section B (Open Choice)	Section C (Open Choice)
			MCQs			
			No. of Questions	K- Level		
1	CLO 1	K4	6	K4	K2	K2
2	CLO 2	K4	6	K4	K2	K3
3	CLO 3	K4	6	K4	K3	K3
4	CLO 4	K4	6	K3	K3	K2
5	CLO 5	K4	6	K3	K1	K2
No. of Questions to be asked			30		5	5
No. of Questions to be answered			30		3	3
Marks for each question			1		5	10
Total Marks for each section			30		15	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K levels

K Levels	Section A MCQs	Section B (Open choice)	Section C (Open choice)	Total marks	% of marks without choice	Consoli-dated
K1		5		5	4.7	42.8%
K2		10	30	40	38.1	
K3	12	10	20	42	40	40%
K4	18			18	17.2	17.1%
Total marks	30	25	50	105		

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc MTHEMATICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Extension	23P4MEXTN	Extension Activity	1	-	-	-	-

Nature of the course	Skill oriented	✓	Employability		Entrepreneurship	

Objectives:

The objective of the course is:

- To motivate students to take up community driven activities and projects.
- To develop the societal awareness of students.
- To promote environmental, sustainability and G20 High-Level Principles on Lifestyles for Sustainable Development (Life) among students.

During the duration of the programme, students shall undertake extension activities for a minimum duration of 15 hours including preparation and submit a work diary and report of activities along with certificates (if any) from trusts/ NGOs/ public offices / schools.

Course Learning Outcomes

At the end of the Programme, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in extension activities and community projects	K4
CLO 2	Develop into dutiful and morally upright citizens of the country with an understanding of the problems of the society	K5
CLO 3	Suggest and implement out of the box solutions to the problems of the society from their domain knowledge and through their learning.	K4
CLO 4	Survey and understand the problems of the society and humanity as a whole.	K2
CLO 5	Communicate the problems of the society to civil administration/government forums for finding solutions to the problems of the locality.	K3

Mapping of CLOs with PSOs

CLOs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3,

Intermediate level –2 ,

Basic level–1

Valuation Schema for Extension Activity

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMENT OF MATHEMATICS				CLASS : II M.Sc. Mathematics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
III	MDC	23P3MMDC	Stochastic Processes, Statistical Mechanics and Biological Macromolecules	3	5	25	75	100

Nature of Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objectives of the course is

- Acquire intense knowledge on the underlying concepts of stochastic processes.
- Familiarize with Markov chain and system.
- Obtain in-depth understanding of birth and death process.
- Develop the acquaintance with applications of Markov process.
- Gain understanding the knowledge of Statistical Mechanics and chemical molecules.

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	Stochastic Processes -Specification of stochastic processes – Stationary processes –Second order process – Covariance function – Gaussian Processes – Martingales-Types of Martingale: Martingale Convergence Theorem(Statement only) - Markov Chains: Definitions and Examples.	15	K2	1
II	Markov Chains: Higher transition probabilities-Generalization of independent Bernoulli trials - Classification of States and Chains – Determination of Higher transition probabilities – Stability of Markov system-Ergodic Theorem – Graph theoretic approach – Statement of Solberg theorem with example.	15	K2	2

III	Markov process with discrete state space - Poisson process - Poisson process and related distributions – Generalizations of Poisson process – Pure Birth process – Yule- Furry Process –Time dependent Poisson Process- Birth and death process –Linear growth process.	15	K2	3
IV	Physics Statistical Mechanics Phase space - Volume of phase space - Ensembles – Micro canonical, canonical and grand canonical ensembles - Microstates and macrostates - General statistical distribution law – Most probable distribution - Statistical weight or a priori probability - Bose-Einstein Statistics.	15	K2	4
V	Microbiology: Modelling of Biological Macromolecules Introduction to biological, macromolecules, Nucleic acids-basic building blocks, structural conformation of DNA, forms of DNA, role of DNA. Proteins-basic concepts, primary, secondary, tertiary and quaternary structure elements, role of protein. Protein Structure/Function Relationship. Introduction to molecular visualization tools. Homology Modelling – steps to get a model, refinement of the model. Molecular modelling in Rational Drug Design. Applications of Molecular Modeling in Biological System.	15	K2	5

Book for Study:

1. Medhi.J, “**Stochastic Processes**”, New Age International, Cochin, 2nd edition 2017.
2. Statistical mechanics – S.L.Gupta& V. Kumar –PragatiPrakashan educational publishers (twenty fifth edition) 2012.
3. Andrew R.Leach “Molecular Modelling Principles and Applications”, 2nd Ed., Prentice Hall, 2009.
4. T K Attwood, D J Parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.

Unit I - Chapter 2(Sections 2.1 - 2.4) &**Chapter 3**(Sections 3.1)

Unit II - Chapter 3(Sections 3.2 - 3.7)

Unit III - Chapter 4(Sections 4.1 - 4.4)

Unit IV - Chapters: 1.1, 1.3, 2.1, 2.4, 2.5, 2.6, 5.8, 6.2

Unit V : Chapters 1.1,1.2,1.8,1.10,10.1,10.2,10.3,10.4 & 12.1

Books for References:

1. Leo Breiman., Probability and Stochastic Processes, Houghton Mifflin, 2008
2. Athanasios Papoulis., Probability Random Variable & Stochastic Process, McGraw Hill, International, II Edition, 2004.
3. Jan H Jensen, “Molecular Modeling Basics”, CRC Press, 2010.

Web Resources:

1. <https://www.youtube.com/watch?v=0fvqTPR1WCQ>
2. <https://www.coursera.org/learn/stochasticprocesses>
3. <https://nptel.ac.in/courses/111/102/111102014/>
4. <https://www.mphysicstutorial.com/2020/11/ensembles-in-statistical-mechanics.html>
5. <https://uou.ac.in/sites/default/files/slm/MSCPH-504.pdf>
6. http://en.wikipedia.org/wiki/Molecular_symmetry
7. <https://chz276.ust.hk/public/Cloud::siqin/References/From-MD-to-MSM/Molecular%20Modelling%20Principles%20and%20Applications.pdf>
8. <https://www.pearson.com/us/higher-education/program/Leach-Molecular-Modelling-Principles-and-Applications-2nd-Edition/PGM251961.html>

Rationale for Nature of the course:

The purpose of this course is to equip students with theoretical knowledge and practical skills, which are necessary for the analysis of stochastic dynamical systems in economics, engineering and other fields. More precisely, the objectives are study of the basic concepts of the theory of stochastic processes; introduction of the most important types of stochastic processes; study of various properties and characteristics of processes; study of the methods for describing and analyzing complex stochastic models. Practical skills, acquired during the study process: understanding the most important types of stochastic processes (Poisson, Markov, Gaussian, Wiener processes and others) and ability of finding the most appropriate process for modelling in particular situations arising in economics, engineering and other fields; understanding the notions of periodicity, stationary, stochastic integration; application of these terms in context of financial mathematics; It is assumed that the students are familiar with the basics of probability theory. Knowledge of the basics of mathematical statistics is not required, but it simplifies the understanding of this course. The course provides a necessary theoretical basis for studying other courses in stochastic, such as financial mathematics, quantitative finance, stochastic modelling and the theory of jump - type processes.

Activities having direct bearing on Skill development/ Employability Entrepreneurship:

Exercises, Seminars, Assignments, Problem solving and Quiz.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

1. Department of Mathematics, The Madura College, Madurai.
2. Department of Physics, The Madura College, Madurai.
3. Department of Microbiology(SF), The Madura College, Madurai.

Course schedule

Unit	Topics	Hours	Mode
I	Stochastic Processes -Specification of stochastic processes – Stationary processes –Second order process.	5	PPT, Chalk and Talk.
	Covariance function – Gaussian Processes – Martingales-Types of Martingale	5	
	Martingale Convergence Theorem(Statement only) - Markov Chains: Definitions and Examples.	5	
II	Markov Chains: Higher transition probabilities-Generalization of independent Bernoulli trials.	4	PPT, Chalk and Talk, Assignments and GD
	Classification of States and Chains – Determination of Higher transition probabilities.	5	
	Stability of Markov system-Ergodic Theorem – Graph theoretic approach – Statement of Solberg theorem with example.	6	
III	Markov process with discrete state space - Poisson process - Poisson process and related distributions.	5	PPT, Chalk and Talk, Assignments
	Generalizations of Poisson process – Pure Birth process – Yule- Furry Process.	5	
	Time dependent Poisson Process- Birth and death process –Linear growth process.	5	
IV	Phase space - Volume of phase space- Ensembles - Microcanonical, canonical and grand canonical ensembles- Microstates and macrostates.	4	PPT, Chalk and Talk, Assignments
	General statistical distribution law – Most probable distribution	5	
	Statistical weight or a priori probability- Bose-Einstein Statistics.	6	

V	Introduction to biological, macromolecules, Nucleic acids-basic building blocks, structural conformation of DNA, forms of DNA, role of DNA.	5	Assignments, Seminar and GD
	Proteins-basic concepts, primary, secondary, tertiary and quaternary structure elements, role of protein. Protein Structure/Function Relationship.	5	
	Introduction to molecular visualization tools. Homology Modelling – steps to get a model, refinement of the model. Molecular modelling in Rational Drug Design. Applications of Molecular Modeling in Biological System	5	
	Total Hours	75	

Course learning Outcomes

At the end of the course, students will be able to

CLO #	Description	K- level
CLO 1	Correlate the concepts of stochastic processes with illustrations	K2
CLO 2	Illustrate Markov chain and its applications	K2
CLO 3	Compare the conceptualization of pure birth and death process	K2
CLO 4	Infer the basic concepts of statistical mechanics and apply them to derive the distribution law of particles mechanics	K2
CLO 5	Study the structure of DNA and molecules with reference to Structure of Modelling.	K2

Mapping of CLOs with POs

#	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7
CLO -1	3	3	2	2	2	2	-
CLO -2	3	3	2	2	2	2	-
CLO -3	3	3	2	2	2	2	-
CLO -4	2	1	1	-	2	-	-
CLO -5	2	1	1	-	2	-	-

Mapping of CLOs with PSOs

#	PSO -1	PSO -2	PSO -3	PSO -4	PSO -5	PSO -6	PSO -7
CLO -1	3	2	1	-	-	-	-
CLO -2	3	2	1	-	-	-	-
CLO -3	3	2	1	-	-	-	-
CLO -4	3	2	1	-	-	-	-
CLO -5	3	2	1	-	-	-	-

Advance application– 3

Intermediate level–2

Basic level–1

SUMMATIVEASSESSMENT-BLUEPRINT

S.No	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short Answers		(Either/or Choice)		
			No of Questions	K - Level	No of Questions	K - Level	
1	CLO1	K2	1	K1	1	K2& K2	1(K2)
2	CLO2	K2	1	K1	1	K2& K2	1(K2)
3	CLO3	K2	1	K1	1	K2& K2	1(K2)
4	CLO4	K2	1	K1	1	K2& K2	1(K2)
5	CLO5	K2	1	K1	1	K2& K2	1(K2)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

Distribution of section wise marks with K levels

K Levels	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	-	10	7.69	8
K2	-	70	50	120	92.31	92
Total Marks	10	70	50	130	100	100%



The Madura College (Autonomous), Madurai – 625 011

Department of Mathematics

Courses offered to PG by the department of Mathematics

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
I	23P1MCCT1	ALGEBRAIC STRUCTURES	6	5			Y			Y	60%
	23P1MCCT2	REAL ANALYSIS - I	6	5			Y			Y	70%
	23P1MCCT3	ORDINARY DIFFERENTIAL EQUATIONS	6	4			Y			Y	No Change
	23P1MECT1(A)	NUMBER THEORY AND CRYPTOGRAPHY	5	3			Y			Y	No change
	23P1MECT1(B)	FUZZY SETS AND ITS APPLICATIONS					Y			Y	New
	23P1MECT2(A)	PROGRAMMING IN PYTHON	3	2	Y		Y			Y	No change
	23P1MECT2(B)	OBJECT ORIENTED SYSTEM DEVELOPMENT					Y			Y	No Change
	23P1MECP1(A)	PRACTICAL IN PYTHON	2	1	Y		Y			Y	No change

	23P1MECP1(B)	PRACTICAL IN OBJECT ORIENTED SYSTEM DEVELOPMENT					Y			Y	No Change
	23P1MSED1	MATHEMATICAL DOCUMENTATION USING LATEX	2	2	Y		Y			Y	New
II	23P2MCCT4	ADVANCED ALGEBRA	6	5			Y			Y	40%
	23P2MCCT5	REAL ANALYSIS - II	6	5			Y			Y	75.8%
	23P2MCCT6	PARTIAL DIFFERENTIAL EQUATIONS	6	4			Y			Y	60%
	23P2MECT3(A)	MATHEMATICAL STATISTICS	5	3			Y			Y	65%
	23P2MECT3(B)	MECHANICS					Y			Y	
	23P2MECT4(A)	ADVANCED LINEAR PROGRAMMING	3	2			Y			Y	60%
	23P2MECT4(B)	NUMERICAL ANALYSIS					Y			Y	New
	23P2MECT5(A)	NONLINEAR PROGRAMMING	2	1			Y			Y	No change
	23P2MECT5(B)	FORMAL LANGUAGES AND AUTOMATA					Y		Y		New
	23P2MSEN1	FOUNDATIONAL MATHEMATICS	2	2			Y		Y		New

III	23P3MCCT7	COMPLEX ANALYSIS	6	5			Y			Y	22.58%
	23P3MCCT8	PROBABILITY THEORY	6	5			Y			Y	New
	23P3MCCT9	TOPOLOGY	6	4			Y			Y	No Change
	23P3MCCT10	GRAPH THEORY AND APPLICATIONS	5	3			Y			Y	No Change
	23P3MMDC	MDC-STOCHASTIC PROCESSES, STATISTICAL MECHANICS AND POINT GROUPS OF MOLECULES	5	3			Y			Y	No change
	23P3MSEN2	NME - BUSINESS STATISTICS	2	2	Y		Y		Y		New
IV	23P3MINTR	INTERNSHIP/ INDUSTRIAL ACTIVITY	-	2	Y	Y	Y		Y		New
	23P4MCCT11	FUNCTIONAL ANALYSIS	6	5			Y			Y	No change
	23P4MCCT12	DIFFERENTIAL GEOMETRY	6	4			Y			Y	No change
	23P4MPROV	PROJECT WITH VIVA VOCE	8	8		Y	Y		Y		New

	23P4MECT6(A)	PROGRAMMING WITH JAVA	4	2	Y		Y			Y	New
	23P4MECT6(B)	DATA STRUCTURES USING C & C++					Y			Y	25 %
	23P4MECP2(A)	PRACTICAL IN JAVA	2	1	Y		Y			Y	New
	23P4MECP2(B)	PRACTICAL IN DATA STRUCTURES USING C & C++					Y			Y	25 %
	23P4MSED2	MATHEMATICS FOR CSIR-UGC NET /GATE/ SET COMPETITIVE EXAMINATIONS	4	2	Y		Y		Y		New
	23P4MEXTN	EXTENSION ACTIVITY	-	1			Y	Y			New

DEPARTMENT OF MATHEMATICS					CLASS: II B.Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Elective	23U3MGET1(C)	ALLIED MATHEMATICS- I (Chemistry)	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To impart basic knowledge of higher order differentiation and application of differential calculus.
- To illustrate the properties of definite integrals and methods of integration of higher powers of trigonometric functions.
- To describe the physical applications of vector derivatives especially divergence and curl.

Unit	Description	Hours	K-level	CLO
I	Application of Demoivre's Theorem: Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ – Expression for $\sin^n \theta$, $\cos^n \theta$ and $\sin^m \theta \cos^n \theta$ – Problems	18	K2	CLO1
II	Differential Calculus: Differentiability – Chain rule – Differentiation of Inverse trigonometric functions – Differentiation by transformation – Differentiation of logarithmic functions – Differentiation of implicit functions – Higher derivatives – n^{th} derivatives of some standard functions – Leibnitz's rule – Problems	18	K3	CLO2
III	Integral Calculus: Evaluation of Definite Integrals - Integration by parts – Reduction formula for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$ and $\int \sin^m x \cos^n x \, dx$ (Problems only)	18	K4	CLO3
IV	Integral Calculus(Continued): Evaluation of double integrals – Problems – Evaluation of triple integrals – Problems	18	K3	CLO4
V	Vector Calculus: Vector differentiation – Vector differential operator – Gradient, Divergence and Curl – Properties – Directional Derivative and its maximum value — Solenoidal and Irrotational vectors – Vector integration (Line Integrals)	18	K3	CLO5

Books for study:

1. Allied Mathematics. Vol I, Dr.S. Arumugam & Isaac, New Gamma Publishing House, Palayamkottai. (2014).

Unit I: Chapter 1 (1.1, 1.2), Unit III: Chapter 3 (3.4), Unit IV: Chapter 3 (3.6)

2. Calculus, Dr.S. Arumugam & Isaac, New Gamma Publishing House, Palayamkottai. (2008)

Unit II: Chapter 2(2.4 – 2.7, 2.10 – 2.13)

3. Allied Mathematics. Vol II, Dr.S. Arumugam & Issac, New Gamma Publishing House, Palayamkottai. (2011).

Unit V: Chapter 1,2

Books for Reference:

1. Ancillary Mathematics, T.K Manikavasagam pillai & Others, Viswanathan printers and publishers Pvt. Ltd., Chennai.
2. Allied Mathematics, Volume II, P. Kandasamy, K. Thilagavathy, S.Chand & Company Pvt. Ltd.

Web Resources

1. <https://www.math24.net/leibniz-formula/>
2. https://www.whitman.edu/mathematics/calculus_online/section08.0.html
3. <http://tutorial.math.lamar.edu/Classes/CalcIII/LineIntegralsVectorFields.aspx>

Rationale for Nature of the course

This course develops elementary techniques that will be useful to science students and applies them in a variety of scientific contexts. Students taking general chemistry would benefit from a conceptual understanding and basic facility with derivatives and integrals and their applications. The knowledge and skills in the area of basic calculus will be a co-requisite to general chemistry.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students will be equipped with problem solving skill in basic differential and integral calculus which will help them to solve problems in chemical context.

Pedagogy

Lecture with PPT, Seminar, Tutorial, Group Discussion, Assignments

Course Designer(s):

1. S.MEENAKSHI SELVARAJAN, Assistant Professor, Department of Mathematics.
2. Dr. U.KARTHIK RAJA, Assistant Professor, Department of Mathematics.

Course Schedule

Unit	Topics	Hours		Mode
I	Application of DeMoivre’s Theorem - Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$	9	18	Lecture, Quiz, Problem Solving, Test
	Expression for $\sin^n \theta$, $\cos^n \theta$ and $\sin^m \theta \cos^n \theta$	9		
II	Differentiability – Chain rule – Differentiation of Inverse trigonometric functions	6	18	Lecture, Quiz, Problem Solving, Test
	Differentiation by transformation			
	Differentiation of logarithmic functions – Differentiation of implicit functions	6		
	Higher derivatives – nth derivatives of some standard functions – Leibnitz’s rule	6		
III	Evaluation of Definite Integrals	6	18	Lecture, Quiz, Problem Solving, Test
	Integration by parts	6		
	Reduction formula for $\int \sin^n x \, dx$, $\int \cos^n x \, dx$ and $\int \sin^m x \cos^n x \, dx$ (Problems only)	6		
IV	Evaluation of double integrals	6	18	Lecture, Quiz, Problem Solving, Test
	Problems on double integrals	6		
	Evaluation of triple integrals – Problems	6		
V	Vector differentiation – Vector differential operator	6	18	Lecture, Quiz, Seminar, Assignment
	Gradient, Divergence and Curl – Properties - Directional Derivative and its maximum value	6		
	Solenoidal and Irrotational vectors - Vector integration (Line Integrals).	6		
Total Hours		90		

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Apply DeMoivre's theorem to solve problems on powers of trigonometric functions.	K2
CLO2	Use the concept of differentiation to find derivatives of inverse trigonometric functions, implicit function and logarithmic functions.	K3
CLO3	Evaluate integrals using integration by parts and solve integrations with n^{th} power.	K4
CLO4	Evaluate integrals over a region using double and triple integral.	K3
CLO5	Use vector differentiation to evaluate gradient, divergence and curl of a vector point function and related identities.	K3

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	3	1	1
CLO-2	3	2	1
CLO-3	3	1	1
CLO-4	3	1	1
CLO-5	3	2	1

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	1	1	1	1
CLO2	3	2	1	1	2	1
CLO3	3	2	1	1	1	1
CLO4	3	2	1	1	1	1
CLO5	3	1	1	1	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	K2	2	K1 &K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
4	CLO 4	K3	2	K1 & K2	1	K1	2(K3 & K3)	1(K3)
5	CLO 5	K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	20	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II B.Sc., Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective Course	23U4MGET2(C)	ALLIED MATHEMATICS-II (Chemistry)	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To know the methods of solving differential equations of first order and higher order.
- To understand the fundamental ideas of Partial differential equations.
- To know the application of Laplace transforms and method of solving ordinary differential equations using Laplace transforms.

Unit	Description	Hours	K-level	CLO
I	Ordinary Differential equations: Differential equation of first order and first degree – Variable-Separable – Homogeneous and Non-homogeneous differential equations – Exact Differential equations – Integrating factors-Problems.	18	K2	1
II	Ordinary Differential equations (Continued): Introduction – Linear equation with constant coefficients – Methods of finding complementary functions – Methods of finding particular integrals – Problems.	18	K3	2
III	Partial Differential Equations: Formation of partial differential equations – Classification of solution of PDE – Solutions of standard types of first order partial differential equations (Types 1-4) – Lagrange's linear equation - Problems.	18	K4	3
IV	Laplace Transform: Introduction – Definitions-Properties-Problems	18	K3	4
V	Inverse Laplace Transforms: Introduction –Definitions-Properties-solution of differential equations using Laplace transforms - Problems.	18	K3	5

Book for study:

1. Allied Mathematics by Dr.S.Arumugam & Issac. Vol III, New Gamma Publishing House, Palayamkottai. (2012)
Unit I : Chapter 1(1.1-1.4)
Unit II : Chapter 2
Unit III: Chapter 4(4.1-4.4)
Unit IV& V: Chapter 3

Books for Reference:

1. Ancillary Mathematics, Volume I, T.K Manikavasagam pillai & Others, Viswanathan Printers and Publishers Pvt Ltd. Chennai.
2. Allied Mathematics, Volume II, P.Kandasamy, K.Thilagavathy, S.Chand & Company Pvt. Ltd.

Web Resources

1. <https://www.math24.net/exact-differential-equations/>
2. <https://www.math24.net/higher-order-linear-homogeneous-differential-equations-constant-coefficients/>
3. https://www.brainkart.com/article/Lagrange---s-Linear-Equation_6488/
4. <https://lpsa.swarthmore.edu/LaplaceXform/FwdLaplace/LaplaceProps.html>
5. <https://www.geeksforgeeks.org/newton-forward-backward-interpolation/>

Rationale for Nature of the course

Differential equations are important because for many physical systems, one can, subject to suitable idealizations, formulate a differential equation that describes how the system changes in time. Numerical analysis is employed to develop and analyze numerical methods for solving problems that arise in the areas like calculus, linear algebra, or differential equations.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Differential equations are important because for many physical systems, one can, subject to suitable idealizations, formulate a differential equation that describes how the system changes in time.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

1. Prof. S.KRISHNA JAYANTHI, Assistant Professor, Department of Mathematics.
2. Dr. U.KARTHIK RAJA, Assistant Professor, Department of mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Differential equation of first order and first degree: Variable – Separable	6	Lecture, Problem
	Homogeneous and Non-homogeneous differential equations	6	Solving, Test,
	Exact Differential equations – Integrating factors.	6	Quiz
II	Introduction – Linear equation with constant coefficients : Methods of finding complementary functions	9	Lecture, Problem
	Methods of finding particular integrals	9	Solving, Test, Quiz
III	Formation of partial differential equations, Classification of solution of PDE	3	Lecture, Group Discussion Problem Solving, Test, Quiz
	Solutions of standard types of first order partial differential equations Type I	3	
	Solutions of standard types of first order partial differential equations Type II	3	
	Solutions of standard types of first order partial differential equations Type III	3	
	Solutions of standard types of first order partial differential equations Type IV	3	
	Lagrange's linear equation	3	
IV	Laplace transforms – Definitions-Properties of Laplace Transforms	9	Lecture, PPT, Problem
	Problems on Laplace Transform	9	Solving, Test, Quiz
V	Inverse Laplace transforms – Definitions- Problems.	6	Problem
	Properties of Inverse Laplace transforms	6	Solving, Quiz,
	Solution of differential equations using Laplace transforms - Problems.	6	Seminar, Assignment
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous and non-homogeneous differential equation.	K2
CLO-2	Solve linear equation with constant coefficients with constant coefficients	K3
CLO-3	Construct partial differential equations and to solve first order partial differential equations	K4
CLO-4	Apply Laplace Transforms to solve differential equations	K3
CLO-5	Solve the differential equations with constant coefficients by Inverse Laplace transform.	K3

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	3	2	2
CLO-2	3	1	2
CLO-3	2	2	2
CLO-4	3	1	2
CLO-5	3	2	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	1	2	1
CLO2	2	1	2	1	1	1
CLO3	3	2	2	1	2	1
CLO4	3	2	1	1	1	1
CLO5	3	2	2	1	2	1

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model

S.No	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	K2	2	K1 &K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K1 & K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
4	CLO 4	K3	2	K1 & K2	1	K1	2(K3 & K3)	1(K3)
5	CLO 5	K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No Choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	20	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II B.Sc., Statistics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Elective Course	23U3MGET1(S)	NUMERICAL METHODS (Statistics)	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To introduce the study of algorithms that used numerical approximation for the problems of Mathematical analysis.
- To solve mathematical problems numerically.
- To obtain approximate solutions to mathematical problems. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.

Unit	Description	Hours	K-level	CLO
I	The Solution of Numerical Algebraic and Transcendental Equations: Bisection Method - Iteration Method –Regula Falsi Method- Newton Raphson Method. (Problems only)	18	K2	1
II	Solution of Simultaneous Linear Algebraic Equations: Gauss Elimination Method – Gauss Jordan Method – Inverse Gauss elimination method - Gauss Jacobi Method - Gauss Seidel Method. (Problems only)	18	K3	2
III	Finite Differences: Operators. Interpolation for Equal intervals: Newton's Forward Interpolation Formula and Newton's Backward Interpolation Formula. Central Difference Interpolation Formula For Equal Intervals: Gauss forward interpolation formula - Gauss backward interpolation formula. (Problems only)	18	K3	3
IV	Interpolation with Unequal Intervals: Divided differences - Newton's divided differences interpolation Formula, Lagrange's interpolation formula and inverse Lagrange's interpolation. (Problems only)	18	K4	4

V	Numerical Differentiation: Taylor Series Method – Euler method - Runge Kutta Method. (Simple Problems Only Without Derivation) Numerical Integration: Trapezoidal Rule - Simpson's 1/3 rd Rule - Simpson's 3/8 th Rule.(Problems only)	18	K3	5

Book for study:

Kandasamy P., Thilagavathy K., Gunavathi K. (2019): Numerical Methods, S.Chand and company limited.

Unit I - Chapter – 3 (3.1 – 3.4)

Unit II - Chapter – 4 (4.1 – 4.3, 4.8, 4.9)

Unit III - Chapter – 5(5.1), Chapter – 6(6.1 – 6.7), Chapter – 7(7.1-7.4)

Unit IV - Chapter – 8 (8.1 – 8.8)

Unit V- Chapter 11(11.5, 11.6, 11.9, 11.12, 11.13)

Books for Reference:

1. S. Arumugam, A. Thangapandi Isaac, A. Somasundaram, - Numerical Methods"- 2022(Reprint) scitech publications(India) Pvt. Ltd.
2. Kalavathy, S., and Thomson. (2004): Numerical Methods, Vijay Nico::le Publications.
3. Gupta, B.D. (2004): Numerical Analysis, Konark Publications.
4. Venkatachalapathy, S.G. (2004): Calculus of Finite Differences and Numerical Analysis, Margam Publications.
5. Gerald Wheatley, (1970): Applied Numerical Analysis, Pearson Education Publications.
6. Jain, M.K., Iyengar, S.R., Jain, R.K., (1994): Numerical Methods Problems and Solutions, New Age International Publishers.

Web Resources

1. <https://www.linkedin.com/advice/1/how-do-you-choose-between-bisection-false-position>
2. <https://unacademy.com/content/jee/study-material/mathematics/gauss-elimination-method/>
3. <https://testbook.com/maths/iterative-methods-gauss-seidel-and-jacobi>
4. <https://byjus.com/maths/runge-kutta-rk4-method/>

Rationale for Nature of the course

Numerical methods are techniques that are used to approximate Mathematical procedures. We need approximations because we either cannot solve the procedure analytically or because the analytical method is intractable (an example is solving a set of a thousand simultaneous linear equations for a thousand unknowns).

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course is generally taught as a traditional lecture format, with frequent problem sets acting as valuable teaching aids. The problems will be discussed in class, students will work together to find solutions.

Pedagogy

Lecture, Seminar, Assignment, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

1. Prof. N. Sriviveka Saratha, Assistant Professor, Department of Mathematics.
2. Dr. V. Sangeethasubha, Assistant Professor, Department of mathematics.

Course Schedule

Unit	Topics	Hours	Mode
Unit I	The Solution of Numerical Algebraic and Transcendental Equations: Bisection Method	6	Problem solving, Lecture, Quiz, Test
	Solution of algebraic and transcendental equations - iteration method.	6	
	Regula Falsi Method- Newton Raphson Method and problems	6	
Unit II	Gauss Elimination Method, Gauss Jordan Method and some problems.	6	Lecture, PPT, Quiz, Test
	Inverse Gauss elimination method problems.	6	
	Gauss Jacobi Method & Gauss Seidel Method With some problems.	6	
Unit III	Operators. Interpolation for Equal intervals: Newton's Forward Interpolation Formula and Newton's Backward Interpolation Formula with some related problems.	9	Problem solving, Lecture, Quiz, Test
	Gauss forward interpolation formula & Gauss backward interpolation formula problems.	9	
Unit IV	Divided differences with some related examples.	6	Lecture, Problem solving, Quiz, Test
	Newton's divided differences interpolation Formula with problems.	6	
	Lagrange's interpolation formula and inverse Lagrange's interpolation and problems.	6	
Unit V	Numerical Differentiation: Taylor Series Method – Euler method.	6	Tutorial, Problem solving, Assignment, Seminar, Quiz
	Runge Kutta Method. (Simple Problems Only Without Derivation)	6	
	Numerical Integration: Trapezoidal Rule - Simpson's $1/3^{\text{rd}}$ Rule - Simpson's $3/8^{\text{th}}$ Rule.(Problems only)	6	
Total		90	

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Solve numerically equations that cannot have direct solution and solve system of linear equations	K2
CLO-2	Use a foundation on algorithms to solve a mathematical problem	K3
CLO-3	Identify the interpolation intervals and solve the related problems.	K3
CLO-4	Analyzing numerical differentiation and solve the differential problem with various method.	K4
CLO-5	Identify the integration problem and solve numerically	K3

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3
CLO-1	1	2	3
CLO-2	3	3	2
CLO-3	3	3	3
CLO-4	3	3	3
CLO-5	3	3	3

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	1	1	1
CLO2	2	1	2	1	1	1
CLO3	3	3	1	1	1	1
CLO4	1	3	2	1	1	1
CLO5	3	3	2	1	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

Units	CLOs	K. Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K. Level	No. of questions	K. level		
1	CLO 1	K2	2	K1&K2	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K1&K2	1	K2	2(K2 & K2)	1(K3)
3	CLO 3	K3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO 4	K4	2	K1&K2	1	K1	2(K4 & K4)	1(K4)
5	CLO 5	K3	2	K1&K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II B.Sc., Statistics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23U4MGET2(S)	REAL ANALYSIS (Statistics)	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- Understand the basic concepts of set theory and real number system, Open and closed sets, limit of a function.
- Determine the sequence whether it is convergent or divergent by using the appropriate tests.
- Determine if an infinite series is convergent or divergent by selecting the appropriate tests such as comparison test, D'Alembert's ratio test, Cauchy's root test, Leibnitz test etc.
- To be familiar with the concepts of continuity, derivative, Properties of derivatives and its theorems.
- Understand the concept of Riemann Integral, Sufficient condition for Riemann integrability and its theorems.

Unit	Description	Hours	K-level	CLO
I	Set Theory: Sets - Operations on sets –Real numbers – Bounded and unbounded sets: supremum, infimum– Completeness in the set of real numbers –Open sets – Limit point of a set – Closed sets.	18	K2	CLO1
II	Sequences: Definition of Sequence –Limit points of a sequence – Limits: Inferior and superior -Convergent and Divergent sequences – Cauchy sequences.	18	K3	CLO2
III	Series: Introduction – Infinite Series– Positive term series – Comparison tests for positive term series – Cauchy's root test - D'Alembert's ratio test – Series with arbitrary terms – Alternating series: Leibnitz test.	18	K3	CLO3
IV	Differentiation: Function of a single variable: Limit and continuity– The Derivative – Increasing and decreasing functions– Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem– Taylor's theorem.	18	K3	CLO4
V	Integration: Concept of Riemann Integral – Definition and existence of Riemann integral– Darboux's theorem – Condition of integrability -Fundamental theorem of calculus – First mean value theorem of integral calculus.	18	K4	CLO5

Book for study:

Malik, S.C., and Arora, S, (2017), Mathematical Analysis, Fifth Edition, New Age International, New Delhi.

Unit – I: chapter 1 (Sec 1 (1.1–1.12), Sec 3, Sec 4 (4.1)), chapter 2 (Sec 1, 2, 3)

Unit – II: chapter 3 (Sec 1, 2, 3, 4, 5, 6)

Unit – III: chapter 4 (Sec 1 (1.1–1.3), 2 (2.2, 2.3), 3, 4, 5, 10(10.1))

Unit – IV: chapter 5 (Sec 1(1.1,1.2)), chapter 6 (Sec 1, 3, 5, 6, 7, 8 (8.1))

Unit – V: chapter 9 (Sec 1, 3, 4, 9, 10)

Books for Reference:

1. Richard R. Goldberg, Methods of Real Analysis: Oxford and IBH Publishing, (1 January 2020).
2. Arora, S. (1988) Real Analysis. Satya Prakashan Mandir, New Delhi.
3. Shanthi Narayan. (2003) Elements of Real Analysis, S. Chand & Co, New Delhi
4. Somasundaram, D. and Choudhary, B. (2002) A First Course in Mathematical Analysis, Narosa, Chennai
5. Walter Rudin,(2016), Principles of Mathematical Analysis, Fourteen reprints McGraw-Hill, New Delhi.

Web Resources

1. <https://mathcs.org/analysis/reals/logic/notation.html>
2. <https://study.com/learn/lesson/open-set-vs-closed-examples-overview.html>
3. <https://mathcs.org/analysis/reals/numser/series.html>
4. <https://www.geneseo.edu/~aguilar/public/notes/Real-Analysis-HTML/ch6-differentiation.html>
5. <https://www.geneseo.edu/~aguilar/public/notes/Real-Analysis-HTML/ch7-riemann-integration.html>

Rationale for Nature of the course

In mathematics, real analysis is the branch of mathematical analysis that studies the behaviour of real numbers, sequences and series of real numbers, and functions. Fundamental properties of the real numbers that lead to the formal development of real analysis and understand limits and their used in differentiation and integration. Aimed at exposing a number systems that under in the development of real analysis and understanding of various physical phenomena.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This subject is generally taught as a traditional lecture course, with recurring problem sets serving as an important learning tool. In class, problems will be discussed and students will work together to find solutions.

Pedagogy

Lecture, Power point Presentation, Group Discussion, Quiz, Seminar, Problem Solving, Tutorial.

Course Designer(s):

1. Prof. S.Meenakshi, Assistant Professor, Department of Mathematics.
2. Dr. V. Sangeethasubha, Assistant Professor, Department of mathematics.

Course Schedule

Unit	Description	Hours	Mode
I	Sets - Operations on sets –Real numbers –Bounded and unbounded sets : supremum, infimum	6	Lecture, Problem Solving, Quiz, Test
	Completeness in the set of real numbers –Open sets.	6	
	Limit point of a set - Closed sets.	6	
II	Definition of Sequence –Limit points of a sequence.	6	Lecture, PPT, Problem Solving, Quiz, Test
	Limits: Inferior and superior – Convergent.	6	
	Divergent sequences - Cauchy sequences.	6	
III	Introduction – Infinite Series – Positive term series.	6	Lecture, Problem Solving, PPT, Quiz, Test
	Comparison tests for positive term series– Cauchy’s root test	6	
	D’Alembert’s ratio test – Series with arbitrary terms – Alternating series: Leibnitz test.	6	
IV	Function of a single variable: Limit and continuity– The Derivative	6	Lecture, PPT, Problem Solving, Quiz, Test
	Increasing and decreasing functions– Rolle’s Theorem	6	
	Lagrange’s mean value theorem- Cauchy’s mean value theorem – Taylor’s theorem	6	
V	Concept of Riemann Integral – Definition and existence of Riemann integral.	6	Lecture, PPT, Seminar, Assignment, Quiz
	Darboux’s theorem – Condition of integrability.	6	
	Fundamental theorem of calculus – First mean value theorem of integral calculus.	6	
Total Hours		90	

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	K- Level
CLO1	Understanding the basic concepts of operations on sets and set of real numbers, Upper and lower bounds and real number system, open and closed sets.	K2
CLO2	Use the concept of sequences, bounded, convergent, and divergent and Cauchy's sequence.	K3
CLO3	Identify the basic ideas of the Inequalities and Recognize when the series converges and diverges, Alternating series.	K3
CLO4	Identify the concept of Continuity properties of a continuous function in a closed interval and Derivatives.	K3
CLO5	Analyzing the Concept of Riemann Integral and Sufficient condition for Riemann integrability.	K4

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3
CLO1	1	2	3
CLO2	3	3	2
CLO3	3	3	1
CLO4	3	3	1
CLO5	3	3	3

Mapping of CLOs with POs

CLO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO1	3	2	2	2	2	3
CLO2	2	2	1	3	1	2
CLO3	3	1	2	1	2	1
CLO4	2	1	3	2	2	3
CLO5	2	2	2	3	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S.No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	K2	2	K1 & K2	1	K1	2(K1&K1)	1(K2)
2	CLO 2	K3	2	K1 & K2	1	K2	2(K3&K3)	1(K3)
3	CLO 3	K3	2	K1 & K2	1	K1	2(K2&K2)	1(K3)
4	CLO 4	K3	2	K1 & K2	1	K2	2(K3&K3)	1(K3)
5	CLO 5	K4	2	K1 & K2	1	K2	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	41.66%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.67%
Total marks	10	10	50	50	120	100	100%

Title of the Course		Computational Mathematics					
TANSICHE Course type		SEC – 3					
Course Category		SEC – 3(Discipline Specific/Generic)					
Nature of Course		Employability / Skill Development					
Category	Core	Year	I	Credits	2	Course Code	23U2MSED3
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Practical		Total
		2	-		-		2
Marks		CIA		Semester		Total	
		25		75		100	
Pre-requisite(s)		Basic arithmetic					
Objectives of the Course		- To be able to design and apply algorithms to solve problems numerically and graphically. - To acquire the skills and confidence to learn new mathematical knowledge as becomes necessary in the course of a lifetime.					
Course Outline		UNIT-I:High Speed Computation: Introduction, Computer Arithmetic, Errors, Machine Computation, Computer Software.					
		Unit-II:Transcendental and Polynomial Equations: Introduction, Iterative Method: Bisection Method, Iteration Method, Newton Raphson Method, Regula Falsi Method. (Problems Only)					
		Unit-III: Transcendental and Polynomial Equations: Graffe’s Root Squaring Method, Birge – Vieta Method, Bairstow Method. (Problems Only)					
		Unit-IV: System of Linear Algebraic Equations: Introduction – Gauss Elimination Method – Gauss Jordan Method, Triangularization Method. Iterative Method: Gauss Jacobi Method – Gauss Seidel Method. (Problems Only)					
		Unit-V:Introduction, Finite Difference Operators $\Delta, \nabla, E, \delta, \mu$ – Problems on Operators - Lagrange Interpolations and Inverse Lagrange Interpolations. (Problems Only)					

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Justification for nature of course	Computational mathematics is an area of mathematics devoted to the interaction between mathematics and computer computation. A large part of computational mathematics consists roughly of using mathematics allowing and improving computer computation in areas of science and engineering where mathematics are useful. This involves in particular algorithm design, computational complexity, numerical methods and computer algebra.
Text Book(s)	1. M.K.Jain, S.R.K.Iyengar, R.K.Jain (2003): Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, fourth edition. Unit I: Chapter 1(1.1- 1.5) Unit II: Chapter 2(2.1- 2.3) Relevant Topics Only Unit III: Chapter 2 (2.9) Relevant Topics Only Unit IV: Chapter 3(3.2, 3.4) Relevant Topics Only Unit V: Chapter 4(4.2, 4.3) Relevant Topics Only
Reference Book(s)	1. S. Arumugam, S.Thangapandi Isaac and A.Soma Sundaram, Numerical Analysis, New Gamma Publishing House 2007. 2. S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India.
Websites and e-Learning resources	1. https://protonstalk.com/polynomials/bisection-method/ 2. https://www.cs.usask.ca/~spiteri/M211/notes/chapter4.pdf 3. https://math.stackexchange.com/questions/1509340/newton-form-vs-lagrange-form-for-interpolating-polynomials

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO	Course learning outcome	K-level
CO1	Apply mathematical and computing knowledge.	Upto K2
CO2	Problem solve through modeling of real world phenomena using mathematics and computing.	Upto K2
CO3	Communicate mathematical and computing knowledge.	Upto K2
CO4	Assess current technology and future trends in computer science.	Upto K2
CO5	Approach mathematics and computer science research questions from a perspective consistent with the norms of the field.	Upto K2

MAPPING WITH PROGRAMME OUTCOMES

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**) in the 3-point scale of STRONG(3), MEDIUM(2) and LOW(1).

	Pos						PSOs		
	1	2	3	4	5	6	1	2	3
CLO1	1	1	1	1	1	1	1	1	1
CLO2	2	1	1	2	2	1	2	1	1
CLO3	2	1	1	2	2	1	2	1	1
CLO4	1	1	1	1	1	1	2	1	1
CLO5	1	1	1	1	1	1	2	1	1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Sl. No	CLO s	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K2	2	K1& K2	1	K1	2(K2& K2)	1(K2)
3	CLO 3	Up to K2	2	K1& K2	1	K2	2(K2& K2)	1(K2)
4	CLO 4	Up to K2	2	K1& K2	1	K2	2(K2& K2)	1(K2)
5	CLO 5	Up to K2	2	K1& K2	1	K2	2(K2& K2)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section-wise Marks with K Levels.*

K Levels	Section A (No choice)	Section B (Either/or)	Section C (Open choice)	Total marks	% of marks without choice	Consolidated
K1	10	-	50	60	46.15	46%
K2	—	70	-	70	53.85	54%
Total marks	10	70	50	120	100	100%

Lecture schedule

Unit	Topics	Hours	Mode
I	High Speed Computation: Introduction.	2	PPT, Chalk and Talk.
	Computer Arithmetic, Errors.	2	
	Machine Computation, Computer Software.	2	
II	Transcendental and Polynomial Equations: Introduction.	2	PPT, Chalk and Talk, Assignments and GD
	Iterative Method: Bisection Method, Iteration Method.	2	
	Newton Raphson Method, Regula Falsi Method.	2	
III	Transcendental and Polynomial Equations: Graffe's Root Squaring Method,	2	PPT, Chalk and Talk, Assignments
	Birge – Vieta Method	2	
	Bairstow Method	2	
IV	Gauss Elimination Method – Gauss Jordan Method, Triangularization Method.	2	PPT, Chalk and Talk, Assignments
	Direct Methods.	2	
	Iterative Method: Gauss Jacobi Method – Gauss Seidel Method.	2	
V	Introduction, Finite Difference Operators $\Delta, \nabla, E, \delta, \mu$ – Problems on Operators	3	Assignments, Seminar and GD
	Lagrange Interpolations	1	
	Inverse Lagrange Interpolations.	2	

Course Schedule

Course Designer:

Dr. S.VALLIRANI, Assistant Professor, Department of Mathematics, The Madura College.

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
I	Elective	23P1MECT1 (A)	Fuzzy sets and its Applications	3	5	25	75	100

Nature of Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Objectives:

The objective of the course is:

- To provide an understanding of the basic mathematical elements of the theory of fuzzy Sets and crisp sets.
- To furnish and emphasis on the operations on fuzzy sets and apply the properties.
- Explain the concept of fuzzy relation and crisp relation.
- Enable the students to solve the fuzzy linear programming using decision making in Fuzzy environments Provide the sufficient real life application thus the students can face the competitive world.

Unit	Description	Hours	K-level	CLO(s)
I	Crisp sets and fuzzy sets Overview of Classical Sets, Membership Function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, α -cuts – Decomposition Theorems, Extension Principle.	15	K3	CLO1
II	Operation on fuzzy sets Standard fuzzy operations – Union, intersection and complement – properties De. Morgan's laws - α -Cuts of fuzzy operations.	15	K4	CLO2
III	Fuzzy relations Cartesian Product, Crisp relations – cardinality – operations and properties of Crisp and Fuzzy relations. Image and inverse image of fuzzy sets - Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.	15	K4	CLO3
IV	Decision making in Fuzzy environments General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming.	15	K4	CLO4

V	Applications Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications.	15	K3	CLO5

Books for Study:

1. George J.Klir and Bo Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Learning Private Limited, New Delhi (2009).

Chapters :1 , 2 ,3(3.1 – 3.5),4(4.3,4.4), 5 (5.1 – 5.6), 15, 17.

Books for References:

1. A. K. Bhargava; Fuzzy Set Theory, Fuzzy Logic and their Applications, published by S. Chand Pvt. Limited (2013).
2. K.Pundir and R.Pundir, Fuzzy sets and their application, Published by A Pragati edition (2012)
3. H.J. Zimmermann, Fuzzy set theory and its application

Web Resources:

1. <https://www.sciencedirect.com/topics/engineering/fuzzy-set-theory#:~:text=Fuzzy%20set%20theory%20%5B9%5D%20allows,respect%20to%20the%20test%20instances.>
2. <https://nitsri.ac.in/Department/Computer%20Science%20&%20Engineering/FuzzyLogic.pdf>
3. https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_set_theory.htm
4. <https://www.iitk.ac.in/eeold/archive/courses/2013/intel-info/d1pdf3.pdf>

Rationale for Nature of the course:

This course, namely Fuzzy sets and its Applications, has applications in various fields. It is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Acquire skills for modelling complex problems with uncertain or distorted inputs. To create artificial intelligence. Opportunities are available in engineering department, Computer software developers, research department, natural scientists, Social Scientists.

Pedagogy:

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

- 1.Dr.S.USHAN, Assistant Professor, Department of Mathematics.
- 2.Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

Course Learning Outcomes:

On the successful completion of the course. Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Illustrate the concepts of Classical Sets, fuzzy sets, fuzzy points and α -cuts..	K3
CLO2	Analyze the axioms and build operations on fuzzy sets	K4
CLO3	Able to know the concept of various relations of fuzzy sets. Using this to analyse the properties and operations of Crisp and Fuzzy relations .	K4
CLO4	Apply and evaluate multistage decision making in dynamic systems.	K4
CLO5	Enhance the knowledge in various branches like Fuzzy Systems, Genetic Algorithms, Medicine, Economics.	K3

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Schedule

Units	Description	Hours	Total Hours	Pedagogy
I	Introduction	2	18	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion& Test
	Overview of Classical Sets,	3		
	Membership Function, Height of a fuzzy set	3		
	Normal and sub normal fuzzy sets, Support, Level sets.	3		
	α -cuts, Decomposition Theorems	3		
	Extension Principle	4		
II	Standard fuzzy operations.	3	18	Chalk and talk, PPT,Interaction, Group Discussion,Quiz & Test
	Fuzzy Union , Intersection.	3		
	Fuzzy Complement.	3		
	Properties De. Morgan's laws	3		
	Properties De. Morgan's laws	3		
	α -Cuts of fuzzy operations.	3		
III	Cartesian Product, Crisp relations – cardinality.	3	18	Chalk and talk, PPT, Interaction, Seminar, Quiz & Test
	operations and properties of Crisp and Fuzzy relations	3		
	Image and inverse image of fuzzy sets	3		
	Image and inverse image of fuzzy sets	3		
	Various definitions of fuzzy operations	3		
	Generalizations – Non interacting fuzzy sets	3		
	Tolerance and equivalence relations.	3		
IV	General Discussion – Individual Decision making .	4	18	Chalk and talk, PPT, Interaction e-Quiz and Test
	Multi person decision making	4		
	Multi criteria decision making	3		
	Multi stage decision making , fuzzy ranking methods	4		
	Fuzzy linear programming	4		
V	Application in Medicine	2	18	Chalk and talk ,Interaction, Assignment, and e-quiz
	Application in Economics	3		
	Fuzzy Systems and Genetic Algorithms.	2		
	Fuzzy Regression.	3		
	Interpersonal Communication.	3		
	Other Applications	5		
Total			90	

Summative Examination – Blue Print

SL.No	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)	Total
			MCQs		Short Answers				
			No. of Questions	K-Level	No. of Questions	K-Level			
1	CLO 1	K 2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)	
2	CLO 2	K 3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)	
3	CLO 3	K 4	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)	
4	CLO 4	K 4	2	K3 & K4	1	K2	2(K4& K4)	1(K4)	
5	CLO 5	K 4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)	
No. of Questions to be asked			10		5		10	5	30
No. of Questions to be answered			10		5		5	3	23
Marks for each question			1		2		5	10	
Total Marks for each Section			10		10		25	30	75

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30 %
K4	2	-	20	20	42	35	35 %
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
I	Elective	23P1MECT2 (B)	OBJECT ORIENTED SYSTEM DEVELOPMENT	2	3	25	75	100

Nature of Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objective of the course is

- To inculcate knowledge on Object-Oriented programming concepts using C++.
- To expose the students in the areas of applying the theoretically learned concepts of object oriented system development and to provide hands on learning experience to nurture their programming skill.
- To understand the basic concepts of object-oriented programming and difference between Procedure Oriented Programming and Object Oriented Programming.
- To enhance program developing skill using object oriented programming concepts, learn the concept of class and object using C++ as an example and develop classes for simple applications.

Unit	Description	Hours	K-level	CLO
I	An overview of object oriented systems development: Overview of object oriented system development introduction-To orthogonal views of the software-Object oriented system development methodology-Why object orientation?-Overview of unified approach-object basics-an object oriented philosophy-objects are grouped in classes.	9	Upto K2	CLO1
II	Object basics and life cycles : Class hierarchy-inheritance-multiple inheritance-polymorphism-object relationships and associations-aggregation and object containment. Object oriented system development life cycle-the software development process-building high quality software-object oriented system development, use case driver approach-reliability.	9	Upto K3	CLO2
III	Classes and objects: Classes and objects-Defining member function-making an outside function inline-private member function array of objects-friendly functions. Constructor-types of constructors-destructors.	9	Upto K3	CLO3
IV	Operator overloading and type conversions: Operator overloading-defining operator overloading-overloading unary operators-overloading binary operators- overloading binary operators using friend-rules for overloading.	9	Upto K4	CLO4

V	Extending classes and pointers: Inheritance-Defining derived class-single inheritance-multilevel inheritance-multiple inheritance.	9	Upto K4	CLO5

Books for study:

1. Ali Bahrami, “Object oriented system development” , (Tata Mcgraw Hills).
Unit I - Chapter 1 (1.1-1.5), Chapter 2 (2.1-2.4)
Unit II - Chapter 2 (2.9-2.12), Chapter 3 (3.1-3.5)
2. E.Balagurusamy , “Object oriented programming with C++” (Tata Mcgraw Hills).
Unit III - Chapter 5 (5.5,5.6,5.13,5.15), Chapter 6 (6.2-6.8)
Unit IV - Chapter 7 (7.2-7.5,7.8)
Unit V - Chapter 8 (8.2-8.8), Chapter 9 (9.2-9.3)

Books for References:

1. Ashok N Kamathene, “Object Oriented Programming With Ansi And Turbo C++” - Pearson Education,2013.
2. Robert Lafore ,”Object Oriented Programming in Microsoft C++” Galgotia, 1993.
3. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Reusable Object-Oriented Software”, First Edition, Addison-Wesley Professional, 2010 (Reprint).
4. Martin Fowler, “UML Distilled”, Third edition, Pearson Education, 2011.

Web resources:

1. <https://kiitcseblog.files.wordpress.com/2017/03/11-12-13-11-37-10-1285sakthivijayan801-pdf>.
2. http://www.velhightech.com/Documents/CS6502_OOAAAD.pdf
3. <https://www.startertutorials.com/blog/classes-objects-c.html>
4. <https://www.edureka.co/blog/operator-overloading-in-cpp/>
5. https://www.tutorialspoint.com/cplusplus/unary_operators_overloading.htm
6. <https://www.programiz.com/cpp-programming/multilevel-multiple-inheritance>.

Rationale and activities having direct bearing on Nature of the Course

The syllabus facilitates the students to master all techniques of software development in object orientation and to demonstrate these techniques by implementing the solution for variety of problems spanning the breadth of the concept. The students will be able to develop the knowledge and practical skills needed to successfully participate in the analysis, design and development of large software systems, using object-oriented approaches, they can apply team dynamics by working in teams, Focus on object-oriented approaches and project management techniques attains quality assurance.

Activities having direct bearing on Skill development

Problem Solving, Analyticalability, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction.

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K- level
CLO 1	Understand the concept of Object oriented system development methodology and encapsulation, inheritance and polymorphism.	UptoK2
CLO 2	Explains basic Concept of object oriented system development life cycle.	UptoK3
CLO 3	Generalize constructors, default constructors, interfaces, abstract classes and abstract methods.	UptoK3
CLO 4	Analyze the importance of object oriented programming and difference between structured oriented and object oriented programming features.	UptoK4
CLO 5	Connect simple applications using an object-oriented system development.	UptoK4

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Schedule

Unit	Description	Hours	Mode
I	Introduction of object oriented system development - Orthogonal views of the software-Object oriented system development methodology-Why object orientation?	9	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion & Test
	Overview of unified approach-definition of object basics-an object oriented philosophy- concept of objects are grouped in classes.		
II	Definition of Class hierarchy-inheritance-multiple inheritance-polymorphism-object relationships and associations-aggregation and object containment.	9	Chalk and talk, PPT, Interaction, Group Discussion, Quiz & Test
	Concept of Object oriented system development life cycle-the software development process-building high quality software-object oriented system development, use case driver approach-concept of reliability.		
III	Introduction of Classes and objects-Definition of member function-making an outside function inline- - concept of private member function	9	Chalk and talk, PPT, Interaction, Seminar, Quiz & Test
	Definition of array of objects-friendly functions. Constructor definition-types of constructors - destructors.		
IV	Introduction of Operator overloading -overloading unary operators definition and related programs	9	Chalk and talk, PPT, Interaction e-Quiz and Test
	Concept of overloading binary operators- overloading binary operators using friend function-rules for overloading.		
V	Inheritance introduction-Defining derived class-Types of introduction single inheritance related concepts.	9	Chalk and talk, PPT, Interaction, Seminar, Quiz & Assignment
	Definition of Multilevel inheritance, multiple inheritance and related concepts.		
Total Hours		45	

Summative Examination – Blue Print

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	Up to K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	Up to K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	Up to K4	2	K3& K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

Course Designer(s):

1. Dr.S.MUTHUKUMAR, Head, Department of Mathematics.

2. Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
I	Elective	23P1MECP1(B)	PRACTICAL IN OBJECT ORIENTATION	1	2	25	75	100

Nature of Course	Skill oriented	✓	Employability	✓	Entrepreneurship oriented	

Course Objectives:

- To learn the syntax and semantics of the C++ programming language.
- To learn how to design C++ classes for code reuse.
- To learn how to implement copy constructors and class member functions.
- To learn how to overload functions and operators in C++.
- To learn how inheritance promotes code reuse in C++.
- To understand the principles of inheritance, packages and interfaces.

S. No.	List of Programs
1.	Implementation of classes and objects.
2.	Write a C++ program to convert temperature in Fahrenheit to Celsius
3.	Developing OOP to print PASCAL triangle.
4.	Banking operation using constructors.
5.	Adding two times using parameterized constructors.
6.	Develop a C++ Program using copy constructors.
7.	Develop a C++ Program using Dynamic Constructors
8.	Using the idea of friend function returning object technique to add two complex numbers.
9.	Write an object oriented program with the help of unary operator overloading concept to check whether the given number is Armstrong or not.
10.	Develop an OOP to implement operator overloading using friend function
11.	Develop an OOP to implement single inheritance.
12.	Develop an OOP to implement single inheritance using private member.
13.	Develop an OOP to implement Multilevel inheritance (Area of triangle and its internal angles provided the sides of triangles).

Book for Study:

1. E.Balagurusamy , “Object Oriented Programming with C++” Sixth Edition -2013,McGraw Hill Education(India)Private Limited, New Delhi.

Books for References:

1. C++ - The Complete Reference by Herbert Schildt,1998,TMH
2. How to program by Paul Deitel,HarveyDeitel, Ninth edition(2014)PHI
3. Object Oriented Programming with ANSI & Turbo C++ by Ashok N.Kamthane, Pearson Education.
4. Object Oriented Programming with C++ by PoornachandraSarang, second edition,PHI

Web Resources:

1. <https://www.learncpp.com/>
2. <https://hackr.io/tutorials/learn-c-plus-plus>
3. <https://www.programiz.com/cpp-programming/examples>

Rationale for the Nature of Course

Object oriented Programming is defined as an approach that provides a way of modularizing programs by creating partitioned memory area for both data and functions that can be used as templates for creating copies of such modules on demand. Writing object-oriented programs involves creating classes, creating objects from those classes, and creating applications, which are stand-alone executable programs that use those objects. After being created, classes can be reused over and over again to develop new programs.

Thinking in an object-oriented manner involves envisioning program components as objects that belong to classes and are similar to concrete objects in the real world; C++ is a general-purpose programming language and widely used nowadays for competitive programming.

Activities having direct bearing on Skill Development /Employability/Entrepreneurship

Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy:

Demonstration of Programs, Quiz, Group-Discussion,Practical Session.

Course Learning Outcomes:

On the successful completion of the course, Students will be able to

Number	Course Learning outcome	Knowledge level
CLO1	Write the code that includes the reuse of both existing code and calling functions in the C++ libraries	Up to K2
CLO2	Demonstrate an understanding of the overall syntax and semantics of C++ programs by writing small programs from specifications given in class	Up to K3
CLO3	Use constructors to initialize the object with the default or initial state.	Up to K3
CLO4	Analyze the concept of overloading to provide a special meaning of an operator for a user-defined data type.	Up to K4
CLO5	Relate the concepts that includes the reusability of both existing code and calling functions in the C++ libraries by applying inheritance concept	Up to K4

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Designer(s):

1. Dr.S.MUTHUKUMAR, Head, Department of Mathematics.
2. Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
II	Elective	23P2MECT5(B)	Formal Languages and Automata	1	2	25	75	100

Nature of Course	Skill oriented	✓	Employability		Entrepreneurship oriented	

Course Objectives:

The objective of the course is

- To identify different formal languages and their relationships.
- To design grammars and recognizers for different formal languages.
- To determine the decidability and intractability of computational problems.
- To introduce concepts in automata that accepts the languages.
- To employ finite state machines to accept and minimize the language.

Unit	Description	Hours	K-level	CLO
I	Formal Languages basic definitions and examples-Definon of Grammar-Phrase structure grammar(PSG)-Derivations and the language generated by a grammar-Chomsky classification of languages-Languages and their relation-Operations on language-Languages and automata.	6	K2	CLO1
II	Regular sets and regular grammars-Regular expressions-Finite automata and regular expressions-Algebraic method using ARDEN's theorem-Construction of finite automata equivalent to a regular expression.	6	K4	CLO2
III	Equivalence of two finite automata-comparison method-Equivalence of two regular expressions-Pumping lemma for regular sets-Closure properties of regular sets-Regular sets and regular grammars.	6	K3	CLO3
IV	Context free languages-derivation of trees-Ambiguity in context-free grammars-Simplification of Context free grammars-normal forms for Context free grammars	6	K4	CLO4
V	Turing machines and linear bounded automata-Turing machine model-Representation of Turing machines-Representation by instantaneous descriptions-Representation by transition table-Language acceptability by Turing machines-Design of Turing machine.	6	K3	CLO5

Books for study:

1. “Theory of Computer science”, K.L.P .Mishra and N .Chandrasekaran, PHI publications.
Unit I - Chapter 3(3.1(3.1.1,3.1.2),3.2,3.3,3.5,3.6.
Unit II - Chapter 4 (4.1,4.2(4.2.1,4.2.2,4.2.3,4.2.4,4.2.5)
Unit III - Chapter4 (4.2.6,4.2.7),4.3,4.5,4.6.
Unit IV - Chapter 5 (5.1,5.2,5.3(5.3.1),5.4.
Unit V - Chapter 7 (7.1,7.2,7.3,7.4)

Books for References:

1. “Introduction to Automata theory, Languages, and computation” John E.Hopcraft , Jeffery D.Ullman,–Narosa Publishing house.
2. ”Formal languages and Automata ”, Dr.Ranisiromoney, Revised edition, 1979.
3. “Discrete Mathematical Structures with Applications to Computer Science”, J.P.Tremblay, R. Manohar, TATA McGraw Hill.
4. “Discrete Mathematics”, N .Chandrasekaran ,M.Umaparvathi, PHI publications.

Web resources:

1. <https://condor.depaul.edu/ichu/csc447/notes/wk2/Grammar.pdf>
2. https://www.tutorialspoint.com/automata_theory/chomsky_classification_of_grammars.htm
3. <https://www.geeksforgeeks.org/generating-regular-expression-from-finite-automata/>
4. <https://www.geeksforgeeks.org/ambiguity-in-context-free-grammar-and-context-free-languages-2/>
5. https://www.vssut.ac.in/lecture_notes/lecture1428551440.pdf
6. <https://www.geeksforgeeks.org/turing-machine-in-toc/>

Rationale and activities having direct bearing on Nature of the Course

The theory of formal languages is an area with a number of applications in computer science. It is an attempt to describe the rules of grammar in a rigorous mathematical way to describe English language. The course formal languages and automata is challenging because there are difficulties in understanding the formal language and automata theory concepts as the course is mathematical in nature. In addition, the conventional approach to the course followed a sequence of machine and then the corresponding language theory. The course structure is redesigned to teach formal languages and corresponding automata followed by the properties of the respective languages according to the hierarchy of the formal languages. This flow of teaching makes students to understand the concepts and relate to the real time applications easily. Research oriented students will make good use of the Automata theory studied in this course.

Activities having direct bearing on Skill development

Problem Solving, Analytical ability, Group activities, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction.

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K- level
CLO 1	Understand the concept of Formal Languages and Phrase structure grammar	K2
CLO 2	Construct the finite automata equivalent to a regular expression	K4
CLO 3	Identify properties of regular sets and regular grammars	K3
CLO 4	List the concept of context free languages and normal forms for context free grammars	K4
CLO 5	Organize the Turing machines and linear bounded automata	K3

Mapping of CLOs with PSOs

CLOs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	1	2

Mapping of CLOs with POs

CLOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	1	3
CLO2	3	3	3	3	1	3
CLO3	3	3	2	2	1	1
CLO4	3	3	3	3	1	2
CLO5	3	2	3	2	2	2

Advance application– 3

Intermediate level–2

Basic level–1

Course Schedule

Unit	Description	Hours	Mode
I	Formal Languages basic definitions and examples- Definition of Grammar-Phrase structure grammar(PSG)- Derivations and the language generated by a grammar.	6	Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion & Test
	Overview of Chomsky classification of languages- Languages and their relation-Operations on language- concept of Languages and automata.		
II	Concept of Regular sets and regular grammars-Regular expressions- Definition of finite automata and regular expressions problems	6	Chalk and talk, PPT, Interaction, Group Discussion, Quiz & Test
	Algebraic method using ARDEN's theorem- Construction of finite automata equivalent to a regular expression.		
III	Equivalence of two finite automata definitions- comparison method-Equivalence of two regular expressions problems	6	Chalk and talk, PPT, Interaction, Seminar, Quiz & Test
	Pumping lemma for regular sets-Closure properties of regular sets-Regular sets and regular grammars problems.		
IV	Context free languages concept-derivation of trees- Ambiguity in context free grammars problems.	6	Chalk and talk, PPT, Interaction e-Quiz and Test
	Simplification of Context free grammars concept- normal forms for Context free grammars problems		
V	Turing machines and linear bounded automata definition- concept of Turing machine model- Representation of Turing machines-Representation by instantaneous descriptions	6	Chalk and talk, PPT, Interaction, Seminar, Quiz & Assignment
	Representation by transition table problems-Language acceptability by Turing machines-Design of Turing machine problems.		
Total Hours		30	

Summative Examination – Blue Print

Sl. No	CLO s	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	K4	2	K1& K2	1	K1	2(K4& K4)	1(K3)
3	CLO 3	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
4	CLO 4	K4	2	K1& K2	1	K2	2(K2& K2)	1(K4)
5	CLO 5	K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.66	42%
K4	-	-	10	10	20	16.66	16%
Total marks	10	10	50	50	120	100	100%

Course Designer(s):

1. Dr.S.MUTHUKUMAR, Head, Department of Mathematics.

2. Dr.R.CHITRA, Assistant Professor, Department of Mathematics(SF).

DEPARTMENT OF MATHEMATICS				CLASS: I M.Sc. Mathematics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
II	Elective	23P2MECT3(B)	MECHANICS	3	5	25	75	100

Nature of the Course:	Skill Oriented	✓	Employability Oriented		Entrepreneurship Oriented	

Objectives:

The objective of the course is:

- To create a foundation for understanding basic principles of mechanics and some classical problems.
- To learn Lagrangian and Hamiltonian formulations of classical mechanics
- To learn the importance and consequences of canonical transformations

Unit	Description	Hours	K-level	CLO
I	Introductory concepts: Mechanical system – generalized coordinates – constraints – virtual work – d'Alembert's principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum.	12	K2	CLO1
II	Lagrange's equations: Derivation of Lagrange's equations for different conditions – Lagrange equations for some simple systems - integrals of motion – Routhian procedure – natural system – Liouville's system – small oscillations.	12	K3	CLO2
III	Hamilton's equations: Stationary values - Hamilton's principle under different conditions – Hamilton's equations – the Legendre transformation – modified Hamilton's principle – principle of least action.	12	K3	CLO3
IV	Hamilton-Jacobi theory: Hamilton's principle function – canonical integral – Pfaffian differential form – Hamilton-Jacobi equation – Jacobi's theorem – modified Hamilton-Jacobi equation – separability – Liouville's system Stackel's theorem.	12	K4	CLO4
V	Canonical transformations: Differential forms and generating functions – some simple, point and momentum transformations - Lagrange and Poisson brackets.	12	K3	CLO5

Book for study:

D.T. Greenwood, Classical Dynamics, Prentice Hall of India Pvt. Ltd, New Delhi, 1979.

Chapters: Unit I: Chapter 1(1.1-1.5)

Unit II: Chapter 2(2.1-2.4)

Unit III: Chapter 4(4.1-4.3)

Unit IV: Chapter 5(5.1-5.3)

Unit V: Chapter 6(6.1-6.3)

Books for References:

1. H. Goldstein, C. Poole & J. Safko, Classical Mechanics, Pearson Education, New Delhi, 2002.
2. N.C.Rane and P.S.C.Joag, Classical Mechanics, Tata McGraw Hill, 1991.
3. J.R. Taylor, Classical Mechanics, University Science Books, Sausalito 2005.

Web Resources

1. <http://kestrel.nmt.edu/~raymond/classes/ph321/notes/lagrange/lagrange.pdf>
2. <https://www.physics.rutgers.edu/~shapiro/507/book3.pdf>
3. <http://complex.gmu.edu/www-phys/phys705/notes/015.5%20Hamilton-Jacobi%20Equation.pdf>
4. <http://complex.gmu.edu/www-phys/phys705/notes/014%20Canonical%20Transformation%20I.pdf>

Rationale for Nature of the course

Knowledge of the motion of non-quantum mechanical, low-energy particles in weak gravitational fields and Hamilton-Jacobi in identifying conserved quantities for a mechanical system.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy

Lecture, Chalk and Talk, Quiz, PPT, Tutorial, Assignment

Course Designer(s):

1. Dr. V. Sangeethasubha, Assistant Professor, PG and Research Department of Mathematics.

COURSE SCHEDULE

Unit	Description	Hours		Mode
I	Introductory concepts: mechanical system – generalized coordinates – constraints – virtual work	7	15	Lecture, Chalk and Talk Problem Solving, Quiz, Test
	d'Alembert's principle - energy and momentum – equilibrium and stability – kinetic energy – angular momentum	8		
II	Lagrange's equations: derivation of Lagrange's equations for different conditions	5	15	Lecture, Problem Solving, Chalk and Talk, Test & Quiz
	Lagrange equations for some simple systems - integrals of motion – Routhian procedure	5		
	Natural system – Liouville's system – small oscillations.	5		
III	Hamilton's equations: stationary values - Hamilton's principle under different conditions	6	15	PPT, Lecture, Quiz, Tutorial Problem Solving, Test
	Hamilton's equations – the Legendre transformation	5		
	modified Hamilton's principle – principle of least action.	4		
IV	Hamilton-Jacobi theory: Hamilton's principle function – canonical integral	5	15	Lecture, Tutorial, Problem Solving, Test & Quiz
	Pfaffian differential form – Hamilton-Jacobi equation	5		
	separability – Liouville's system Stackel's theorem	5		
V	Canonical transformations: differential forms and generating functions	5	15	Lecture, Chalk and Talk, PPT, Problem Solving, Quiz & Assignment
	some simple, point and momentum transformations	5		
	Lagrange and Poisson brackets	5		
Total Hours		75		

Course Learning Outcomes:

At the end of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the concepts of mechanical system, energy, momentum and d'Alembert's principle	K2
CLO2	Use the concept of Lagrange's equations in simple systems and in Routhian procedure, Liouville's system.	K3
CLO3	Evaluate stationary values using Hamilton's equations and find about Liouville's system	K3
CLO4	Use Hamilton Jacobi theory and find pfaffin differential form, Liouville's system stackel's theorem	K4
CLO5	Acquire the knowledge about canonical transformations, momentum transformations and poisson brackets	K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	1	-	-
CLO2	3	2	1	-	-
CLO3	3	2	1	-	-
CLO4	3	2	1	-	-
CLO5	3	2	1	-	-

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	1	-
CLO2	3	2	2	-	1	-
CLO3	3	2	3	-	2	-
CLO4	3	2	-	-	2	-
CLO5	3	-	-	2	3	-

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO2	K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
4	CLO4	K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
5	CLO5	K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS					CLASS: II M.Sc., Mathematics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23P2MECT4(B)	Numerical Analysis	2	3	25	75	100

Nature of the Course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

The object of this course is,

- To impart knowledge about to model engineering systems using differential equations and solve the equations both analytically and numerically
- To develop the methods of cubic spline to solve the differential equations
- To formulate and apply numerical techniques for differentiation and integration
- To analyse the concepts of finite element method

Unit	Description	Hours	K-level	CLO
I	Numerical Differentiation: Introduction, Numerical Differentiation – Errors in Numerical Differentiation – The Cubic Spline Method, Maximum and Minimum Values of a Tabulated Function	9	K2	CLO1
II	Numerical Integration: Boole's and Weddle's Rules, Use of Cubic Splines, Romberg Integration, Newton – Cotes Integration Formulae, Euler – Maclaurin Formula, Adaptive Quadrature Method.	9	K3	CLO2
III	Numerical Solution of Ordinary Differential Equations : Introduction, Solution by Taylor's Series, Euler's Method – Error Estimates for the Euler Method, Modified Euler's Method, Runge – Kutta Methods.	9	K3	CLO3
IV	Numerical Solution of Partial Differential Equations : Introduction, Finite – Difference Approximations to Derivatives, Laplace's Equation – Jacobi's Method – Gauss – seidal Method.	9	K4	CLO4
V	The Finite Element Method : Introduction, Functionals - Base Functions, Methods of Approximation – The Rayleigh – Ritz Method – The Galerkin Method	9	K4	CLO5

Book for study:

Introductory Methods of Numerical Methods S. S. Sastry, 4th edition 2008, Prentice – Hall India

Unit-I : Chapter –5(5.1 - 5.4)

Unit-II : Chapter –5(5.4(5.4.4 – 5.4.7)), 5.5, 5.6

Unit-III : Chapter –7(7.1, 7.2, 7.4, 7.5)

Unit-IV : Chapter –8(8.1 – 8.3(8.3.1 – 8.3.2))

Unit-V : Chapter –10(10.1 – 10.2)

Books for Reference:

1. Elementary Numerical Analysis Samuel D. Conte and Cardle Boor, McGraw Hill, 1981.
2. Numerical Methods for Scientific and Engineering Computation, M.K.Jain, S.R.K. Iyengar and R.K.Jain, New Age International Publishers, 4th edition, 2013.

Web Resources

1. <https://mathworld.wolfram.com/NumericalDifferentiation.html>
2. <https://homepage.divms.uiowa.edu/~atkinson/na-resources.pdf>
3. <https://www.comsol.com/multiphysics/finite-element-method>

Rationale for Nature of the course

Numerical analysis is employed to develop and analyze numerical methods for solving problems that arise in other areas of mathematics, such as calculus, linear algebra or differential equations.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course leads to wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behavior of the systems concerned can be studied.

Pedagogy

Lecture, Power point Presentation, Group Discussion, Quiz, Seminar, Tutorial.

Course Designer(s):

1. Dr. S.Vallirani, Assistant Professor, Department of Mathematics
2. Dr. K.Dharmalingam, Assistant Professor, Department of Mathematics

Course Schedule

Unit	Topics	Hours	Mode
I	Introduction, Numerical Differentiation – Errors in Numerical Differentiation	3	Lecture, Quiz PPT & Test
	The Cubic Spline Method	3	
	Maximum and Minimum Values of a Tabulated Function	3	
II	Boole's and Weddle's Rules, Use of Cubic Splines	3	Lecture, PPT, Quiz&Test
	Romberg Integration, Newton – Cotes Integration Formulae	3	
	Euler – Maclaurin Formula, Adaptive Quadrature Method.	3	
III	Introduction, Solution by Taylor's Series Method	3	PPT, Lecture, Tutorial, Quiz& Test
	Euler's Method – Error Estimates for the Euler Method, Modified Euler's Method	3	
	Runge – Kutta Methods	3	
IV	Introduction, Finite – Difference Approximations to Derivatives	3	Lecture, PPT, Tutorial, Quiz, Seminar &Test
	Laplace's Equation –Jacobi's Method – Gauss – seidal Method	3	
	Successive Over – relaxation Method	3	
V	Introduction, Functionals - Base Functions	3	PPT, Lecture, Assignment&Quiz
	Methods of Approximation – The Rayleigh – Ritz Method	3	
	Methods of Approximation - The Galerkin Method	3	
Total Hours		45	

Course Learning Outcomes:

At the end of the course, the students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Compute the values of the derivatives at some point using numerical differentiation	K2
CLO2	Compute numerical approximations to the integral of the function	K3
CLO3	Formulate mathematical models in the form of ordinary differential equations and learn various techniques of getting solutions of linear differential equations.	K3
CLO4	Solve mathematical models represented by initial or boundary value problems involving partial differential equations	K4
CLO5	To learn basic principles of finite element analysis procedure .	K4

Mapping of CLOs with PSOs

CLO	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	2	3	2	1
CLO2	3	2	1	2	1
CLO3	3	2	2	3	1
CLO4	3	2	2	1	1
CLO5	3	2	3	3	1

Mapping of CLOs with POs

CLO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CLO-1	3	1	3	2	1	-
CLO-2	2	1	3	1	1	-
CLO-3	3	2	3	1	2	1
CLO-4	1	2	3	2	2	1
CLO-5	3	1	2	3	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative Examination – Blue Print

S.No.	CLOs	K-level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	K2	2	K1& K1	1	K1	2(K1 & K1)	1(K2)
2	CLO 2	K3	2	K2& K3	1	K2	2(K3& K3)	1(K3)
3	CLO 3	K3	2	K2& K3	1	K1	2(K2 & K2)	1(K3)
4	CLO 4	K4	2	K3& K4	1	K3	2(K4& K4)	1(K4)
5	CLO 5	K4	2	K3 &K4	1	K2	2(K4& K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – solving problems

K4- Examining, analyzing, presentation and make inference with evidences.

K5 - Evaluating the ode problems

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF MATHEMATICS			Class: PG Students				
Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
Certificate Course	-	Industrial Quality Techniques	2	30	50	50	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objective of the course is

- To understand the performance of advanced level of control charts
- To know how to design sampling plans based on the attributes and variables.
- To gain knowledge on products lifetimes.
- To Implement corrective and preventive actions
- To maximize production by achieving economies of scale.

Unit	Description
I	Introduction to SQC-Chance and Assignable causes of variation-Benefits of SQC-Process and Product control-Tools for SQC-Control Charts for variables- X-Bar and R chart.
II	Control charts for attributes-Control chart for fraction defective(p-chart)-Control chart for number of defectives(d-chart for fixed and variable sample size)-Control chart for number of defects per unit(c-chart)-Natural tolerance limit and specification limits.
III	Acceptance sampling by Attributes- Acceptance quality level(A.Q.L)-Lot tolerance proportion or percent defective(LTPD)-Process average fraction defective (p)- Rectifying inspection plan -Average outgoing quality level(AOQL).Average sample number (ASN) and average amount of total inspection.
IV	Industrial uses of acceptance sampling-Lot formation-Sampling methods-Symbols used in relation to sampling acceptance – The operating characteristics (OC)curve - concepts of Producer's risk and Consumer's risk. Characteristics of OC curve-Sampling plans-Single sampling plan – Double sampling plans-Multiple sampling plan.
V	Sequential sampling plan-SPRT- OC of sequential sampling plan-Five points of OC curve-ASN function of t-Five points of ASN curve.

Books for study:

1. Kapoor, V.K. and Gupta, S.P. (2007) Fundamentals of Applied Statistics, Sultan Chand & Sons.
UNIT – 1: Chapter – 1: Sections 1.1 to 1.8 (Page No:1.1 to 1.26)
UNIT – 2: Chapter – 1: Sections 1.9,1.10 (Page No:1.30 to 1.44)
UNIT – 3: Chapter - 1: Sections 1.11 (Page No:1.45 to 1.50)
UNIT – 5: Chapter - 1: Sections 1.12.4 (Page No:1.60 to 1.66)
2. Mahajan, M. (2002). Statistical Quality Control, (Third Edition), Dhanpat Rai and Co., Delhi.
UNIT - 4 : Chapter- 10 (Page No:315 to 332)

Books for References:

1. Montgomery, D.C. (2009) Introduction to Statistical Quality Control, 6th/edition, Wiley India, New Delhi.
2. Schilling, E. G. and Nuebauer, D.V. (2009) Acceptance Sampling in Quality Control, 6th/edition, CRC Press, New York.
3. Grant, E.L. and Leavenworth, R.S. (2000) Statistical Quality Control, 7/e, Tata McGraw Hill, New Delhi.
4. Juran, J.M. and De Feo, J.A. (2010) Juran's Quality control Handbook – The Complete Guide to Performance Excellence, 6/e, Tata McGraw-Hill, New Delhi.
5. Wetherill, G.B. (1977) Sampling Inspection and Quality Control, 2/e, Chapman and Hall, London.

Web Resources:

1. Statistical Quality Control Introduction <https://www.britannica.com/topic/statistical-quality-control>
2. <https://egyankosh.ac.in/bitstream/123456789/20753/1/Unit-1.pdf>
3. NPTEL Course on Quality Design and control
4. <https://nptel.ac.in/courses/110/105/110105088/>

Pedagogy:

Chalk and Talk, Seminar, Quiz, Group Discussion and PPT.

Course Designer:

Dr.R.CHITRA,

Assistant Professor, Department of Mathematics, The Madura College (Autonomous)-SF.



DEPARTMENT OF STATISTICS

Revised Curriculum

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCHE)
(Choice Based Credit system with Outcome Based Education)

Academic Year 2023-2024 onwards

III and IV semesters (B.Sc. Statistics)

III and IV semesters (M.Sc. Statistics)

Certificate Courses



The Madura College (Autonomous), Madurai – 625 011

Department of Statistics

B.Sc., Statistics – Course Structure

Semester – III

Part	Course description	Course Code	Hours	Credits
I	Language - III Tamil / Hindi / Sanskrit	23U3TLAN3/ 23U3HLAN3/ 23U3SLAN3	6	3
II	Language - III English	23U3NENG3	6	3
III	Core Course - 5 (CC5)-ESTIMATION THEORY	23U3SCCT5	4	4
	Core Course - 6(CC6)-SAMPLING TECHNIQUES	23U3SCCT6	3	3
IV	Skill Enhancement Course-4 STATISTICAL PRACTICAL – III (CALCULATOR BASED)	23U3SSEP4	2	2
	Skill Enhancement Course-5- DATABASE MANAGEMENT SYSTEM	23U3SSED5	2	2
V	EVS	23U3EVST1	1	-
	Total		24	17

Semester – IV

Part	Course description	Course Code	Hours	Credits
I	Language – IV Tamil / Hindi / Sanskrit	23U4TLAN4/ 23U4HLAN4/ 23U4SLAN4	6	3
II	Language – IV English	23U4NENG4	6	3
III	Core Course – 7(CC7)-TESTING OF STATISTICAL HYPOTHESIS	23U4SCCT7	4	4
	Core Course – 8(CC8)- ACTUARIAL STATISTICS	23U4SCCT8	3	3
IV	Skill Enhancement Course-6 STATISTICAL PRACTICAL –IV (CALCULATOR BASED)	23U4SSEP5	2	2
	Skill Enhancement Course-7- BIOSTATISTICS	23U4SSED7	2	2
V	EVS	23U4EVST2	1	2
	Total		24	19

SEMESTER	Course description	Course Code	Hours	Credits
III	Add on Course – Statistics for Big Data	-	30	2
IV	Add on Course – Combinatorics	-	30	2
	Selfstudy Course - Time Series Analysis	-		2
-	Certificate course - Official Statistics	-	30	2

DEPARTMENT OF STATISTICS					CLASS: II B.Sc STATISTICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Core - V	23U3SCCT5	Estimation Theory	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To Emphasize on the Concept of Point Estimation and Interval Estimation.
- To learn properties of a good estimator
- To understand various methods of estimation

Unit	Description	Hours	K-level	CLO
I	Point estimation -Estimator – Consistency and Unbiasedness – Efficiency and asymptotic efficiency– Estimators based on sufficient statistics – Neyman Factorization theorem (statement only) – Simple illustrations	12	Up to K3	1
II	Minimum variance unbiased estimators - Cramer – Rao Inequality – Rao Blackwell theorem – Simple illustrations.	12	Up to k2	2
III	Methods of Estimation- Methods of Maximum likelihood and moments – Properties of estimators obtained by these methods – Examples only.	12	Up to k3	3
IV	Method of Minimum Variance-Methods of moments -Methods of Least squares- Interval estimation.	12	Up to k4	4
V	Notion of Bayes Estimation, concept of prior ,Posterior Distribution, Simple Problems involving loss function approach -Simple illustrations.	12	Up to k3	5

Books for study:

1. Gupta, S.C. Kapoor, V.K. (2007) Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi

Unit I: Chapter 17(17.1,17.2(17.2.1,17.2.2,17.2.3 upto example 17.8,17.2.4), Theorem 15.7(statement only)

Unit II: Chapter 17(17.2.3 from M.V.U Estimators,17.3,17.9)

Unit III: Chapter 17(17.6(17.6.1)) - Examples only

Unit IV: Chapter 17(17.6(17.6.2,17.6.3,17.6.4,),17.7)

2. Mood, A.D. Graybill, F.A. and Boes, D.C (1974): Introduction to the Theory of Statistics, 3/e, Mc.Graw Hill, New York.

Unit V :Chapter VII -7(7.1,7.2)

Books for References:

1. Goon, A.M. Gupta M.K. and Das Gupta B (1977) An Outline of Statistical Theory, Vol I, 6/e, World Press, Calcutta.
2. Hogg, R.V. and Graig, A.T. (1978) : Introduction to Mathematical Statistics, A/e, Mc.Graw Hill Publishing Co.Inc., New York

Web Resources

1. <http://web.mit.edu/14.381/www/Estimation.pdf>http://www.utstat.toronto.edu/~olgac/sta255_2013/notes/sta255_Lecture9.pdf
2. <https://study.com/academy/lesson/statistical-estimation-explanation-overview.html>
3. <https://www.britannica.com/print/article/193511>

Rationale for Nature of the course

Estimation theory is a branch of statistics that deals with estimating the values of parameters based on measured empirical data that has a random component. The parameters describe an underlying physical setting in such a way that their value affects the distribution of the measured data.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

- 1.Prof.KRISHNA JAYANTHI.S, Assistant Professor,Department of Mathematics &Statistics.

Course Schedule

Unit	Topics	Hours	Mode
I	Estimator – Consistency and Unbiasedness – Efficiency	4	PPT, Chalk and Talk, Test, Quiz.
	Estimators based on sufficient statistics	4	
	Neyman Factorization theorem (statement only) – Simple illustrations	4	
II	Cramer – Rao Inequality	4	PPT, Chalk and Talk Test, Quiz.
	Rao Blackwell theorem	6	
	Simple illustrations	2	
III	Methods of Maximum likelihood and moments	6	PPT, Chalk and Talk, Test, Quiz.
	Properties of estimators obtained by these methods	4	
	Example Problems	2	
IV	Method of Minimum Variance-Methods of moments -	5	PPT, Chalk and Talk, Test, Quiz.
	Methods of Least squares	4	
	Interval estimation	3	
V	Posterior distribution	6	Chalk and Talk, Test, Quiz. Assignments and Seminar
	Loss Function Approach	4	
	Simple illustrations	2	
TOTAL		60	

Course Learning Outcomes:

At the end of the course , the students will be able to

CO	Course Learning Outcome	K-level
CLO 1	Apply the properties of point estimator such as Consistency, Unbiasedness, Sufficiency.	Up to K3
CLO 2	Find minimum variance unbiased estimator.	Up to K2
CLO 3	Obtain estimators using methods of estimation.	Up to K3
CLO 4	Construct Confidence Interval and acquire the knowledge of Interval estimation.	Up to K4
CLO 5	Infer the concepts of Bayes estimation in different fields of applications.	Up to K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	2	1	2	3
CLO-2	2	2	1	2	3
CLO-3	1	1	1	2	3
CLO-4	1	1	1	2	3
CLO-5	1	1	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	-	2	1
CLO2	3	3	-	-	2	1
CLO3	3	2	-	-	2	1
CLO4	2	2	-	-	1	1
CLO5	2	2	-	-	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: II B.Sc., Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
III	Core	23U3SCCT6	Sampling Techniques	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To know the basic operation of sampling.
- To study the theory and applications of simple random sampling
- To learn practical uses of stratification.
- To apply systematic and PPS sampling in real time problems.

Unit	Description	Hours	K-level	CLO(s)
I	Unit I Basic concepts of sample surveys – Advantages of Sampling –Principal steps in Sample survey, Sampling unit – Sampling frame – Census – Probability Sampling, Alternatives to probability sampling, Mean Square Error.	9	K2	1
II	Unit II Simple random sampling, Methods of selection, Sampling with and without replacement – Properties of estimates, Finite population correction, Estimation of Standard error, Confidence limits.	9	K3	2
III	Unit III Stratified random sampling, principles of stratification, Notations – Estimation of population mean and its variance – Estimated variance and confidence limits, Allocation techniques -equal allocation, proportional allocation, Neyman allocation and optimum allocation, Estimation of gain due to stratification.	9	K3	3
IV	Unit-IV Systematic sampling, Estimation of population mean and its sampling variance – Comparison of systematic sampling with stratified random samples.	9	K4	4
V	Unit- Varying Probability sampling, Selection of one unit with PPS, PPS Sampling with replacement, Estimator for population total and its variance.	9	K3	5

Books for study:

1. Singh. D. and Chaudry F.S. (1986) : Theory and Analysis of Sample Surveys Design Wiley Eastern Ltd.
2. Cochran, W.G. (1978): Sampling Techniques, John Wiley Eastern, Third Edition.
Unit I: **Book 1: Chapter 1: 1.1 - 1.9**
Unit II: **Book 1: Chapter 2: 2.1-2.3, 2.5, 2.6, 2.7**
Unit III: **Book 1: Chapter 3: 3.1 - 3.7, 3.9**
Unit IV: **Book 1: Chapter 4: 4.1, 4.4, 4.6**
Unit V: **Book 1: Chapter 5: 5.1, 5.3**

Books for Reference:

1. Murthy M.N. (1967): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
2. Sampath.S, (2001), Sampling Theory and Methods, CRC Press.

Web Resources:

1. <http://ocw.jhsph.edu/courses/statmethodsforamplesurveys/pdfs/lecture2.pdf>
2. <https://www.questionpro.com/blog/stratified-random-sampling/>
3. <https://www.scribbr.com/methodology/systematic-sampling/>
4. <http://home.iitk.ac.in/~shalab/sampling/chapter7-sampling-varying-probability-sampling.pdf>

Rationale for Nature of the course

Thinking analytically and applying basic techniques of Sampling to interpret data, draw conclusions about the characteristics of the population. Developing proficiency in making decisions based on data and estimates the distribution functions.

Activities having direct bearing on Skill development/ Employability/ Entrepreneurship

Exercises with problems asked in TNPSC, Seminars, Assignments, Problem solving and Quiz.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer:

Dr. S.VALLIRANI, Assistant Professor, Department of Mathematics and Statistics, The Madura College.

Course Schedule:

Units	Description	Hours		Mode
I	Basic concepts of sample surveys	2	9	PPT, Chalk and Talk, Quiz, Test
	Advantages of Sampling, Principal steps in Sample survey	2		
	Sampling unit – Sampling frame – Census	2		
	Probability Sampling, Alternatives to probability sampling, Mean Square Error	3		
II	Simple random sampling	2	9	PPT, Chalk and Talk, Quiz, Test
	Methods of selection, Sampling with and without replacement	2		
	Properties of estimates, Finite population correction,	3		
	Estimation of Standard error, Confidence limits.	2		
III	Stratified random sampling, principles of stratification, Notations – Estimation of population mean and its variance	2	9	PPT, Chalk and Talk, Quiz, Test
	Estimated variance and confidence limits	2		
	Allocation techniques - equal allocation, proportional allocation, Neyman allocation and optimum allocation	2		
	Estimation of gain due to stratification, Estimation of sample size for continuous data.	3		
IV	Systematic sampling	2	9	Lecture with PPT, Quiz, and Test
	Estimation of population mean and its sampling variance	2		
	Comparison of systematic sampling with stratified random samples.	3		
	Systematic sampling in two dimensions.	2		
V	Varying Probability sampling, Selection of one unit with PPS.	2	9	PPT, Chalk and Talk, Assignment, Quiz
	PPS Sampling with replacement	2		
	Estimator for population total and its variance, Selection procedures, Cumulative total method,	2		
	Lahiri's method, Split method	3		
Total		45		

COURSE OUTCOMES:

At the end of the course, students will be able to

CLO	Course Learning Outcomes	Knowledge Level
CLO 1	Know the difference between census and sampling.	UptoK2
CLO 2	Understand basic operations and advantages of sampling	UptoK3
CLO 3	Understand widely used sampling techniques	UptoK3
CLO 4	Know to estimate population information using sampling	UptoK4
CLO 5	Apply sampling techniques in real time problems	UptoK3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	1	2	3
CLO-2	3	2	1	2	3
CLO-3	3	2	1	2	3
CLO-4	3	2	1	2	3
CLO-5	3	2	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	1	2	2	1
CLO2	3	3	1	1	2	1
CLO3	3	2	2	1	2	1
CLO4	2	2	1	1	1	1
CLO5	2	2	1	1	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
Mapping with Course Learning Outcomes (CLOs)

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10				25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS : II B.Sc. Statistics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/week	CIA	External	Total
III	Core Practical	23U3SSEP4	Statistical Practical – III (Calculator based)	1	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- To Emphasize on the concept of point estimation and interval estimation
- To understand various methods of estimation
- To know the basic concept of operations of sampling
- To learn the practical uses of Stratification, Systematic samplings.

S.No.	LIST OF PROBLEMS
1	Problems on Estimator.
2	Problems on unbiased ness.
3	Problems on Consistency.
4	Problems on Cramer Rao inequality.
5	Problems on efficient estimator
6	Problems on sufficient estimator
7	Problems on methods of Maximum likelihood.
8	Problems on Least square method.
9	Problems on confidence interval
10	Problems on confidence limits
11	Problems on Minimum variance estimators
12	Problems on Minimum Chi-square method
13	Problems on Simple random sampling
14	Problems on Stratified random sampling
15	Problems on Systematic sampling
16	Problems on varying probability sampling
17	Problems on Estimator for population total
18	Problems on Cumulative total method
19	Problems on Lahiri's method
20	Problems on Split method.

Book for Study:

1. Gupta.S.C and Kapoor.V.K (1991), “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons.
2. Gupta.S.P, “Statistical Methods”, Sultan Chand and sons.
3. Goon, A.M. Gupta M.K. and Das Gupta B (1977) An Outline of Statistical Theory, Vol I, 6/e, World Press, Calcutta.
4. Singh D. and Chaudry F.S(1986):Theory and Analysis of Sample Survey Design Wiley Eastern Ltd. Cochran, W.G. (1978) : Sampling Techniques,Jphn Wiley Eastern

Web resources:

1. <http://web.mit.edu/14.381/www/Estimation.pdf>
2. <http://www.utstat.toronto.edu/>
3. <http://www.questionpro.com/blog/stratified-random-dampling/>
4. <http://www.scribbr.com/methodology/systematic-sampling/>

Rationale for Nature of the course

The course provides knowledge to identify various types of estimators and their properties. The student estimates the result using various methodology in estimators. Developing proficiency in making decisions based on data and estimates the distribution functions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Pedagogy:

Practical session, PPT, Group discussion, Interaction.

Course Designer:

Prof. V.VIJAYALAKSHMI, Assistant Professor, Department of Mathematics & Statistics (SF)

COURSE OUTCOMES:

At the end of the course, the student will be able to:

Number	Course Learning outcome	K-level
CO1	Understand the properties of point estimator like Consistency, Unbiasedness, Sufficiency.	Upto K3
CO2	Understand the minimum variance unbiased estimator	Upto K3
CO3	Infer the concepts of Bayes estimation in different fields of interval estimation.	Upto K3
CO4	Understand the basic operations and apply sampling techniques in real life problems.	Upto K3
CO5	Estimate the population information using sampling.	Upto K3

MAPPING WITH PROGRAMME SPECIFIC OUTCOMES:

CLO	PSOs				
	1	2	3	4	5
CLO1	2	1	2	3	3
CLO2	2	1	2	3	3
CLO3	1	1	2	3	3
CLO4	1	1	2	3	2
CLO5	1	1	2	3	2

MAPPING WITH PROGRAMME OUTCOMES:

Mapping of Course Outcomes (**CLO**) against Programme Outcomes (**PO**)

CLO	POs					
	1	2	3	4	5	6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Advance application– 3

Intermediate level–2

Basic level–1

DEPARTMENT OF STATISTICS					CLASS: II B.Sc., STATISTICS			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	SEC	23U3SSED5	Database Management System	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- Understand the basic concepts and applications of database systems.
- Understand the relational database design principle.
- Master the basics of SQL and Construct queries using SQL
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra.
- Design ER-models to represent simple database application scenarios.

Unit	Description	Hours	K-level	CLO
I	Introduction: Database – System Applications – Purpose of Database Systems – View of Data – Database Languages – Relational Databases.	6	Upto K2	1
II	Relational databases: Structure of Relational Databases – Fundamental Relational -Algebra Operations – Additional Relational-Algebra Operations – Null Values.	6	Upto K3	2
III	SQL: Background – Data definition – Basic structure of SQL Queries – Set Operations – Aggregate functions – Null values –Modification of database.	6	Upto K3	3
IV	Database Design: Overview of the Design Process – The Entity -Relationship Model – Constraints – Entity -Relationship Diagrams – Weak Entity sets. Relational Database Design: Features of Good Relational Designs – Atomic Domains and First Normal Form.	6	Upto K4	4
V	Transaction Management: Transaction Concept – Transaction State – Concurrent Executions – Concurrency Control: Lock-Based Protocols – Timestamp-Based Protocols – Validation-Based Protocols.	6	Upto K3	5

Books for study:

Database system Concepts, Abraham Silberschatz, Henry F. Korth, S.Sudharshan, 5th Edition.

Chapters:

UNIT-I: Chapter 1(1.1-1.5)

UNIT-II: Chapter 2 (2.1 -2.3,2.5)

UNIT-III: Chapter 3(3.1 -3.6, 3.10)

UNIT-IV: Chapter 6(6.1 - 6.4,6.6), Chapter 7(7.1,7.2)

UNIT-V : Chapter 15(15.1, 15.2, 15.4), Chapter 16(16.1- 16.3)

Books for References:

1. Fundamental of Database Management Systes, Alexis Leon, Mathews Leon, Vijay Nicole Imprints Private Limited.
2. Database Systems Using Oracle, Nilesesh shah, 2nd Edition, PHI.
3. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems 5th edition, Pearson Education, 2008.

Web Resources

1. <https://www.javatpoint.com/dbms-tutorial>
2. <https://www.geeksforgeeks.org/introduction-of-er-model/>
3. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf
4. <https://www.lido.app/post/database-101>
5. <https://www.oreilly.com/library/view/relational-theory-for/9781449365431/ch01.html>

Rationale for Nature of the course

The students are able to effectively manage and use the information through data management skills. Data management skills involve looking for patterns, understanding database design concepts and being able to participate in short and long-term planning about database projects.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Problem Solving, Analytical ability, Professional Competency, Professional Communication.

Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

Course Designer(s):

Dr. B.SEETHALAKSHMI, Assistant Professor, Department of Mathematics & Statistics.

Course Schedule

Unit	Topics	Hrs	Mode
I	Database – System Applications – Purpose of Database Systems – View of Data.	3	ICT tools, Quiz, Test Lecture And Tutorials
	Database Languages - Relational Databases	3	
II	Structure of Relational Databases – Fundamental Relational -Algebra Operations	3	PPT, Quiz, Test Lecture
	Additional Relational-Algebra Operations – Null Values.	3	
III	Background – Data definition – Basic structure of SQL Queries – Set Operations	3	Lecture ,Quiz, Test and Tutorials
	Aggregate functions – Null values – Modification of database.	3	
IV	Overview of the Design Process – The Entity -Relationship Model – Constraints – Entity -Relationship Diagrams – Weak Entity sets .	3	Lecture, Test Tutorials & Quiz
	Relational Database Design: Features of Good Relational Designs – Atomic Domains and First Normal Form.	3	
V	Transaction Concept – Transaction State – Concurrent Executions.	3	Lecture, Quiz & Assignment
	Concurrency Control: Lock-Based Protocols – Timestamp-Based Protocols – Validation-Based Protocols.	3	
Total Hours		30	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

Number	Course Learning Outcome	Knowledge level
CLO1	Demonstrate the basic elements of relational database management systems.	Upto K2
CLO2	Identify the data models for relevant problems.	Upto K3
CLO3	Formulate the queries on the data.	Upto K3
CLO4	Design entity relationship and convert entity relationship diagrams into relational database design.	Upto K4
CLO5	Extend normalization for the development of application software's.	Upto K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5
CLO–1	2	1	2	3	3
CLO–2	2	1	2	3	3
CLO–3	1	1	2	3	3
CLO–4	1	1	2	3	2
CLO–5	1	1	2	3	2

Summative - Blue – Print – Model

Units	CLO s	K Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K4	2	K1& K2	1	K1	2(K4& K4)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2(K2& K2)	1(K4)
5	CLO 5	Up to K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/ or)	Section D (Open choice)	Total Marks	% of marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.66	42%
K4	-	-	10	10	20	16.66	16%
Total marks	10	10	50	50	120	100	100%

DEPARTMET OF STATISTICS				CLASS: II B.Sc Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Core	23U4SCCT7	Testing of Statistical Hypothesis	4	4	25	75	100
Nature of Course		Skill oriented	✓ Employability oriented	✓	Entrepreneurship oriented			

Objectives:

- To make familiar with testing concepts
- To understand the concept of Most Powerful test.
- To understand the Likelihood ratio tests and their use
- To apply tests for samples from unknown distributions.

Unit	Description	Hours	K-level	CLO
I	Statistical Hypothesis – Null and Alternative Hypothesis – Simple and Composite hypothesis – Critical region – Type-I and Type-II error – Most Powerful test – Uniformly Most powerful test – Neyman Pearson Lemma – Simple problems.	12	Upto K3	CLO1
II	Likelihood ratio test – Tests of mean of a normal population – Equality of two means of normal populations – test for variance of a normal population – Equality of variances of two normal populations	12	Upto K2	CLO2
III	Exact tests based on t distribution – One sample tests – one sided and two sided tests – Two sample tests – One sided and two sided.	12	Upto K4	CLO3
IV	Chi-square tests, Distribution of quadratic forms, Test of equality of several mean, Analysis of Variance.	12	Upto K3	CLO4
V	Non Parametric Methods – Confidence interval for distribution quantiles – Tolerance limits for distributions. Sign test, wilcoxon test.	12	Upto K3	CLO5

Book for study:

1. Gupta S. C. and Kapoor V. K. (1991): “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons.
2. Robert V. Hogg and Allen T. Craig (1978), Introduction to Mathematical Statistics, 4th edition, Macmillan Publishing Co., Inc. New York.
3. An introduction to Probability and Statistics (2001), Rohatgi. V.K, and A.K.Md.Ehsanessaleh, Jhon Wiley & Sons.

- Unit I:** Book 1 (Page No.18.2 – 18.22) - Chapter 18(18.2 – 18.5)
- Unit II:** Book 1(Page No.18.22-18.32, 18.35-18.39) - Chapter 18 – 18.6(18.6.2, 18.6.3, 18.6.5, 18.6.6)
- Unit III:** Book 1(Page No. 16.12 – 16.18) – Chapter 16(16.3.1, 16.3.1)
- Unit IV:** Book 1(Page No.18.33-18.35) - Chapter 18(18.6.4)
 Book 2(Page No. 283,555) - Chapter 4(4.7), 9(9.8)
 Book 3(Page No.577 - 590) - Chapter 12(12.4 – 12.6)
- Unit V:** Book 1(Page No.18.40, 18.41, 18.46-18.48) - Chapter 18 - 18.7(18.7.6, 18.7.7)
 Book 2(Page No. 261, 315) - Chapter 4 – 4.4(4.4.2), 4.10.

Book for References:

1. A.M. Graybill, F.A. and Boes, D.C. (1974) Introduction to the theory of Statistics, Tata McGraw Hill, New Delhi.
2. Introduction to Mathematical Statistics third edition, Amerind, New Delhi. Hoel, P.G. (1971) Rajagopalan, M. and Dhanavanthan, P.
3. Manoj Kumar Srivastava, Abdul Hamid Khan, Namita Srivastava, (2014), Statistical Inference: Theory of Estimation, PHI Learning, New Delhi.
4. George Casella, Roger L.Berger, Statistical Inference, Second Edition, Duxbury Publication.
5. Hogg, Rains, Zimmerman, Probability and Statistical Inference, Ninth Edition, Pearson Publication.
6. D.R.Cox, Principles of Statistical Inference, Cambridge university press.

Web Resources

1. https://www.probabilitycourse.com/chapter8/8_4_5_likelihood_ratio_tests.php
2. <https://www.scibbr.com/statistics/hypothesis-testing>
3. <https://www.vendantu.com/maths/hypothesis-testing>

Rationale for Nature of the course

Proficiency in hypothesis testing allows students to carry out data-driven analyses, identify patterns and make data-backed recommendations. Student who possess these skills can contribute to evidence-based decision-making processes within organization, leading to more effective problem-solving and informed business strategies. Furthermore, students with a solid understanding of hypothesis testing can help improve the accuracy and reliability of research studies, experimentation, and data analysis projects.

Activities having direct bearing on skill development/Employability Entrepreneurship

Case Study, Formulation an Analysis Plan and Problem Solving.

Pedagogy

Lecture, Seminar, Quiz, Group Discussion, Assignment, PPT, LMS(CANVAS)

Course Designer(s):

Course Schedule

Units	Topics	Hrs	Mode
I	Statistical Hypothesis	1	Quiz & Seminar, Test
	Null and Alternative Hypothesis	2	
	Simple and Composite hypothesis, Critical region	2	
	Type-I and Type-II error	2	
	Most Powerful test – Uniformly Most powerful test	3	
	Neyman Pearson Lemma – Simple problems.	2	
II	Likelihood ratio test	1	Quiz & Seminar, Test
	Tests of mean of a normal population	2	
	Equality of two means of normal populations	3	
	test for variance of a normal population	3	
	Equality of variances of two normal populations	3	
III	Exact tests based on t distribution	4	Chalk and Talk, Test
	One sample tests – one sided and two sided tests	4	
	Two sample tests – One sided and two sided	4	
IV	Chi-square tests, Distribution of quadratic forms.	4	Chalk and Talk, Test
	Test of equality of several means	4	
	Analysis of Variance	4	
V	Non Parametric Methods	4	Chalk and Talk & Seminar, Assignment
	Confidence interval for distribution quantiles, Tolerance limits for distributions.	4	
	Sign test, Wilcoxon test.	4	
Total Hours		60	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Frame hypotheses about population in real life research	Upto K3
CLO2	Identify suitable testing procedure for given hypotheses	Upto K2
CLO3	Compare two populations using samples taken from them	Upto K4
CLO4	Compare populations in its means and variances separately	Upto K3
CLO5	Identify situations to apply parametric and nonparametric tests	Upto K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	2	2	1	2	3	3	2
CLO2	2	2	1	2	3	3	1
CLO3	1	1	1	2	3	3	3
CLO4	1	1	1	2	3	2	3
CLO5	1	1	1	2	3	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	2	1	3
CLO2	1	2	3	3	3
CLO3	3	1	3	2	3
CLO4	2	3	2	3	1
CLO5	3	3	3	2	2

Advance application-3;**Intermediate level-2;****Basic level-1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K – Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K - Level	No. of questions	K - Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K1	2(K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2(K2 & K2)	1(K2)
3	CLO 3	Up to K4	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2(K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2(K3 & K3)	1(K3)
No. o f Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-	-	10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS : II B.Sc. Statistics				
Sem	Course Type	Course code	Course Title	Credits	Contact Hours/week	CIA	External	Total
IV	Core	23U4SCCT8	Actuarial Statistics	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Course Objectives:

The objectives of the course is

- It develops a greater understanding of statistical principles and their application in actuarial statistics.
- Describe the core areas of actuarial practice and relate to those areas actuarial principles, theories and models.
- It gives the understanding of the application knowledge of the life insurance environment.

Course content:

Unit	Description	Hours	K-level	CLO(s)
I	Unit I: Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest.	9	K3	1
II	Unit II: Mortality: Gompertz - Makeham laws of mortality - life tables. Annuities: Endowments, Annuities, Accumulations, Assurances.	9	K2	2
III	Unit III : Policy Values: Surrender values and paid up policies, industrial assurances.	9	K3	3
IV	Unit-IV: Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capitalsums on retirement and death, widow's pensions, benefits dependent on marriage.	9	K4	4
V	Unit-V : Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans-level annual premium under temporary assurance.	9	K3	5

Book for Study:

1. Mathematical Basis of Life Assurance (IC-81) (2000), published by insurance institute of India, Bombay.
2. S.C. Gupta and V. K. Kapoor (2007) Fundamentals of Applied Statistics, sultan chand and sons, New Delhi.
3. Alistair Neill(1977) : Life contingencies, Heinemann professional publishing.
4. Hooker,P.F., Longley, L.H.-Cook (1957) : Life and other contingencies, Cambridge

Unit I - Text Book 1: Chapter 1(Page No: 1-6, 12-17)

Unit II - Text Book 1: Chapter 2(Page No: 27-50), Chapter 9(Page No: 248-263)

Text Book 2: Chapter 9(Page No: 9.15-9.18, 9.33)

Unit III - Text Book 1: Chapter 15(Page No: 349-366)

Unit IV - Text Book 1: Chapter 16(Page No: 369-375)

Unit V -Text Book 1: Chapter 11(Page No: 289-296), Chapter 12(Page No: 317-321)

Books for References:

- Actuarial Mathematics for life Contingent Risks by David Dickinson, Mary Hardy, and Howard waters.
- Hosack,I.B., Pollard, J.H. and Zehnwirth, B.(1999) : introductory statistics with applications in generalinsurance, Cambridge University.
- An introduction to Actuarial Mathematics by Michiel Gerhard and Thomas Mikosch.

Web Resources:

1. <http://mshaocong.github.io/actuarial.pdf>
2. <https://www.investopedia.com/terms/c/cash-value-life-insurance.asp>
3. <http://www.atlas-mag.net/en/article/pension-fund-and-social-investment>

Rationale for Nature of the course:

The strength of our Actuarial Statistics subjects is the emphasis on understanding statistical concepts and methods, and their practical application to actuarial problems. In both CS1 and CS2, emphasis is placed on being able to apply statistical methods to actuarial problems using real data sets and the open-source software environment R. In designing these new subjects will enhance Actuarial Science for our student members through the development of transferable skills and enhanced employability.

Activities having direct bearing on Skill development/ Employability /Entrepreneurship:

Seminars, Assignments , Group Discussion, Quiz.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

Course Designer:

Dr. M. Revathi, Assistant Professor, Department of Statistics, The Madura College, Madurai.

Course Schedule

Unit	Topics	Hours	Mode
I	Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest.	2	PPT, Chalk Test, Quiz and Talk.
	Present value and accumulated values of fixed rate.	3	
	Accumulated values of fixed rate, varying rate of interest.	3	
	Tutorial	1	
II	Mortality: Gompertz - Makeham laws of mortality - life tables	3	PPT, Chalk and Talk, Test, Quiz and GD
	Annuities: Endowments, Annuities,	3	
	Accumulations, Assurances.	2	
	Tutorial	1	
III	Policy Values: Surrender values and paid up policies,	2	PPT, Chalk and Talk, quiz, Test
	Industrial assurances.	2	
	premiums.	2	
	Premiums-Simple problems.	2	
	Tutorial	1	
IV	Contingent Functions: Contingent probabilities, assurances.	2	PPT, Chalk and Talk, Quiz, Test
	Decrement tables. Pension funds: Capitalsums on retirement	3	
	Capital sums on retirement death, widow's pensions, benefits dependent on marriage.	3	
	Tutorial	1	
V	Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans.	4	Assignments, Seminar and Group Discussion, Quiz
	Level annual premium under temporary assurance.	4	
	Tutorial	1	
	Total Hours	45	

Course learning Outcomes

On the successful completion of the course, students will be able to

CLO #	Description	K- level
CLO 1	To explain the utility theory and insurance terminologies.	Upto K3
CLO 2	To articulate the insurance and annuity benefits through multiple life functions evaluation for specialmortality laws.	UptoK2
CLO 3	To describe the various types of premium and their numerical evaluations.	UptoK3
CLO 4	To describe Insurance payable at the moment of death and at the end of the year of death-level benefitinsurance.	UptoK4
CLO 5	To explain implementation of the Life insurance policies. To understand real life problems related to insurance.	UptoK3

Mapping of CLOs with POs

#	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7
CLO -1	3	3	2	3	3	2	-
CLO -2	3	3	3	3	3	2	-
CLO -3	3	3	3	3	3	2	-
CLO -4	3	3	3	3	3	2	-
CLO -5	3	2	2	3	3	2	-

Mapping of CLOs with PSOs

#	PSO -1	PSO -2	PSO -3	PSO -4	PSO -5
CLO -1	3	3	3	2	3
CLO -2	3	2	2	2	3
CLO -3	3	3	2	2	3
CLO -4	3	2	3	3	3
CLO -5	3	3	3	3	3

*Advance application– 3**Intermediate level–2**Basic level–1*

SUMMATIVE ASSESSMENT-BLUEPRINT

S.No.	CLOs	K-Level	Section A		Section B		Section C (Either /or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. Of questions	K-Level	No. Of questions	K- Level		
1	CLO1	UptoK3	2	K1&K2	1	K1	2(K2& K2)	1(K3)
2	CLO2	UptoK2	2	K1&K2	1	K1	2(K2&K2)	1(K2)
3	CLO3	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
4	CLO4	UptoK4	2	K1&K2	1	K2	2(K4& K4)	1(K4)
5	CLO5	UptoK3	2	K1&K2	1	K2	2(K3& K3)	1(K3)
No.of Questions to be asked			10		5		10	5
No.of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of section wise marks with K levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	-	-	09	7.50	41.67%
K2	5	6	20	10	41	34.16	
K3	-	-	20	30	50	41.67	41.67%
K4	-		10	10	20	16.67	16.66%
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS					CLASS: II B.Sc., STATISTICS			
Sem	Course type	Course code	Course title	Credits	Contact hours / Week	CIA	Ext	Total
IV	SEC	23U4SSEP5	STATISTICAL PRACTICAL – IV (Calculator Based)	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To make them understand the concept of testing of hypothesis.
- To classify hypothesis tests by type.
- To impart the knowledge on insurance related concepts to the students.
- To acquaint the student with the different aspects of life insurance.

S.No.	LIST OF PROBLEMS
1	Problems on Type I and Type II error.
2	Problems on Neyman – Pearson Lemma.
3	Problem on Chi-Square Test – Goodness of Fit.
4	Problem on Chi-Square Test – Independence of Attributes.
5	Problems on t – test with one sample.
6	Problems on t – test with two samples.
7	Problems on testing of hypothesis with variance known.
8	Problems on testing of hypothesis with variance unknown.
9	Problem on Sign Test.
10	Problem on Rank Sum test: The Mann Whitney U Test.
11	Problem on Kruskal Wallis – H Test.
12	Problem on Rank Correlation.
13	Computation of Simple and Compound Interest.
14	Computation of Present value and Accumulated value of Fixed Rate.
15	Computation of Annuities.
16	Problem on Contingent functions.
17	Problem on Contingent Probabilities.
18	Computation of Capital sums on retirement and death.
19	Calculation of Pure endowment, Whole life assurance.
20	Computation of Net premium for assurance.

Books for References:

1. Gupta.S.C and Kapoor.V.K (1991), “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons.
2. Gupta.S.P, “Statistical Methods”, Sultan Chand and sons.
3. Mathematical Basis for Life Insurance (IC – 81) (2000), Insurance Institute of India, Bombay.
4. Gupta.S.C and Kapoor.V.K (2007), “Fundamentals of Applied Statistics”, Sultan Chand and Sons, New Delhi.

Web Resources

1. <https://guides.jstor.org/mathstats>
2. <https://www.insuranceinstituteofindia.com>
3. <https://libertyinsurance.in>

Rationale for Nature of the course

Students will understand the concept of testing the statistical hypothesis through problem solving. They will be familiar with which test need to be applied for testing the samples from unknown distributions. By problem solving related to insurance, students will able to know the different aspects of insurance and its detailed features.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercises, Seminars, Assignments, Problem solving using calculator and Quiz.

Pedagogy

Lecture with PPT, Quiz, Tutorial.

Course Designer:

S. MEENAKSHI SELVARAJAN, Assistant Professor, Department of Statistics

Course Learning Outcomes:

At the end of the course, Students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Calculate Type I and Type II Error.	Upto K3
CLO2	Test the goodness of fit and the independence of attributes.	Upto K3
CLO3	Solve problems using Non – Parametric tests.	Upto K3
CLO4	Understand the concept of annuities in Insurance.	Upto K3
CLO5	Describe various types of Premium and their numerical evaluations.	Upto K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	1	2	1
CLO-2	2	1	1	2	1
CLO-3	2	1	1	2	1
CLO-4	2	1	1	2	1
CLO-5	2	1	1	2	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	1
CLO2	3	2	1	1	1	1
CLO3	3	2	2	1	1	1
CLO4	3	2	2	1	1	1
CLO5	3	1	2	2	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF STATISTICS					CLASS:II B.SC STATISTICS			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	SBE	23U4SSED7	BIOSTATISTICS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- To acquire idea to know methods , procedures for classifying and analyzing data for making inferences
- To understand the concepts of sampling statistics
- To impart the knowledge of application of statistical methods.

Unit	Description	Hours	K-level	CLO
I	Descriptive Methods for Categorical data: Proportions-Comparative Studies, Screening Tests, Displaying Proportions. Rates – Changes, Measures of Morbidity and Mortality, Standardization of Rates.	6	K2	1
II	Descriptive Methods for Categorical data(Continued): Ratios-Relative Risk, Odds and Odds Ratio, Generalized odds for Ordered 2xk Tables, Mantel- Haenszel Method, Standardized Mortality Ratio	6	K4	2
III	Logistic Regression: Multiple Regression Analysis-Polynomial Regression, Testing Hypotheses in Multiple Logistic Regression, Receiver Operating Characteristic Curve, ROC Curve and Logistic regression	6	K3	3
IV	Analysis of survival Data and Data from Matched Studies: Survival Data, Introductory Survival Analyses-Kaplan-Meier Curve, Comparison of Survival Distributions	6	K4	4
V	Study Designs: Types of Study Designs(Retrospective Studies, Prospective Studies, Cohort Studies, Clinical Trials), Classification of Clinical Trials, Designing Phase I Cancer Trials, Sample Size Determination for Phase II Trials and Surveys	6	K3	5

Books for study:

Introductory Biostatistics by CHAP T.LE, A JOHN WILEY & SONS PUBLICATION, 2003 Edition.

UNIT-I: Chapters: 1(1.1, 1.2)(page no.1 to 18)(Excluding Problems)

UNIT-II: Chapter: 1(1.3) (page no.19 to 31) (Excluding Problems)

UNIT-III: Chapter: 9(9.2.3, 9.2.4, 9.2.5, 9.2.6) (page no.328 to 339) (Excluding Problems)

UNIT-IV: Chapter: 11(11.1, 11.2) (page no.381 to 390) (Excluding Problems)

UNIT-V: Chapter: 12(12.1, 12.2, 12.3, 12.4) (page no.446 to 453) (Excluding Problems)

Books for References:

1. Introduction to Biostatistics - Dr. Pranab Kumar Banaerjee . - S.Chand & Company Ltd.
2. BIOSTATISTICS - P. Ramakrishnan - Saras Publication
3. Fundamentals Of Mathematical Statistics - S. C. Gupta, V.K Kapoor - 2002 Sultan Chand & Sons, New Delhi – Eleventh thoroughly revised edition.

Web Resources

1. https://onlinecourses.swayam2.ac.in/ugc19_ma03/preview
2. https://onlinecourses.nptel.ac.in/noc21_bt07/preview
3. <https://www.ibri.org.in/biostatisticsdistanc.html>
4. <https://www.statistics.com/courses/biostatistics-for-college-credit/>
5. <https://www.coursera.org/learn/biostatistics>

Rationale for Nature of the course

Biostatistics comprises the reasoning and methods for using data as evidence to address public health and biomedical question. It is an approach and set of tools for designing studies and for quantifying the resulting evidence, for quantifying what we believe, and for making decisions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

Prof. S.KRISHNA JAYANTHI, Assistant Professor, Department of Statistics, The Madura College (Autonomous-SF).

Course Schedule

Unit	Description	Contact Hours	Pedagogy
I	Descriptive Methods for Categorical data: Proportions-Comparative Studies, Screening Tests, Displaying Proportions	3	PPT, Chalk and Talk, Test, Quiz.
	Rates – Changes, Measures of Morbidity and Mortality, Standardization of Rates.	3	
II	Descriptive Methods for Categorical data(Continued): Ratios- Relative Risk, Odds and Odds Ratio	3	PPT, Chalk and Talk, Test, Quiz.
	Generalized odds for Ordered 2xk Tables, Mantel-Haenszel Method, Standardized Mortality Ratio	3	

III	Logistic Regression: Multiple Regression Analysis-Polynomial Regression, Testing Hypotheses in Multiple Logistic Regression	3	PPT, Chalkand Talk, Test, Quiz.
	Receiver Operating Characteristic Curve, ROC Curve and Logistic regression	3	
IV	Analysis of survival Data and Data from Matched Studies: Survival Data, Introductory Survival Analyses.	3	PPT, Chalkand Talk, Test, Quiz.
	Kaplan-Meier Curve, Comparison of Survival Distributions	3	
V	Study Designs: Types of Study Designs, Classification of Clinical Trials	3	PPT, Chalkand Talk, Test, Quiz, Assignment
	Designing Phase I Cancer Trials, Sample Size Determination for Phase II Trials and Surveys	3	
Total Hours		30	

Course Learning Outcomes:

At the end of the course, Students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To Understand the idea of Screening Tests.	Upto K2
CLO-2	To Analyze the concept of Odds and Odds Ratios	Upto K4
CLO-3	To Study the concepts of Receiver Operating Characteristic Curves	Upto K3
CLO-4	To Analyze the concept of Kaplan-Meier Curves	Upto K4
CLO-5	To Remember the basic concepts on Clinical Trials	Upto K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	2	1	2	3	3
CLO-2	2	1	2	3	3
CLO-3	1	1	2	3	3
CLO-4	1	1	2	3	2
CLO-5	1	1	2	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	-	2	2	2
CLO2	3	3	-	2	2	2
CLO3	3	2	-	2	2	2
CLO4	2	2	2	2	1	2
CLO5	2	2	2	2	1	2

Basic level-1

Intermediate level-2;

Advance application- 3

Summative - Blue – Print – Model

Sl. No	CLO s	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K Level	No. of Questions	K Level		
1	CLO 1	Up to K2	2	K1& K2	1	K1	2(K1& K1)	1(K2)
2	CLO 2	Up to K4	2	K1& K2	1	K1	2(K4& K4)	1(K3)
3	CLO 3	Up to K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
4	CLO 4	Up to K4	2	K1& K2	1	K2	2(K2& K2)	1(K4)
5	CLO 5	Up to K3	2	K1& K2	1	K2	2(K3& K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

(Mapping with Course Learning Outcomes (CLOs))

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No choice)	Section B (No choice)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.66	42%
K4	-	-	10	10	20	16.66	16%
Total marks	10	10	50	50	120	100	100%

Department: Statistics				Class: II B.Sc., Statistics				
Semester	Course Type	Course Code	Course Title	Credits	Hours	CIA	External Exam	Total
III	Add on Course	-	Statistics for Big Data	2	30	50	50	100

Course Objectives: The main objectives of this course are to:

1. Know the types of Data
2. Know the Data science
3. Know the big Data technology Expected

Course Outcomes: On the successful completion of the course, student will be able to:

1. Understand the different types of Data
2. Understand the relation between Data science and statistics
3. Know Evolution of Big Data, Sources of Big Data and Big Data Exploration

UNIT I	Introducing Big Data Statistics-Characteristics of Big Data-Exploratory Data Analysis-Statistical Analysis of Big Data- Probability Distributions-Regression Analysis-Time series Analysis.
UNIT II	Characteristics of Big Data-Volume-Velocity-Variety-DBMS.
UNIT III	Using Big Data: The Hot Applications- Big Data and weather Forecasting- Big Data and Health care services- Big Data and Insurance- Big Data and Finance- Big Data and Electric Utilities- Big Data and Higher Education- Big Data and Social media.
UNIT IV	Understanding Probabilities-The core structure: Probability spaces-Discrete Probability distributions-Continuous Probability distributions- Introducing Multivariate probability distributions.
UNIT V	Basic Statistical Ideas- Some preliminaries regarding Data-Summary statistical measures- Overview of Hypothesis Testing- Higher order measures.

Books for Study:

Statistics for Big Data for Dummies by Alan Anderson Ph.D, with David Semmelroth published by John Wiley and sons, 2015, New Jersey.

Chapters : 1,2,3,4,5

Books for Reference:

1. Mayer- Schonberger, V., and Cukier, K. (2013). Big Data: A Revolution that will Transform How We Live Work and Think, Hodder And Stoughton (Publisher)
2. Hu, H., Wen, Y., Chua, T. S., Li, X. (2014). Toward Scalable Systems for Big Data Analytics: A Technology Tutorial, IEEE.

Web Resources:

1. <https://www.toolsqa.com/sql/Data-Database-and-Database-management-system>
2. <https://priceonomics.com/whats-the-difference-between-Data-science-and-Statistics>
3. <https://www.techrepublic.com/blog/big-Data-analytics/the-role-of-the-Data-scientist-in-bigData>

Internal Components (CIA): 50 Marks

Component	Allocation	Suggestive evaluation types (Any one Option)
I	15%	Periodic Assignments (3 Nos./Mini Project/Case Studies
II	15%	Paper Presentation/Group Discussion/Criticism of a Book /Oratorical Skill
III	20%	Quiz/Viva-Voce (Related to the Paper)/Innovative Experiment Modeling
Total	50%	

External Components: 50 Marks**Part – A (Multiple Choice Questions, 10 X 1 = 10 Marks)****Part – B (Answer any Four Questions out of Seven Questions, 4 X 10 = 40 Marks).****Course Designer:**

Dr. M. REVATHI, Assistant Professor, Department of Statistics.

Department: Statistics			Class: II B.Sc., Statistics					
Semester	Course Type	Course Code	Course Title	Credits	Hrs	CIA	Ext	Total
IV	Add on course	-	Combinatorics	2	30	50	50	100

Learning Objectives

- To impart the knowledge of counting principles which is essential for the students to think critically and apply it in real – world problems.
- To acquire the knowledge Lattices and its applications.

Learning Outcomes

After successful completion of this course, the students will be able to

- Solve counting problems by applying elementary counting techniques using the sum and product rules, permutations, combinations, and pigeonhole principle.
- Apply the ideas of permutation and Combinations, Combinatorial number theory in various real life situations.

UNIT I Techniques of Counting

Basic Counting Principle – Sum rule principle and product rule principle – Mathematical Function - Factorial notation – Binomial coefficient – Binomial coefficient and Pascal's triangle – Binomial Theorem.

UNIT II Permutations and Combinations

Permutations - Permutations with Repetitions – Ordered Samples – Sampling with replacement - Sampling without replacement – Combinations - Combinations with Repetitions - The Pigeonhole principle – Problems.

UNIT III Ordered partitions

Ordered partitions and Unordered partitions – The inclusion - Exclusion principle – The inclusion - Exclusion principle Revisited - Number of onto function – Derangements - Tree diagrams – Problems.

UNIT IV Ordered sets

Ordered sets – Dual order – ordered subsets – Quasi order – Comparability and linearly ordered sets – Product sets and order - Hasse Diagrams of partially ordered sets – Consistent enumeration – Supremum and infimum – Isomorphic ordered sets – Well-ordered sets – Problems.

UNIT V Lattices

Lattices – Axioms Defining a Lattice – Duality and the Idempotent law – Lattices and order – Sublattices, Isomorphic lattices - Bounded Lattices – Distributive Lattices – Complements and complemented Lattices – Problems.

Text Book:

1. Seymour Lipschutz and Marc Lars Lipson, Discrete Mathematics (Schaum's Outlines), 3rd Edition. Tata McGraw Hill Third Reprint.
Unit I : Chapter 5 (5.2, 5.3)
Unit II : Chapter 5 (5.4, 5.5, 5.6), Chapter 6 (6.2)
Unit III : Chapter 5 (5.7, 5.8), Chapter 6 (6.3, 6.4)
Unit IV : Chapter 14 (14.2, 14.3, 14.4, 14.5, 14.6, 14.7)
Unit V : Chapter 14 (14.8, 14.9, 14.10, 14.11)

Book for References:

1. V.K. Balakrishnan, Combinatorics, Schaum's Outlines, 1995.
2. Dr. M.K. Venkataraman, Dr. N. Sridharan and N. Chadrasekaran, Discrete Mathematics, Reprint September 2007. The National Publishing Company.
3. K.H. Rosen: Discrete Mathematics and its applications. 5th edition. Tata McGraw Hill.

Internal Components (CIA): 50 Marks

Component	Allocation	Suggestive evaluation types (Any one Option)
I	15%	Periodic Assignments (3 Nos./Mini Project/Case Studies)
II	15%	Paper Presentation/Group Discussion/Criticism of a Book/Oratorical Skill
III	20%	Quiz/Viva-Voce (Related to the Paper)/Innovative Experiment Modeling
Total	50%	

External Components : 50 Marks

Part – A (Multiple Choice Questions, 10 x 1 =10 Marks).

Part – B (Answers any Four Questions out of Seven Questions 4 x 10 = 40 Marks).

Course Designer:

1. Dr.R. Chitra, Assistant Professor, Department of Statistics.
2. Ms. G.K. Lakshmi, Assistant Professor, Department of Statistics.

DEPARTMENT OF STATISTICS				CLASS: II B.Sc., STATISTICS				
Semester	Course Type	Course Code	Course Title	Credits	Hrs	CIA	Ext	Total
III & IV	Self Study		Time Series Analysis	2		50	50	100

Unit -I Utility of Time Series

Introduction to time series Data – Meaning – Application of time series –Analysis – Recording – Comparison – Evaluation – Forecasting – Dissection of Data – Preparation of Data Analysis – Period Coverage – Population Changes – Price Changes – Data Comparability.

Unit - II Components of Time Series

Introduction – Secular Variations or Trend – Seasonal Variations – Cyclical Variations – Irregular or Erratic Variations – Decomposition of time series data – Models – Additive model – Multiplicative model – Mixed model.

Unit - III Methods of finding Trend

Introduction – Graphic method – Statistical method – Selected points method – Semi average method – Algebraic methods – Linear Trends -Fitting a straight line for odd number of years – Fitting a straight line for even numbers of years – Non linear Trend – Second degree parabola – Geometric Trend – Exponential Trend – Growth Curves.

Unit IV (Measurement of Seasonal Variations)

Introduction – Method of Simple Averages – Ratio to Trend method - Method of Moving averages –Specific Seasonal index and typical Seasonal index – Method of link relatives – De-seasonalisation of data.

Unit V (Measurement of Cyclical Variations)

Introduction – Cyclical variations – Direct percentage variation – Fitting of a sine function – Reference cycle analysis – Regular variations - Irregular variations.

Books for Reference:

1. **“Statistics (Theory, Methods & Application)”** by D.C. Sancheti and V.K. Kapoor, Revised seventh edition (Reprint 2019), Sultan Chand & Sons Publishers New Delhi.
2. **“The Analysis of Time Series: An Introduction”** by Chris Chatfield, 1980 sixth edition, Chapman & Hall.
3. **“Applied Statistics”** by Mukhopadhyay P. Second edition, Reprint 2011.
4. **“Time Series”** by Kendall M.G., 1976, Charles Griffin.
5. **“Time Series Analysis”** by James Douglas Hamilton, 1994.

Course Designer(s):

1. Prof. N.SRIVIVEKA SARATHA, Assistant Professor, Department of Mathematics and Statistics.
2. Prof. B. SEETHALAKSHMI, Assistant Professor, Department of Mathematics and Statistics.



The Madura College (Autonomous), Madurai – 625 011

Department of Statistics

UG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
I	23U1SCCT1	Descriptive Statistics	4	4	Y		Y			Y	55.71% Revised
	23U1SCCT2	Probability Theory	4	4	Y		Y				20.45% No change
	23U1SGET1	Statistical Methods and its Applications -I	6	5	Y		Y				New
	23U1SSEN1	Statistical Practical –I (Calculator based)	2	2	Y	Y	Y	Y			New
	23U1SFCT1	Bridge Statistics	2	2	Y		Y		Y		New
II	23U2SCCT3	Matrix and Linear Algebra	4	4	Y		Y			Y	52.9% Revised
	23U2SCCT4	Distribution Theory	4	4	Y	Y	Y			Y	0% No change
	23U2SGET2	Statistical Methods and its Applications -II	6	5	Y	Y	Y			Y	New

	23U2SSEP2	Statistical Practical – II (Calculator based)	2	2	Y		Y			Y	New
	23U2SSEP3	Lab Practical in R	2	2	Y	Y	Y			Y	20% Revised
III	23U3SCCT5	Estimation Theory	4	4	Y		Y			Y	No Change
	23U3SCCT6	Sampling techniques	3	3	Y	Y	Y		Y		25% Revised
	23U3SSEP4	Statistical Practical –III (Calculator based)	2	2	Y	Y	Y		Y		New
	23U3SSED5	Database Management System	2	2	Y		Y			Y	New
	23U3EVST1	EVS-I	1	-							
		Add on Course – Statistics for Big Data			Y	Y	Y			Y	No change
IV	23U4SCCT7	Testing of statistical hypothesis	4	4	Y	Y	Y			Y	46.67 % Revised
	23U4SCCT8	Actuarial statistics	3	3	Y	Y	Y		Y		New
	23U4SSEP5	Statistical Practical – IV(Calculator based)	2	2	Y	Y	Y	Y			New
	23U4SSED7	Biostatistics	2	2	Y		Y	Y			New
	23U4EVST2	EVS-II	1	2							
		Add on Course – Combinatorics			Y	Y	Y			Y	No change

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development

DEPARTMENT OF STATISTICS							
Course type	Course code	Course title	Credits	Contact hours	CIA	Ext	Total
Certificate course	-	Official Statistics	2	30	50	50	100

Learning Objectives:

The main objectives of this course are to:

- Know the population and agricultural statistics.
- Understand industrial statistics and price statistics.
- Know the National sample survey.

Learning Outcomes:

- Understand Indian official statistics and offices related to it.
- Understand Indian surveys for collecting official statistics.
- Know uses of index number and know demand analysis and its need.
- To understand economic India by knowing agricultural and economic surveys.

UNIT – I

Population Statistics: Statistical organization – Population Statistics – Agricultural Statistics – Indices of Agricultural production – Miscellaneous Agricultural Statistics.

UNIT – II

Industrial statistics – ASI – Indices of Industrial Production and profits.

UNIT - III

Price statistics – Price index numbers – Labour statistics; Index number of Retail prices – Indices of security price

Unit – IV

Wage statistics – trade statistics – Financial statistics – National income statistics.

Unit – V

National sample surveys – Activities and publications of CSO and the Department of Statistics, Government of Tamil Nadu. National Income compilation.

Books for References:

1. Central Statistical Organisation, Guide to Official Statistics 1979 Ed , Department of Statistics, Ministry of Planning, India
2. Gupta S.C. and Kapoor V.K. (2007) :Fundamentals of Applied Statistics , 4th edition ,Sultan Chand & Sons Publishers, New Delhi.
3. Gupta S.P. (2011): Statistical Methods, Sultan Chand & Sons Publishers, New Delhi.
4. Spyros Makridakis, Steven C. Wheelwright and Rob J .Hyndman (2003): Forecasting Methods and

5. Applications, 3rd Edition, John Wiley and Sons Inc.
6. Websites of Government of India – Ministry of Statistics & Programme Implementation

Web Resources

1. <https://agriculture.uk.gov.in/pages/show/221-agriculture-statistics-Data>
2. <http://labourbureau.gov.in/CPIW05%20Methodolgy.html>
3. <https://byjus.com/free-ias-prep/nssso>

Course Designer(s):

1. Dr. B.SEETHALAKSHMI , Assistant Professor, Department of Mathematics & Statistics.
2. Prof. S.MEENAKSHI , Assistant Professor, Department of Mathematics & Statistics.



THE MADURA COLLEGE, MADURAI

DEPARTMENT OF STATISTICS

Programme Outcomes

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes (PSOs)

PSO1 – Placement: To prepare the students who will demonstrate respectful engagement with others' ideas, behaviours, beliefs and apply diverse frames of reference to decisions and actions.

PSO 2 – Entrepreneur: To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

PSO3 – Research and Development: Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.

PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit.

Eligibility criteria for Admission

A candidate who has acquired B.Sc., degree in Statistics or B.Sc., degree in Mathematics shall permit to join the course.

Duration of the Course

The students shall undergo prescribed course of study for the period of two academic years under CBCS semester pattern with outcome based education.

Medium of Instruction: English

System: Choice Based Credit System with Outcome Based Model

Courses of Study with Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
Part A	12	14	19	17	62
Part B					
(i) Discipline – Centric / Generic Skill	6	6	3	3	18
(ii) Skill Enhancement	2	2	2	2	10
(iii) Summer Internship / Industrial Training			2		
Part C				1	1
Total	20	22	26	23	91

Nature of the Course

Courses are classified according to the following nature

- Skill Oriented
- Employability Oriented
- Entrepreneurship Oriented

Teaching & Evaluation Pattern

- Outcome Based Education (OBE) & Assessment
- This curriculum is designed based on Tamilnadu State Council for Higher Education (TANSCH) State Integrated Board of Studies and UGC.
- Students understanding must be built on and assessed for wide range of learning activities, which includes different approaches and are classified along several bases, such as

Based on Purpose

- **Formative** (Internal tests, Assignment, Seminar, Quiz, ICT based Assignment etc.)
- **Summative** (Evaluation of students learning at the end of instructional unit)
- **Based on Domain knowledge: (Post Graduate Up to K4 Levels)**
- Assessment through K1, K2, K3, K4

Evaluation

Methods	Marks
Formative (CIA)	25
Summative (External)	75
Total	100

Formative Test (CIA-Continuous Internal Assessment): 25 Marks

- Centralised system of Internal Assessment Tests
- There will be a two internal assessment tests
- Duration of Internal assessment test will be 1 hour
- Students shall write retest on the genuine grounds if they are absent in either Test I or Test II with the approval of HoD and the Principal.

Question Paper Pattern for Formative Test

Section	Question pattern	Marks
A	Short answer (2 X 2 ½ marks)	5
B	Either / Or type (2 X 5 marks)	10
C	Open choice type (1 out of 2 X 10 marks)	10
Total		25

The blue print for the internal test will be as follows.

Pattern	No. of questions	Marks per question	Total marks
Part A (Short answer type - no choice)	2	2 ½	5
Part B (Paragraph answer type - Either-or)	2	5	10
Part C (Essay type - open choice – one question to be answered out of 2 question asked)	½	10	5
Total marks		25	

- K1- Remembering and recalling facts with specific answers
- K2- Basic understanding of facts and stating main ideas with general answers
- K3- Application oriented- Solving Problems
- K4- Examining, analyzing, presentation and make inferences with evidences

✓ For the purpose of Formative assessment (CIA), the course teacher may decide the CLO for the two tests as per the following conditions.

- Any two CLOs shall be considered for the first test.
- Two CLOs (other than those already considered for the first test) shall be considered for the second test.
- The remaining CLO may be considered for assignment

Question Paper Pattern for Summative Examination

Section	Question pattern	Marks
A	Multiple choice (10 X 1 marks)	10
B	Short answer (5 X 2 marks)	10
C	Either / Or type (5 X 5 marks)	25
D	Open choice type (3 out of 5 X 10 marks)	30
Total		75

In respect of external examinations passing minimum is 45% for PG Courses and in total, aggregate of 50%. The curriculum is revised to suit the changing trends by propagation of ideas ensuring professional growth through innovative method of teaching.

Evaluation Pattern for Practical Papers

I) Continuous Internal Assessment: 40 Marks

Internal Components	Marks
Internal test	30
Observation	10
Total	40

II). External Assessment: 60 Marks (50 marks – practical + 10 marks – viva)**Total marks (I + II): 100 Marks****M.Sc. Statistics - II Year – Third Semester**

List of Courses	Course Code	Credit	Hours
Core-VII (Testing of Statistical Hypothesis)	23P3SCCT7	5	6 (5L + 1T)
Core-VIII (Linear Models)	23P3SCCT8	5	6 (5L + 1T)
Core-IX (Multivariate Analysis)	23P3SCCT9	4	6 (5L + 1T)
Core-X (Design of Experiments)	23P3SCCT10	3	5 (4L + 1T)
MDC (Operations Research and Cost Analysis)	23P3SMDC1	3	5 (5L)
Skill Enhancement Course-II (NME) (Elements of Operations Research)	23P3SSEN2	2	2
Internship / Industrial activity [credits]	23P3SINTR	2	-
Total		24	30

Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

Course Type	CC7	CC8	CC9	CC10	MDC	NME-II
Course Title	Testing of Statistical Hypothesis	Linear Models	Multivariate Analysis	Design of Experiments	Operations Research and Cost Analysis	Elements of Operations Research
PSO1	3	3	3	2	3	2
PSO2	2	3	3	2	3	2
PSO3	2	3	3	3	3	3
PSO4	3	2	2	2	3	2
PSO5	2	2	2	3	2	3

DEPARTMENT OF STATISTICS				Class: II M.Sc. Statistics				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	CORE	23P3SCCT7	Testing of Statistical Hypothesis	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To get theoretical knowledge in Statistical Testing procedure
- To provide knowledge about Most Powerful test and how to build it
- To understand concepts Unbiasedness for hypotheses testing, invariance, Likelihood Ratio tests and SPRT test
- To develop analytical thinking in statistical testing of hypothesis

Unit	Description	Hours	K-level	CLO
I	Uniformly most powerful tests, the Neyman-Pearson fundamental Lemma, Distributions with monotone likelihood ratio Problems, two sided hypotheses, testing the mean and variance of a normal distribution.	17	Up to K2	CLO 1
II	Generalization of the fundamental lemma, locally most powerful tests, UMP unbiased tests for multi parameter exponential families, likelihood ratio test.	18	Up to K3	CLO2
III	Unbiasedness for hypotheses testing, similar and completeness, comparing two Poisson or Binomial populations, testing the parameters of a normal distribution (unbiased tests), comparing the mean and variance of two normal distributions.	20	Up to K4	CLO 3
IV	Symmetry and invariance, maximal invariance, most powerful invariant tests, non-parametric tests.	15	Up to K3	CLO4
V	SPRT procedures, OC and ASN functions of SPRT and their derivation, Optimum properties of SPRT.	20	Up to K4	CLO 5

Books for study:

1. M.Rajagopalan, P.Dhanavanthan(2012): Statistical Inference, PHI Learning Pvt. Ltd., New Delhi.
2. V.K.Rohatgi et.al., (2002):An introduction to probability and statistics, John Wiley.
3. Lehmann,E.L.(1986):Testing of statistical hypothesis, John Wiley.

Books for References:

1. Ferguson,T.S.(1967):Mathematical Statistics, A decision theoretic approach, Academic press.
2. Rao,C.R.(1973):Linear statistical inference and its applications, Wiley Eastern, 2nd ed.
3. Gibbons, J.D. (1971) : Non-parametric statistical inference, McGrawHill.

Web Resources:

1. <https://online.stat.psu.edu/stat415/lesson/26/26.1>
2. <https://pages.stat.wisc.edu/~shao/stat710/stat710-14.pdf>
3. <https://www.ncl.ac.uk/webtemplate/ask-assets/external/maths-resources/statistics/hypothesis-testing/hypothesis-testing-with-the-normal-distribution.html>
4. <https://web.stanford.edu/~lmackey/stats300a/doc/stats300a-fall15-lecture17.pdf>
5. <https://www.statisticshowto.com/sequential-probability-ratio-test/>

Rationale for Nature of the course

This course enables the students to gain in-depth theoretical and applied knowledge on statistical hypothesis by measuring and examining a random sample of the population with different test.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Seminars / Assignments on different test based with testing of statistical hypothesis

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem Solving

Course Designer(s):

1. **Dr. A. Saberunnisa**

Course Schedule

Unit	Topics	Hours	Mode
I	Uniformly most powerful tests	4	Chalk & Talk, Test, Quiz, Seminar
	The Neyman-Pearson fundamental Lemma	4	
	Distributions with monotone likelihood ratio Problems	3	
	Two sided hypotheses	3	
	Testing the mean and variance of a normal distribution.	3	
II	Generalization of the fundamental lemma	5	Chalk & Talk, Test, Quiz, Seminar
	locally most powerful tests	4	
	UMP unbiased tests for multi parameter exponential families	5	
	likelihood ratio test	4	
III	Unbiasedness for hypothesis testing	4	Chalk & Talk, Test, Quiz, Seminar
	Similar and completeness	4	
	comparing two Poisson or Binomial populations	4	
	Testing the parameters of a normal distribution(unbiased tests)	4	
	Comparing the mean and variance of two normal distributions	4	
IV	Symmetry and invariance	4	Chalk & Talk, Test, Quiz, Seminar
	Maximal invariance	4	
	Most powerful invariant tests	4	
	Non-parametric tests	3	
V	SPRT procedures	5	Chalk & Talk, Quiz, Seminar Assignment
	OC and ASN functions of SPRT and their derivation	5	
	Optimum properties of SPRT	5	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand Most Powerful test for randomized and two sided hypotheses.	Up to K2
CLO2	Model most powerful tests and Likelihood ratio test	Up to K3
CLO3	Evaluate unbiasedness, Similar and completeness	Up to K4
CLO4	Apply invariance and Non-parametric tests	Up to K3
CLO5	Analyze SPRT procedures	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	2	3	3	3	2
CLO3	3	3	3	2	3
CLO4	3	3	3	3	3
CLO5	3	2	3	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Upto K2	2	K1&K1	1	K1	2(K1 &K1)	1(K2)
2	CLO2	Upto K3	2	K2&K3	1	K1	2(K2 &K2)	1(K3)
3	CLO3	Upto K4	2	K2&K3	1	K2	2(K4 &K4)	1(K4)
4	CLO4	Upto K3	2	K3&K4	1	K2	2(K3 &K3)	1(K3)
5	CLO5	Upto K4	2	K3&K4	1	K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	CORE	23P3SCCT8	LINEAR MODELS	4	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To model cross sectional data using minimum number of parameters
- To estimate unbiased estimators for model parameters
- To estimate standard errors of estimates to construct the confidence intervals.
- To test the goodness of fit of the models

Unit	Description	Hours	K-level	CLO
I	Linear Models – Classification, Estimability. The General Linear Hypothesis of Full Rank – Point Estimation (Estimation Under Normal Theory) – Gauss–Markov theorem, Tests of Hypothesis – Testing the Hypothesis $\beta = \beta^*$.	16	Up to K3	1
II	Introduction to Generalized Linear Models: Components of Generalized Linear Model, Binomial Logit Model, Poisson Log linear Model, Deviance, Linear Probability Model, Logistic Regression Model, Probit and Inverse CDF Link Function, GLM for Counts, Inference for GLM, Deviance and Goodness of Fit, Deviance for Poisson and Binomial Models.	20	Up to K3	2
III	Methods of Estimations – ordinary least squares, generalized least square, maximize likelihood, BLUE.	20	Up to K4	3
IV	General Linear Hypothesis – four common hypotheses – reduced models – null model – saturated model.	15	Up to K4	4
V	Regression and dummy variables – grouped variables – unbalanced data - describing linear models- 1-way classification, 2- way classification, 3-way classification – main and interaction effects - Models not of full rank.	19	Up to K2	5

Books for study:

1. S.R. Searle, Linear Models, John Wiley, 1971.

Books for References:

1. Alan Agresti, (2002): Categorical Data Analysis, WileyInterscience, John Wiley& Sons
2. Radhakrishna Rao, "Linear Statistical Inference and its Applications" Wiley- Inter-science

Web Resources

1. Categorical Data Analysis
<https://mybiostats.files.wordpress.com/2015/03/3rd-ed-alan-agresti-categorical-data-analysis.pdf>
2. Generalized Linear Hypothesis
<https://home.iitk.ac.in/~shalab/anova/chapter2-anova-general-linear-hypothesis.pdf>
3. Linear Statistical Inference and its Applications
https://books.google.com.gi/books?id=gKXYxdw-24YC&printsec=frontcover&source=gbs_vpt_read#v=onepage&q&f=false

Rationale for Nature of the course

This course enables to understand the linear model building with the proper assumptions and able to apply for the real world problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Real time situation based problems will be given as assignment.

Pedagogy

Chalk & Talk with PPT, Assignment, Seminar and Quiz

Course Designer(s):

1. **Dr. M. Venkateswaran**

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Linear Models – Classification, Estimability	3	Chalk & Talk, Test, Quiz, Seminar
	The General Linear Hypothesis of Full Rank	3	
	Point Estimation (Estimation Under Normal Theory)	3	
	Gauss–Markov theorem	3	
	Tests of Hypothesis – Testing the Hypothesis $\beta = \beta^*$.	4	
Unit II	Introduction to Generalized Linear Models: Components of Generalized Linear Model	3	Chalk & Talk, Test, Quiz, Seminar
	Binomial Logit Model, Poisson Loglinear Model Deviance	3	
	Linear Probability Model, Logistic Regression Model Probit and Inverse CDF Link Function	6	
	GLM for Counts, Inference for GLM, Deviance and Goodness of Fit,	4	
	Deviance for Poisson and Binomial Models.	4	
Unit III	Methods of Estimations	4	Chalk & Talk, Test, Quiz, Seminar
	ordinary least squares	5	
	generalized least square	5	
	maximize likelihood	3	
	BLUE	4	
Unit IV	General Linear Hypothesis	4	Chalk & Talk, Test, Quiz, Seminar
	four common hypotheses	3	
	reduced models and null model	4	
	saturated model	4	
Unit V	Regression and dummy variables – grouped variables – unbalanced data - describing linear models- -	7	Chalk & Talk, Quiz, Seminar Assignment
	1-way classification, 2- way classification, 3-way classification – main and interaction effects	7	
	Models not of full rank.	5	

Course Learning Outcomes:

At the end of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand about statistical modelling	Up to K2
CLO2	model the given cross sectional data	Up to K3
CLO3	evaluate the model	Up to K3
CLO4	Interpret the model based on the variables involved	Up to K4
CLO5	predict using fitted model	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	3	3	3	3
CLO2	2	3	3	2	2	2
CLO3	3	2	3	3	3	2
CLO4	3	3	3	3	2	2
CLO5	3	2	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
2	CLO2	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
3	CLO3	Upto K4	2	K3 & K4	1	K1	2(K4 & K4)	1(K4)
4	CLO4	Upto K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO5	Upto K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	CORE	23P3SCCT9	Multivariate Analysis	5	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

The main Course Objectives are:

1. To impart basic theoretical knowledge about multivariate normal distribution, and its properties to deal with multi-dimension data.
2. To derive inference based on multi-variate statistical analysis concerning Mean vector and Covariance matrix.
3. To provide requisite knowledge to handle multi-dimensional data about dimensionality reduction using Principal Component and Factor Analysis. To imbibe skills to classify and assign a new item/object to any of the two or more populations using Discrimination and Classification.
4. To Instruct theoretical knowledge to group variables or items belonging to multi-dimensional data using the Cluster algorithm.

Unit	Description	Hours	K-Level	CLO(s)
1	Multivariate Normal Distribution and Its Properties. Maximum Likelihood Estimators of Parameters, Distribution of Sample Mean Vector, Sample Dispersion Matrix.	19	Up to K3	1
2	Partial and multiple correlation coefficients - Null distribution - Application in testing. Null distribution of Hotelling's T2 statistics. Application in tests on mean vectors for one or more multivariate normal populations and equality of the components of a mean vector in a multivariate normal population.	23	Up to K3	2
3	Classification and discrimination procedures for discrimination between two multivariate normal populations – Linear Discriminant function, Mahalanobis Distance, tests associated with Discriminant functions, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations.	19	Up to K2	3
4	Principal component analysis, Canonical correlation analysis – Extraction of canonical correlation and their variables	14	Up to K4	4

5	Clustering - similarity measures- hierarchical algorithms- Single Linkage, Non-hierarchical Clustering– Interpretation of canonical variables.	15	Up to K4	5

Books for Study:

1. Anderson, T. W (2003). An Introduction to Multivariate Statistical Analysis (Third Edition), Wiley and Sons, New Jersey.
2. Johnson, R.A. and D.W. Wichern. (2013). Applied Multivariate Statistical Analysis (Sixth Edition), Pearson New International Edition.

Books for references:

1. Brain S. Everitt and Graham Dunn (2001): Applied Multivariate Data Analysis, 2ndEd. (chap 4).
2. Neil H.Timm (2002): Applied Multivariate Analysis – Springer-Verlag.
3. Dallas E.Johnson (1998) : Applied Multivariate Methods For Data Analysts- Duxbury Press.
4. William R Dillon and Mathew Goldstein (1984): Multivariate Analysis Methods and Applications, John Wiley.

Web Resources:

1. Multivariate Statistical Analysis
<https://nptel.ac.in/courses/111/104/111104024/>
2. **Multivariate Normal Distribution**
<https://www.mygreatlearning.com/blog/introduction-to-multivariate-analysis/>
3. **Principal Component and Factor Analysis**
<https://www.sartorius.com/en/knowledge/science-snippets/what-is-principal-component-analysis-pca-and-how-it-is-used-507186>
<https://towardsdatascience.com/a-one-stop-shop-for-principal-component-analysis-5582fb7e0a9c>
4. **Cluster Analysis**
<http://www.stat.columbia.edu/~madigan/W2025/notes/clustering.pdf>

Rationale for Nature of the course

This course will empower the students to understand the theoretical and applied concepts of multivariate statistical analysis. Students identify the most appropriate statistical techniques for a multivariate dataset, apply it and interpret the results.

Activates having direct bearing on skill development / employability / entrepreneurship

Data collection, real time problems related to multivariate data analysis will be given.

Pedagogy: Chalk and Talk, PPT, Assignments, Seminar, Problem solving.

Course Designer:

1. **Dr. R. Madhanagopal**

Course Schedule

Unit	Topics	Hours	Mode
I	Multivariate Normal Distribution and Its Properties	6	Chalk & Talk, Test, Quiz, Seminar
	Maximum Likelihood Estimators of Parameters	6	
	Distribution of Sample Mean Vector	4	
	Sample Dispersion Matrix	3	
II	Partial and multiple correlation coefficients	6	Chalk & Talk, Test, Quiz, Seminar
	Null distribution - Application in testing	5	
	Null distribution of Hotelling's T ² statistics	4	
	Application in tests on mean vectors for one or more multivariate normal populations.	4	
	Equality of the components of a mean vector in a multivariate normal population.	4	
III	Classification and discrimination procedures for discrimination between two multivariate normal populations	5	Chalk & Talk, Test, Quiz, Seminar
	Linear Discriminant function	4	
	Mahalanobis Distance	2	
	Tests associated with Discriminant functions	3	
	Probabilities of misclassification and their estimation	2	
	Classification into more than two multivariate normal populations.	3	
IV	Principal component analysis	6	Chalk & Talk, Test, Quiz, Seminar
	Canonical correlation analysis	3	
	Extraction of canonical correlation and their variables	3	
	Interpretation of canonical variables.	2	
V	Clustering - similarity measures	5	Chalk & Talk, Quiz, Seminar Assignment
	hierarchical algorithms- Single, Complete and Average Linkage,	6	
	Non-hierarchical Clustering – K Means.	4	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	K-Level
CLO-1	Explain and interpret the importance of data that come from high dimensional setup using appropriate properties.	Upto K3
CLO-2	Draw inferences based on multi-variate statistical analysis concerning the Mean vector and covariance matrix.	Upto K3
CLO-3	Classify and assign a new item/object to any of the two or more populations using discrimination and classification.	Upto K2
CLO-4	Reduce dimensions and identify factors from multi-dimensional data using principal components and group variables or items that belong to multi-dimensional data using cluster algorithms.	Upto K4
CLO-5	proficient in canonical correlation Analysis, demonstrating the ability to extract canonical correlations, interpret canonical variables, and apply these techniques to multivariate datasets	Upto K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	2	2	3
CLO3	3	3	3	2	3	3
CLO4	3	3	3	3	3	3
CLO5	3	2	3	S	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of questions	K Level	No. of questions	K level		
1	CLO 1	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
2	CLO 2	Upto K3	2	K2 & K3	1	K2	2(K2 & K3)	1(K3)
3	CLO 3	Upto K2	2	K3 & K4	1	K1	2(K4 & K4)	1(K4)
4	CLO 4	Upto K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
5	CLO 5	Upto K4	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

Distribution of Section wise marks with K levels for summative Examination

K Levels	Section A MCQs	Section B (Short Answers)	Section C (Either/or)	Section D (Open choice)	Total marks	% of marks without choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
K5	-	-	-	-	-	-	-
Total marks	10	10	50	50	120	100	100%

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
III	CORE	23P3SCCT10	Design of Experiments	4	5	25	75	100

Nature of Course						
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented		

Objectives:

- To get theoretical knowledge in Statistical Design of Experiments and Analysis of Variance.
- To build strong theoretical foundation in Orthogonal Latin squares, Hyper Graeco Latin squares, factorial and fraction al factorial experiments, PIBD, inter and intra blocks, split plot, analysis covariance, Response surface methodology.
- To develop analytical thinking in problem solving skills.

Unit	Description	Hours	K-level	CLO
I	Review of basic designs; Orthogonal latin squares, Hyper Graeco Latin squares – Analysis of Variance – multiple comparisons –multiple range tests-Missing plot technique.	15	Up to K2	1
II	General factorial experiments, study of 2 and 3 factorial experiments in randomized blocks; complete and partial confounding; Fractional designs for symmetric factorials; basic idea of asymmetric factorials	15	Up to K3	2
III	General block design and its information matrix (C),criteria for connectedness, balanced and orthogonality; BIBD– recovery of inter block information; PBIBD(2).-Association scheme, Intra block analysis, Lattice Design –analysis; Youden design– intra block analysis;	17	Up to K3	3
IV	Nested and split plot designs–Two stage nested designs, split plot designs, split-split plot designs, strip-split designs, Analysis of covariance with one, two covariates; clinical trials.	15	Up to K4	4
V	Response surface methodology-first order and second order rotatable designs, applications:	13	Up to K4	5

Books for study:

1. Das, M.N. and Giri, N. (1979): Design and analysis of experiments, Wiley Eastern.
2. John, P.W.M. (1971): Statistical design and analysis of experiments, Macmillan.
3. Montgomery, D.C. (2012). Design and Analysis of Experiments. John Wiley & Sons, New Delhi.

Books for References:

1. Montgomery, C.D. (2001): Design and analysis of experiments, John Wiley, New York.
2. Robert, O. Kuehl (2000): Design of experiments. Statistical principles of research design and analysis, Duxbury.
3. Federer, W.T. (1963): Experimental design; Theory and application, Oxford & IBH publishing Co.

Web Resources

<https://nptel.ac.in/courses/110/105/110105087/>
<http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf>
<http://home.iitk.ac.in/~shalab/anova/chapter9-anova-confounding.pdf>
https://www.afit.edu/stat/statcoe_files/Classical%20Designs-Fractional%20Factorial%20Designs%20Rev1.pdf
<https://stat.ethz.ch/~meier/teaching/anova/incomplete-block-designs.html>
<https://www.ndsu.edu/faculty/horsley/spsplot.pdf>

Rationale for Nature of the Course

This course provides a massive knowledge in linear models and designing the experiment towards research.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Problem solving with real time data by applying the different types of experiments.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem Solving

Course Designer(s):

1. Dr. A.SABERUNNISA

Course Schedule

Unit	Topics	Hours	Mode
I	Review of basic designs	3	Chalk and Talk, Test, Quiz, Seminar
	Orthogonal latin squares	3	
	Hyper Graeco Latin squares	3	
	Analysis of Variance	5	
	Multiple comparisons	4	
	multiple range tests-Missing plot technique	4	
II	General factorial experiments	4	Chalk and Talk, Test, Quiz, Seminar
	Study of 2 and 3 factorial experiments in randomized blocks	3	
	complete and partial confounding	3	
	Fractional designs for symmetric factorials	4	
	Basic idea of asymmetric factorials	3	
III	General block design and its information matrix (C), criteria for connectedness	4	Chalk and Talk, Test, Quiz, Seminar
	Balanced and Orthogonality	3	
	BIBD–recovery of inter block information	3	
	PBIBD(2).-Association scheme, Intra block analysis	4	
	Lattice Design –analysis	4	
	Youden design– intra block analysis	4	
IV	Nested and split plot designs–Two stage nested designs	4	Chalk and Talk, Test, Quiz, Seminar
	split plot designs, split-split plot designs	3	
	strip-split designs	3	
	Analysis of covariance with one, two covariates	4	
	clinical trials	2	
V	Response surface methodology	5	Chalk and Talk, Quiz, Seminar, Assignment
	First order and second order rotatable designs, applications	8	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand analysis of variance and experimental designs Orthogonal Latin squares, Hyper Graeco Latin squares	Up to K2
CLO2	Have strong theoretical knowledge in, factorial and fractional factorial experiments.	Up to K3
CLO3	Identify the BIBD, PBIBD	Up to K3
CLO4	Know the split designs, clinical trials.	Up to K4
CLO5	Understand Response surface methodology, and its application	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	2	3	2
CLO3	3	3	3	2	3
CLO4	3	3	3	3	3
CLO5	3	3	3	2	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1&K1	1	K1	2(K1 &K1)	1(K2)
2	CLO2	Up to K3	2	K2&K3	1	K1	2(K2 &K2)	1(K3)
3	CLO3	Up to K3	2	K2&K3	1	K2	2(K3 &K3)	1(K3)
4	CLO4	Up to K4	2	K3&K4	1	K2	2(K4 &K4)	1(K4)
5	CLO5	Up to K4	2	K3&K4	1	K3	2(K4 &K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	100%

Department of Statistics				Class: II M.Sc.				
Sem.	Course Type	Course code	Course title	Credits	Contact Hours/ week	CIA	Ext	Total
III	MDC	23P3SMDC1	Operations Research and Cost Analysis	3	5	25	75	100

Nature of Course						
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓	

Course Objectives:

The main Course Objectives are to:

1. To apply the mathematical methods in economic analysis
2. To improve operational efficiency by teaching them how to design and implement effective inventory systems, fostering critical thinking and decision-making skills.
3. Equip students with a thorough grasp of queuing theory, empowering them to analyze and optimize systems with waiting lines and service processes.
4. Enable strategic decision-making through Game Theory concepts.
5. To gain comprehensive knowledge of costing and acquaint skills on the preparation of budget

Unit	Description	Hours	K-Level	CLO(s)
1	Nature and Scope of Economics – Cost concepts – Total cost, Marginal cost and Average variable cost, Average Fixed cost – Revenue Concepts – Total revenue, Marginal revenue and average revenue – Price and output determination under perfect competition and Monopoly - Elasticity of demand – Utility maximization – Profit Maximization – Consumer surplus and Producer Surplus – Concepts and its applications	15	Up to K2	1
2	Inventory models – Structure of Inventory system – General deterministic problem for one item, one level – Inventory models with and without shortage – multi-item deterministic problem – one level model with one break.	15	Up to K2	2
3	Queuing theory – Basic characteristics of queuing models – Arrival and service distribution – Steady state solution of M/M/1 and M/M/C models with associated distribution of queue length and waiting time – M/G/I queue and Pollazeck-Khinchin result.	15	Up to K2	3

4	Games Theory. Competitive games, rectangular games, saddle point, minimax (maximin) method of optimal strategies, the value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	15	Up to K2	4
5	Introduction to Cost – Costing- Elements of Cost – Classification of Cost – Preparation of Cost sheet – Concept of Pricing – Methods of Pricing – Quoting Price for Tenders – Cost-Volume Profit Analysis – Break Even Point – Break Even Charts. Budgeting – Commercial Budget vs. Government Budget – Types of Budgets – Cash Budget – Flexible Budget.	15	Up to K2	5

Books for Study:

1. Base D., (2013) An Introduction to Mathematical Economics, Himalaya Publishing House, Mumbai (2013).
2. Agarwal H.S., (1976) Introduction to Econometrics, Lakshmi Narain Agarwal Educational Publishers, Agra.
3. Swarup, K., Mohan, M., and Gupta, P.K. (2001) Operations Research, Sultan Chand & Sons, New Delhi.
4. Natarajan, A.M., Balasubramani, P., and Tamilarasi, A. (2005) Operations Research, Pearson Education, New Delhi.
5. Reddy, T.S. and Hari, Y. (2013) Prasad Reddy, “Cost and Management Accounting”, Fourth Edition, Margham Publications, Chennai.

Books for reference:

1. Chiang, A.C., (1984) Fundamental Methods in Mathematical Economics, McGraw Hill, New Delhi.
2. Maddala, G.S. and KajaLagari. (2009) Introduction to Econometrics, Wiley, New York.
3. Gupta, P.K. and Man Mohan. (1979) Operations Research: Linear Programming and Theory of Games, 3/e, Sultan Chand & Sons, New Delhi.
4. Madnani, G.M.K. (2008) Introduction to Econometrics: Principles and Applications. Oxford and IBH, New Delhi.
5. Sankara Iyer. P., (2008) Operations Research, Tata McGraw-Hill.
6. Sharma, J.K (2007) Operations Research Theory and Applications, 3e”, Macmillan India Ltd, 2007.
7. Taha, H.A., (2011) Operations Research - An Introduction, (Edition 9) Prentice Hall, New Delhi.
8. Pandey, I. M., (2010) Management Accounting”, Third Edition, Vikas Publishing House.
9. Murthy, A. and Gurusamy, S., (2014) Cost Accounting, Vijay Nicole Imprints Private Limited, Chennai.

Web Resources:

1. Michael Klein, Mathematical methods for Economics,
www.amazon.in/Mathematical-methods-Addison-Wesley/dp/0201726262
2. NPTEL Course on Introduction to Econometrics
<https://nptel.ac.in/courses/130/106/130106001/>

Rationale for the Nature of the Course

This course prepares the student in business view of economics and forecasting techniques with various statistical assumptions in the real-time scenario.

Activities having a direct bearing on Skill development / Employability / Entrepreneurship

Assignments on the applications of business models applying various statistical tools to face real-time scenario issues.

Pedagogy

Chalk and Talk, PPT, Seminar and Assignment

Course Schedule

Unit	Topics	Hours	Mode
I	Nature and Scope of Economics	2	Chalk and Talk, Test, Quiz, Seminar
	Cost concepts – Total cost, Marginal cost and Average variable cost, Average Fixed cost – Revenue Concepts	3	
	Total revenue, Marginal revenue and average revenue	3	
	Price and output determination under perfect competition and Monopoly - Elasticity of demand	2	
	Utility maximization – Profit Maximization	3	
	Consumer surplus and Producer Surplus – Concepts and its applications	2	
II	Inventory models	2	Chalk and Talk, Test, Quiz, Seminar
	Structure of Inventory system	3	
	General deterministic problem for one item, one level	3	
	Inventory models with and without shortage	2	
	Multi-item deterministic problem	3	
	One-level model with one break.	2	
III	Queuing theory - Basic characteristics of queuing models	2	Chalk and Talk, Test, Quiz, Seminar
	Arrival and service distribution	2	
	Steady state solution of M/M/1 and M/M/C models with associated distribution of queue length and waiting time	4	
	M/G/I queue	4	
	Pollazeck-Khinchin result	3	
IV	Games Theory	2	Chalk and Talk, Test, Quiz, Seminar
	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, Value of the game	5	
	Solution of games with saddle points	2	
	Dominance principle	2	
	Rectangular games without saddle point	2	
	mixed strategy for 2 X 2 games	2	
V	Introduction to Cost – Costing	2	Chalk and Talk, Quiz, Seminar Assignment
	Elements of Cost – Classification of Cost	2	
	Preparation of Cost sheet	2	
	Concept of pricing – Methods of Pricing – Quoting Price for a Tenders Cost	3	
	Volume Profit Analysis – Break Even Point – Break Even Charts.	3	
	Budgeting – Commercial Budget vs. Government Budget – Types of Budgets – Cash Budget – Flexible Budget.	3	

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	K-Level
CLO-1	Apply the concepts of differentiation and their applications in Economics	Upto K2
CLO-2	Acquire insights into inventory issues and their practical applications across diverse business sectors.	Upto K2
CLO-3	Utilize Queuing models to address real-world challenges effectively.	Upto K2
CLO-4	Develop proficiency in employing game theory principles, cultivating strategic decision-making and problem-solving skill.	Upto K2
CLO-5	Apply the skills in preparation of Budget with the knowledge of costing	Upto K2

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	2	3	3	2	3
CLO2	2	3	3	1	2	2
CLO3	2	2	3	3	3	3
CLO4	1	3	3	3	2	2
CLO5	1	2	3	1	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	2	2	3	1	2
CLO2	3	3	3	3	3
CLO3	3	3	3	3	2
CLO4	3	3	2	2	3
CLO5	1	2	3	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print Model
(Mapping with Course Learning Outcomes (CLOs))

S. No.	CLOs	K Level	Section A		Section B		Section C	
			Short Answers		(Either/or Choice)		(Open Choice)	
			No. of questions	K Level	No. of questions	K level	No. of questions	K level
1	CLO 1	Upto K2	1	K1	1	K2	1	K2
2	CLO 2	Upto K2	1	K1	1	K2	1	K2
3	CLO 3	Upto K2	1	K1	1	K2	1	K2
4	CLO 4	Upto K2	1	K1	1	K2	1	K2
5	CLO 5	Upto K2	1	K1	1	K2	1	K2
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total marks for each Section			10		35		30	

Distribution of Section wise marks with K levels for summative Examination

K Levels	Section (No Choice)	Section B (No Choice)	Section C (No Choice)	Total marks	% of marks without choice	Consolidated
K1	10	-		10	7.69	100
K2	-	70	50	120	92.31	
K3	-	-	-	-	-	-
K4	-	-	-	-	-	-
Total marks	10	70	50	130	100.00	100

Course Designer:

- 1. Dr.V. Sriman Narayanan, Assistant Professor of Economics (Unit-I)**
- 2. Dr. R. Madhanagopal (Unit-II,III,IV)**
- 3. Dr. A. Mayilmurugan, Associate Professor & HoD of Commerce (Unit-V)**

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	NME	23P3SSEN2	Elements of Operations Research	2	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To understand the concepts of linear programming problem
- To understand the concepts of Transportation and Assignment problems.

Unit	Description	Hours	K-level	CLO
I	Formulation - Graphical and simplex methods of solving LPP - Use of artificial variables - Two-phase method and Big-M method.	5	Up to K2	1
II	Transportation problem: Transportation problem formulation- North-West Corner, Least cost, Vogel's Approximation method - UV-method.	9	Up to K2	2
III	Assignment problem - Hungarian Method - Travelling Salesman Problem.	4	Up to K2	3
IV	Network analysis by CPM/PERT: Basic Concept - Constraints in Network - Construction of the Network - Time calculations - Concept of slack and float in Network Analysis - Network crashing.	6	Up to K2	4
V	Sequencing problems with 2 machines n jobs and 3 machines n jobs.	6	Up to K2	5

Books for study:

1. Operations Research by Kanti Swarup, Gupta, P K and Man Mohan, Sultan Chand & Sons, Nineteenth Edition, New Delhi (2017).
2. Operations Research: An Introduction by Taha, H, Third Edition, McMillan Publishing Co., Inc, London (1982).

Books for References:

1. Introduction to Operations Research by Hillier F S and Lieberman GJ, Fifth Edition, McGraw-Hill, NY (1990).

2. Operations Research: Theory, Methods and Applications by Sharma SD, KedarNath, RarNath and Co, Meerut (2017).
3. Principles of Operations Research with Application to Managerial Decisions by Wagner H M Second Edition, Prentice Hall India Learning Private Limited and New Delhi (1980).

Web Resources

e-books, online tutorials taken from MOOC/SWAYAM platform for this subject.

Rationale for Nature of the course

This course enables the students to gain in-depth knowledge on operation research.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminars/Assignments on the different methods of operation research

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem Solving

Course Designer(s):

Dr. A. SABERUNNISA

Course Schedule

Unit	Topics	Hours	Mode
I	Formulation	1	Chalk and Talk, Test, Quiz, Seminar
	Graphical and simplex methods of solving LPP	1	
	Use of artificial variables	1	
	Two-phase method	1	
	Big-M method	1	
II	Transportation problem formulation	2	Chalk and Talk, Test, Quiz, Seminar
	North-West Corner	1	
	Least cost	2	
	Vogel's Approximation method	1	
	UV-method	3	
III	Assignment problem	1	Chalk and Talk, Test, Quiz, Seminar
	Hungarian Method	1	
	Travelling Salesman Problem	2	
IV	Network analysis by CPM/PERT- Basic Concept	1	Chalk and Talk, Test, Quiz, Seminar
	Constraints in Network	2	
	Construction of the Network	1	
	Time calculations - Concept of slack and float in Network Analysis	1	
	Network crashing	1	
V	Sequencing problems with 2 machines n jobs	3	Chalk and Talk, Quiz, Seminar, Assignment
	3 machines n jobs.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Formulate and solve linear programming problems (LPP) using graphical and simplex methods to find optimal solutions.	Up toK2
CLO2	Will possess the skills to formulate transportation problems.	Up toK2
CLO3	Formulate assignment problems and applying the Hungarian Method to find optimal solutions.	Up toK2
CLO4	Demonstrate a solid understanding of the basic concepts of CPM/PERT, will also be able to implement network crashing techniques to optimize project schedules.	Up toK2
CLO5	Acquire the ability to formulate and solve sequencing problems.	Up toK2

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	2	3	2	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	2	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	2	3	3	3
CLO3	3	3	2	3	2
CLO4	3	3	3	2	2
CLO5	3	3	3	2	2

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up to K2	1	K1	1	K2/K2	1	K1
2	CLO2	Up to K2	1	K1	1	K2/K2	1	K1
3	CLO3	Up to K2	1	K1	1	K2/K2	1	K1
4	CLO4	Up to K2	1	K1	1	K2/K2	1	K1
5	CLO5	Up to K2	1	K1	1	K2/K2	1	K1
No. of Questions to be asked			5		5		5	
No. of Questions to be answered			5		5		3	
Marks for each question			2		7		10	
Total marks for each			10		35		30	

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	10	-	50	60	46.15	100	10
K2	-	70	-	70	53.85		-
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
Total Marks	10	35	50	130	100.00	100	10

DEPARTMENT OF STATISTICS				CLASS : II M.Sc.				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
III	Internship	23P3SINTR	Internship	2	-	-	-	-

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

- To motivate students to takeup internship in research institutions / industry.
- To develop the employability of students.
- To promote entrepreneurial tendencies among students.

During the second semester vacation, students shall undertake internship for a minimum period of two weeks and submit a report and certificate from the company / industry / institution offering internship.

At the end of the internship, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in mission critical projects in real-time	K4
CLO 2	Develop into a critical thinker and solve every day problems in the industry.	K5
CLO 3	Learn and analyze problems faced by the industry and workforce at large.	K4
CLO 4	Survey the job market / understand entrepreneurial opportunities / research opportunities available to them.	K2
CLO 5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation schema for Internship

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

M.Sc. Statistics - II Year – Fourth Semester

List of Courses	Course Code	Credit	Hours
Core-XI (Stochastic Processes)	23P4SCCT11	5	6 (5L + 1T)
Core-XII (Machine Learning techniques)	23P4SCCT12	4	6 (5L + 1T)
Project with Viva Voce	23P4SPROV	8	8
Elective-V Statistical Quality Control or Reliability Theory	23P4SSECT5 (A) 23P4SSECT5 (B)	2	4
Elective-VI Practical in Python or Practical in JASP	23P4SECP3 (A) 23P4SECP3 (B)	1	2
Skill Enhancement Course-III (Statistics for Competitive Examination)	23P4SSED2	2	4 (4L)
Extension Activity	23P4SEXTN	1	-
Research and Publication Ethics		2	-
Total		23	30

Semester wise Mapping of Course with Programme Specific Outcomes (PSOs)

Course Type	CC11	CC12		Elective-V (A)	Elective-V (B)	Elective-VI (A)	Elective-VI (B)	Skill Enhancement Course-III	Ad-On Course
Course Title	Stochastic Processes	Machine Learning techniques	Project with Viva Voce	Statistical Quality Control	Reliability Theory	Practical in Python	Practical in JASP	Statistics for Competitive Examination	Research and Publication Ethics
PSO1	3	3	3	2	3	2	2	2	2
PSO2	2	3	3	2	3	2	2	2	2
PSO3	2	3	3	3	3	3	3	3	3
PSO4	3	2	2	2	3	2	2	2	2
PSO5	2	2	2	3	2	3	3	3	3

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	CORE	23P4SCCT11	STOCHASTIC PROCESSES	4	6	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- To expose the basic concepts of the theory of stochastic processes and develops the mathematical theory of random processes.
- It provides the fundamentals and advanced concepts of probability theory and help them appreciate and understand the application of the mathematical tool.
- To describe the advanced topics related to continuous and discrete time random processes.

Unit	Description	Hours	K-level	CLO
I	Definition of Stochastic process – Specification of Stochastic Processes. Stationary Processes – Second order process, Stationarity, Gaussian processes. Martingales: Definition and properties. Martingales in discrete time - Supermartingales and submartingales - Continuous Parameter Martingales- Martingale convergence theorem and its applications	16	Up to K2	1
II	Markov chains – Definitions and examples. Higher order transition probabilities: Chapman – Kolmogorov equation. Classification of States and Chains – Determination of Higher order Transition Probabilities -Aperiodic Chain: Limiting Behaviour. Stability of a Markov system.	20	Up to K3	2
III	Poisson process – Poisson process and related distributions. Pure Birth Process, Birth Immigration – Birth and Death process – Simple examples.	20	Up to K3	3
IV	Renewal theory - Renewal equation - Stopping time - Wald's equation - Elementary renewal theorem and its applications - Renewal reward processes - Residual and Excess life times - Markov renewal and Semi Markov processes	19	Up to K4	4
V	Branching process – properties of generating function of branching process – Probability of extinction – fundamental theorem of branching process.	15	Up to K4	5

Books for study:

1. Medhi, J. (1984): Stochastic Processes, New Age International Publishing Limited, New Delhi. (Reprint 2002).
2. Karlin, S. and Taylor H.M. (1996): First Course in Stochastic Process, Academic Press.

Books for References:

1. Prabhu. N.U. (1965) : Stochastic Process, Macmillan, New York.
2. Ross, S.M (1996): Stochastic Processes, 2nd Edition, John Wiley & Sons, New Delhi.

Web Resources

1. NPTEL Course on Introduction to Stochastic Process
<https://nptel.ac.in/courses/110/101/110101141/>

Rationale for Nature of the course

This course will enable the students to understand and analyse the unpredictable situations with respect to time. Also enable in developing a model for the situation relevant to the real time scenario.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Real time situation based problems will be given as assignment with concentration on the different process via various probability distributions.

Pedagogy

Chalk & Talk with PPT, Assignment, Seminar and Quiz

Course Designer(s):

Dr. M. Venkateswaran

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Definition of Stochastic process – Specification of Stochastic Processes.	4	Chalk & Talk, Test, Quiz, Seminar
	Stationary Processes – Second order process, Stationarity, Gaussian processes.	4	
	Martingales: Definition and properties. Martingales in discrete time - Supermartingales and submartingales	4	
	Continuous Parameter Martingales- Martingale convergence theorem and its applications	4	
Unit II	Markov chains – Definitions and examples	2	Chalk & Talk, Test, Quiz, Seminar
	Higher order transition probabilities: Chapman – Kolmogorov equation.	5	
	Classification of States and Chains	6	
	Determination of Higher order Transition Probabilities - Aperiodic Chain	4	
	Limiting Behaviour. Stability of a Markov system.	3	
Unit III	Poisson process	3	Chalk & Talk, Test, Quiz, Seminar
	Poisson process and related distributions	5	
	Pure Birth Process	4	
	Birth Immigration	4	
	Birth and Death process – Simple examples.	4	
Unit IV	Renewal theory	4	Chalk & Talk, Test, Quiz, Seminar
	Renewal equation - Stopping time - Wald's equation	5	
	Elementary renewal theorem and its applications	5	
	Renewal reward processes - Residual and Excess life times - Markov renewal and Semi Markov processes	5	
Unit V	Branching process – properties of generating function of branching process	5	Chalk & Talk, Quiz, Seminar Assignment
	Probability of extinction	5	
	fundamental theorem of branching process.	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Equip their knowledge with theoretical and practical skills which are necessary for the analysis of stochastic dynamical system in economic, financial mathematics, engineering, business and other fields.	Up to K2
CLO2	Attain knowledge about stochastic process in the time domain such as Markov processes with a discrete state space, including Markov chains, Poisson processes and birth and death processes.	Up to K3
CLO3	Demonstrate the specific applications to Poisson and Gaussian processes.	Up to K3
CLO4	Carry out derivations involving conditional probability distributions and conditional expectations.	Up to K4
CLO5	Define basic concepts from the theory of Markov chains and present proofs for the most important theorems.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	3	2	3	3
CLO2	3	3	3	2	2	3
CLO3	3	3	3	2	3	3
CLO4	3	3	3	3	3	2
CLO5	3	2	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	2
CLO2	3	3	3	2	2
CLO3	3	3	3	3	2
CLO4	3	2	2	2	2
CLO5	3	2	2	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2 (K3&K3)	1 (K3)
3	CLO3	Up to K3	2	K2 & K3	1	K2	2 (K2&K2)	1 (K3)
4	CLO4	Up to K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
5	CLO5	Up to K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: II M.Sc				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	CORE XII	23P4SCCT12	Machine Learning Techniques	4	6	25	75	100

Nature of Course						
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented		

Objectives:

- To provide theoretical knowledge on the concept of functions of machine learnings.
- To educate the knowledge on the both theory and practical applications of machine learning techniques.
- To acquire the knowledge on deriving its characteristics of various functions.

Unit	Description	Hours	K-level	CLO
I	Data types – Measures of similarity and dissimilarity - Hierarchical Clustering Methods – k-means and k-medoids clustering methods – Clustering Validity measures	14	Up to K2	1
II	Fuzzy c-means – Fuzzy Clustering Validity Measures – Decision Trees – Building a decision tree – Tree induction algorithm – Splitting of nodes based on information gain and Gini index - Nearest Neighbor classifiers – kNN algorithm – Naïve Bayesian classifier	14	Up to K3	2
III	Association rules mining – Basics – Apriori algorithm – Pruning and candidate generation – Rule mining. Machine learning – Introduction - Examples of various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension	25	Up to K4	3
IV	Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non- Linear, Kernel Functions, K-Nearest Neighbors	19	Up to K3	4

V	Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking. Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining Frequent Patterns	18	Up to K4	5

Books for study:

1. Tan, T., Steinbach, M. and Kumar, V. (2006): Introduction to Data Mining, Pearson Education.
2. Gupta, G.K. (2008): Introduction to Data Mining with case studies, Prentice – Hall of India Pvt. Ltd.
3. Daniel T. Larose (2006): Data Mining: Methods and Models, John Wiley and Sons.
4. Han, J. and Kamber, M. (2006): Data Mining: Concepts and Techniques, 2nd Edition, Morgan Kaufmann Publishers.

Books for References:

1. Paolo Gludici (2003): Applied Data Mining: Statistical Methods for Business and Industry, John Wiley and sons
2. Rajan Chattamvelli (2009): Data Mining Methods, Narosa Publishing House, New Delhi.
3. Wayne, W. David (1987) : A foundation for analysis in Health Sciences 4th ed., John Wiley & Sons. Jerrold H. Zar (1984) : Bio statistical analysis, Prentice hall 2nd ed.
4. Susan Milton, J. (1992) : Statistical methods in the biological and health sciences, McGraw Hill. Jain, J.R. (1982) : Statistical techniques in quantitative genetics, Tata McGraw Hill

Web Resources

1. Types of Sources of Data in Data Mining
<https://www.geeksforgeeks.org/types-of-sources-of-data-in-data-mining/>
2. Introduction to OLAP - OLAP technology for Data Mining
https://www.tutorialspoint.com/dwh/dwh_olap.htm
3. Data mining Primitives
http://www.brainkart.com/article/Data-mining-primitives_8311/
4. Neural Network <https://www.getsmarter.com>
5. Web Mining
<https://www.techopedia.com/definition/15634/web-mining>

Rationale for Nature of the course

Analyzes massive volumes of data to discover business intelligence that helps companies solve problems, mitigate risks, and seize new opportunities

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminars / Assignments on different algorithms in current scenario

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

1. Dr. M.RABERT

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Data types – Measures of similarity and dissimilarity	4	Chalk and Talk, Test, Quiz and Seminar
	Hierarchical Clustering Methods	4	
	k-means and k-medoids clustering methods	3	
	Clustering Validity measures	3	
Unit II	Fuzzy c-means – Fuzzy Clustering Validity Measures.	4	Chalk and Talk, Test, Quiz and Seminar
	Decision Trees – Building a decision tree – Tree induction algorithm	3	
	Splitting of nodes based on information gain and Gini index	3	
	Nearest Neighbor classifiers – kNN algorithm – Naïve Bayesian classifier.	4	
Unit III	Association rules mining – Basics – Apriori algorithm .	4	Chalk and Talk, Test, Quiz and Seminar
	Pruning and candidate generation	4	
	Rule mining. Machine learning	3	
	Introduction - Examples of various Learning Paradigms,	4	
	Perspectives and Issues, Version Spaces,	3	
	Finite and Infinite Hypothesis Spaces,	4	
	PAC Learning, VC Dimension.	3	
Unit IV	Learning a Class from Examples, Linear, Non-linear,	4	Chalk and Talk, Test, Quiz and Seminar
	Multi-class and Multi-label classification, Decision Trees: ID3,	4	
	Classification and Regression Trees (CART), Neural Networks: Introduction, Perceptron,	4	
	Multilayer Perceptron, Support vector machines: Linear and Non- Linear,	4	
	Kernel Functions, K-Nearest Neighbors	3	
Unit V	Ensemble Learning Model Combination Schemes, Voting,	4	Chalk and Talk, Assignment, Quiz and Seminar
	Error-Correcting Output Codes, Bagging: Random Forest Trees,	3	
	Boosting: Adaboost, Stacking. Bayesian Learning,.	4	
	Bayes Optimal Classifier, Naïve Bayes Classifier,	3	
	Bayesian Belief Networks, Mining Frequent Patterns	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the knowledge on importance of the data types and its role in the machine learning techniques.	Up to K2
CLO2	Explain the moments for the fuzzy concepts come from the various types of algorithms.	Up to K3
CLO3	Interpret the properties of Machine learning techniques and examples of various Learning Paradigms	Up to K4
CLO4	Analyze data from multi-stage sampling method To interpret the distributions of order statistics with regard to Median, Sample Range and Joint distribution of order two.	Up to K3
CLO5	Identify the data distribution based on One sample and two samples using KS tests.	Up to K4

Mapping of CLOs with PSOs

_#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	2
CLO4	3	3	3	3	3
CLO5	3	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
4	CLO4	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
5	CLO5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	-

DEPARTMENT OF STATISTICS				CLASS : II M.Sc.				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Project	23P4SPROV	Project & Viva-voce	2	8	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

- To motivate students to take up research projects in their field of interest.
- To promote scientific temper and systematic approach to problem solving and research methodology.
- To promote research writing aptitude among students.

During the fourth semester, students shall undertake a project work and submit the project report.

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K5
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Internal& External Valuation for Project

Internal	External
25 marks	75 Marks
Guide Evaluation: • 10 Marks for Students ability and interest • 10 Marks for Regularity and Punctuality • 5 Marks for Quality of the work and Presentation	Dept Evaluation: 25 (Min (No.) 50 % of faculty must be present) • 15 Marks for Presentation using ICT tools. • 10 Marks for Quality and Publications / Presentation in Seminar/ conferences External Evaluation: 50 • 20 Marks for the Report • 30 Marks for Presentation, Quality of work and Viva voce.

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Elective (Discipline Specific)	23P4SECT5(A)	Statistical Quality Control	2	4	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	

Objectives:

- Benefits of understanding Statistical Quality Control
- To understand the performance of advanced level of control charts
- To know how to design sampling plans based on the variables.
- To know how to design sampling plans based on the attributes.

Unit	Description	Hours	K-Level	CLO(s)
I	Modified control limits - use of control limits for moving average –difference control Charts - basic principles and design of cumulative charts - V-mask. Mid range and median charts, Moving average control chart, Exponentially weighted Moving-average control chart.	13	Upto K2	1
II	Acceptance sampling - lot formation – sampling inspection by attributes – single sampling plans – OC function – rectifying inspection - Double sampling plan – OC, ASN, ATI and AOQ functions	13	Upto K3	2
III	Sampling inspection by variables - known and unknown sigma variables sampling plan - merits and demerits of variables sampling plan - derivation of OC curve and the parameters of the plan.	14	Upto K3	3
IV	Continuous sampling plans by attributes - CSP-1 and its modifications - concept of AOQL in CSPs	10	Upto K4	4
V	Multi-level continuous sampling plans - Operation of multi-level CSP of Lieberman and Solomon - Wald-Wolfowitz continuous sampling plans - Sequential Sampling Plans by attributes - OC and ASN functions.	10	Upto K4	5

Books for study:

1. Montgomery, D.C. (2009) Introduction to Statistical Quality Control, 6th edition, Wiley India, New Delhi.
2. Mahajan, M. (2002) Statistical Quality Control, 3rd edition, Dhanpat Rai and Co., Delhi.
3. Schilling, E. G. and Nuebauer, D.V. (2009) Acceptance Sampling in Quality Control, 6th edition, CRC Press, New York.

Books for References:

1. Bowker, A.H. and Lieberman, G.J. (1982) Engineering Statistics, 2/e, Prentice Hall, New Delhi.
2. Grant, E.L. and Leavenworth, R.S. (2000) Statistical Quality Control, 7/e, Tata McGraw Hill, New Delhi.
3. Juran, J.M. and De Feo, J.A. (2010) Juran's Quality control Handbook – The Complete Guide to Performance Excellence, 6/e, Tata McGraw-Hill, New Delhi.
4. Wetherill, G.B. (1977) Sampling Inspection and Quality Control, 2/e, Chapman and Hall, London.
5. Lawless, J.F. (1972) Statistical models and methods of Lifetime Data, Wiley, New York.
6. John T. Burr, (2004) Elementary Statistical Quality Control (Second Edition), Marcel Dekker New York.
7. Duncan, A.J. (2006). Quality Control and Industrial Statistics, Irwin - Illinois

Web Resources

1. Cumulative charts, V-Mask Cusum Chart, Exponentially weighted
<https://inst.eecs.berkeley.edu/~ee290h/fa05/Lectures/PDF/lecture%2014%20CUSUM%20and%20EWMA.pdf>
2. Sampling Inspection
https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004032250571287Rajiv_Sakse na Sampling Inspection.pdf
3. NPTEL Course on Quality Design and control
<https://nptel.ac.in/courses/116/102/116102019/>

Rationale for Nature of the course

This course will enable the students to comprehend the theoretical and applied concepts of Statistical Quality Control and Reliability which enables to apply for the statistical concepts.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Exercise problems on Control charts and sampling plans given on real time situations

Pedagogy

Chalk and Talk, PPT, Assignments, Seminar, Problem solving.

Course Designer(s):

Dr. P. Vetri Selvi

Course Schedule

Unit	Topics	Hours	Mode
I	Modified control limits	2	Chalk and Talk, Quiz, Test problem solving and Seminar
	Use of control limits for moving average –difference control Charts	2	
	Basic principles and design of cumulative charts	2	
	V-mask, Mid-range and median charts	2	
	Moving average control chart,	3	
	Exponentially weighted Moving-average control chart	2	
II	Acceptance sampling - lot formation	2	Chalk and Talk, Quiz, Test problem solving and Seminar
	Sampling inspection by attributes – single sampling plans	2	
	OC function – rectifying inspection	2	
	Double and multiple sampling plans	4	
	OC, ASN, ATI and AOQ functions	3	
III	Sampling inspection by variables	3	Chalk and Talk, Quiz, Test and Seminar
	Known and unknown sigma variables sampling plan	3	
	Merits and demerits of variables sampling plan	3	
	Derivation of OC curve and the parameters of the plan.	5	
IV	Continuous sampling plans by attributes	4	Chalk and Talk, Quiz, Test and Seminar
	CSP-1 and its modifications	3	
	Concept of AOQL in CSPs -	3	
V	Multi-level continuous sampling plans - Operation of multi-level CSP of Lieberman and Solomon	2	Chalk and Talk, Quiz, Test Assignment
	Wald-Wolfowitz continuous sampling plans -	3	
	Sequential Sampling Plans by attributes - OC and ASN functions	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Design, use, and interpret Modified control limits, EWMA and moving average control charts.	Upto K2
CLO-2	Construct and design graphical representations of various sampling plans in deciding the quality of the lot	Upto K3
CLO-3	Demonstrate the ability to design, use, and interpret control charts for variables.	Upto K3
CLO-4	Demonstrate the ability to design, use, and interpret control charts for attributes.	Upto K4
CLO-5	Construct and design graphical representations advanced level sampling plans	Upto K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	3	2	3	2	2	2	3
CLO-2	3	3	3	3	2	1	3
CLO-3	3	2	3	2	2	1	3
CLO-4	3	2	3	2	2	1	3
CLO-5	3	2	3	3	2	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	2	2	2	2
CLO2	3	2	2	2	2
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K- Level	Section A		Section B		Section C (Either / or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Up toK2	2	K1& K1	1	K1	2(K1&K1)	1(K2)
2	CLO2	Up toK3	2	K2& K3	1	K1	2(K3&K3)	1(K3)
3	CLO3	Up toK3	2	K2& K3	1	K2	2(K2&K2)	1(K3)
4	CLO4	Up toK4	2	K3& K4	1	K2	2(K4&K4)	1(K4)
5	CLO5	UptoK4	2	K3& K4	1	K3	2(K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30.00	30%
K4	2	-	20	20	42	35.00	35%
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF STATISTICS				CLASS: II M.Sc				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Elective (Discipline Specific)	23P4SECT5 (B)	Reliability Theory	2	4	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- To provide theoretical knowledge on the concept of reliability theory
- Students are able to understand the cost of Reliability and its applications.
Students able to apply the reliability theory using various distributions

Unit	Description	Hours	K-level	CLO
I	Reliability – Definition – basic elements of reliability – bath tub curve – Designing for reliability –methods for improving design reliability-measurement of reliability-achievement of reliability.	14	K2	1
II	Cost of reliability- maintenance and reliability -mean time between failures (MTBF) - Mean time to repair (MTTR) - Maintenance action rate—criteria of adequate performance=Availability-Failure mode, effect and critically analysis (FMECA) –Stages of FMECA-Uses of FMECA.	14	K3	2
III	coherent systems; reliability coherent systems; cuts and paths; modular decomposition; boundson system reliability; structural and reliability importance of components.	25	K4	3
IV	Hazard analysis – failure rate and hazard function – constant hazard model – linear hazard model –MTTF – system reliability .	19	K3	4
V	Life distributions; reliability function; hazardrate; common life distributions exponential, Weibull, Gamma. Estimation of parameters and tests in these models	18	K4	5

Books for study:

1. Mahajan, M. (2002) Statistical Quality Control,3/edition, Dhanpat Rai and Co., Delhi.
2. Barlow R.E. and Proschan F. (1985) Statistical Theory of Reliability and Life Testing, To Begin with, Silver Spring.
3. Lawless J.F. (1982) Statistical Models and Method of Life Time Data, Wiley, New York.

Books for References:

1. Bain L.J. and Engelhardt, M. (1991) Statistical Analysis of Reliability and Life Testing Models, Marcel Dekker, New York.
2. Nelson, W. (1982) Applied Life Data Analysis, Wiley, New York.
3. Zacks, S. (1995) Reliability Analysis, Springer, New York.
4. Miller, R.G. (1981) Survival analysis, Wiley, New York.
5. Cox, D.R. and Oakes, D. (1984) Analysis of Survival Data, Chapman & Hall, New York.
6. Gross, A.J. and Clark, V.A. (1975) Survival distribution: Reliability applications in the Biomedical Sciences, Wiley, New Delhi.
7. Kalbfleisch, J.D. and Prentice, R.L. (1980) The Statistical Analysis of Failure Time Data, Wiley, New York.
8. Lawless, J.F. (1982) Statistical Models and Methods of Life Time Data, Wiley, New York.

Web Resources

1. Reliability: <https://nptel.ac.in/courses/105/108/105108128/>

Rationale for Nature of the course

The course provides the knowledge on evaluation of the life time of a product and its related distributions.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Seminars / Assignments on different algorithms in current scenario.

Pedagogy

Chalk and Talk, PPT, Seminar, Interaction, Problem solving.

Course Designer(s):

1. Dr. M. RABERT

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Reliability – Definition – basic elements of reliability.	4	Chalk and Talk, Test, Seminar and Quiz
	bath tub curve – Designing for reliability –methods for improving design reliability.	4	
	measurement of reliability-achievement of reliability.	3	
Unit II	Cost of reliability- maintenance and reliability -mean time between failures (MTBF).	3	Chalk and Talk, Test, Seminar and Quiz
	Mean time to repair (MTTR) - Maintenance action rate—criteria of adequate performance-Availability.	4	
	Failure mode, effect and critically analysis (FMECA) – Stages of FMECA-Uses of FMECA.	5	Chalk and Talk, Test, Seminar and Quiz
UnitIII	coherent systems; reliability coherent systems.	4	Chalk and Talk, Test, Seminar and Quiz
	cuts and paths; modular decomposition; boundson system reliability.	4	
	structural and reliability importance of components.	4	
Unit IV	Hazard analysis – failure rate and hazard function.	4	Chalk and Talk, Test, Seminar and Quiz
	constant hazard model – linear hazard model –	3	
	MTTF – system reliability.	4	
Unit V	Life distributions; reliability function; hazardrate.	5	Chalk and Talk, Assignment, Seminar and Quiz
	common life distributions exponential, Weibull, Gamma.	4	
	Estimation of parameters and tests in these models.	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Gain the knowledge on Reliability and its conceptual measures.	Upto K2
CLO2	Explain the cost of reliability, maintenance and its uses uses.	Upto K3
CLO3	Interpret the structural and reliability importance of components.	Upto K4
CLO4	Analyze the failure rate and hazard rate and its types of models.	Upto K3
CLO5	Study the life distribution and estimation of parameters	Upto K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO1	3	3	3	3	3	3	3
CLO2	3	3	3	3	3	3	3
CLO3	3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3	3
CLO5	3	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	2
CLO4	3	3	3	3	3
CLO5	3	2	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model

(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO1	Up to K2	2	K1 & K1	1	K1	2(K1 & K1)	1(K2)
2	CLO2	Up to K3	2	K2 & K3	1	K1	2(K2 & K2)	1(K3)
3	CLO3	Up to K4	2	K3 & K4	1	K3	2(K4 & K4)	1(K4)
4	CLO4	Up to K3	2	K2 & K3	1	K2	2(K3 & K3)	1(K3)
5	CLO5	Up to K4	2	K3 & K4	1	K2	2(K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	2	4	10	-	16	13.33	35%
K2	2	4	10	10	26	21.67	
K3	4	2	10	20	36	30	30%
K4	2	-	20	20	42	35	35%
Total Marks	10	10	50	50	120	100	-

DEPARTMENT OF STATISTICS				CLASS: II M. Sc				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Elective (Discipline Specific)	23P4SECP3 (A)	Practical in Python	1	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

The main Course Objectives are:

1. To introduce various concepts of programming to the students using Python.
2. To learn how to build and package Python modules for reusability
3. To equip students with Statistical Programming Skills based on real life examples and datasets

Units	Programs	Hours	CLOs
1	Program to Data Visualization: Bar Charts, Scatter Plots, Histogram, Scatter Diagram, Box Plots, Grouped Bar Charts, Pie Charts	3	1
2	Program to compute Descriptive Statistics and Quantifying Variability	3	2
3	Program to compute Correlation, and Regression analysis	2	3
4	Program to compute Parametric and Non-Parametric tests	4	4
5	Program to compute Time Series Analysis & Visualization	3	5

Books for Study

1. Nageswara Rao, R, Core Python Programming, 2nd edition, Dreamtech Press, New Delhi (2018).
2. Haslwanter, T, An Introduction to Statistics with Python with Application in the Life Sciences, Springer, Switzerland (2016).

Books for References

1. Wesley J.Chun, Core Python programming, 2/e, Pearson education (2010).
2. Mark Lutz, Programming Python, 4/e, O'Reilly Media (2010).
3. Mark Summerfield, Programming in Python 3, Pearson Education (2009).

Web Resources

1. <https://scipy-lectures.org/packages/statistics/index.html>
2. <https://www.kdnuggets.com/2016/07/statistical-data-analysis-python.html>
3. <https://bedford-computing.co.uk/learning/wp-content/uploads/2015/10/Python-for-Data-Analysis.pdf>

4. <https://www.reneshbedre.com/blog/anova.html>
5. <https://www.geeksforgeeks.org/time-series-data-visualization-in-python/>
6. <https://www.simplilearn.com/tutorials/python-tutorial/time-series-analysis-in-python>

Rationale for Nature of the course

Python is used by market researchers, health researchers, survey companies, government entities, education researchers, marketing organizations, data miners, and many more for processing and analyzing survey data

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The goal for the lab is to provide an opportunity for you to become familiar with the Python software which is designed to solve problems in statistics and to analyze experimental data

Pedagogy

Demonstration and Practical session in computer lab

Course Designer:

Dr. P. Vetri Selvi

Course Learning Outcomes

At the end of the course, the student will be able to:

CLO's	Course Learning Outcomes	Knowledge Level
CLO-1	Understand how to use data visualization	Upto K2
CLO-2	Presenting data using relevant tables and summary statistics	Upto K3
CLO-3	Perform advanced statistical analyses such as correlation and regressions	Upto K3
CLO-4	Perform Parametric and non-parametric test	Upto K4
CLO-5	Perform Time Series Analysis & Visualization	Upto K4

Mapping close with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CLO-1	2	1	2	1	3	1	3
CLO-2	2	1	2	2	3	1	3
CLO-3	2	3	3	3	3	2	3
CLO-4	2	3	3	3	3	2	3
CLO-5	2	3	3	3	3	2	3

Advance application – 3; Intermediate level – 2; Basic level – 1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	2	2	2	2
CLO2	3	2	2	2	2
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Elective (Discipline Specific)	23P4SECP3 (B)	Practical in JASP	1	2	25	75	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Objectives:

- To enrich the technical skills in Data analytics through the statistical methods using software orientation towards job roles.
- To enhance the intuition of the students towards the insights of the theoretical concepts with its application in real time domain through software

Unit	Description	Hours	CLO
I	Data Visualization: Bar Charts, Cluster Bar Charts , Pie Charts.	2	1
II	Descriptive Statistics and exporting data from csv	2	2
III	Correlation and Regression	6	3
IV	Parametric tests and Non- parametric tests	10	4
V	Fitting of probability distributions and Time Series analysis	10	5

Books for study:

- Christopher P. Halter (2018): Classical Statistical Analysis Using JASP Volume One Frequentist Approaches

Web Resources

<https://jasp-stats.org/2020/06/16/training-videos-for-using-jasp-in-online-statistics-instruction/>
<https://jasp-stats.org/how-to-use-jasp/>

Rationale for Nature of the course

JASP is used by market researchers, health researchers, survey companies, government entities, education researchers, marketing organizations, data miners, and many more for processing and analyzing survey data

Activities having direct bearing on Skill development / Employability Entrepreneurship

The goal for the lab is to provide an opportunity for you to become familiar with the SPSS software which is designed to solve problems in statistics and to analyze experimental data

Pedagogy

Demonstration and Practical session in computer lab

Course Designer(s):

1. Dr. M. Venkateswaran

	Course Learning Outcomes
CLO1	Understand the basic workings of JASP and data visualization
CLO2	Presenting data using graphs
CLO3	Explore relationship among variables
CLO4	Perform common parametric and non-parametric tests
CLO5	Perform advanced statistical analyses in Time series analysis

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	3
CLO3	2	3	3	3	3	2
CLO4	2	3	3	2	3	3
CLO5	2	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	2	2
CLO2	3	3	3	2	2
CLO3	3	3	3	3	2
CLO4	3	2	2	2	2
CLO5	3	2	2	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

DEPARTMENT OF STATISTICS				CLASS: II M.Sc.				
Sem	Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Skill Enhancement	23P4SSED2	Statistics for Competitive Exam	4	6	25	75	100

Nature of Course						
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓	

Objectives:

- To model cross sectional data using minimum number of parameters
- To estimate unbiased estimators for model parameters
- To estimate standard errors of estimates to construct the confidence intervals.
- To test the goodness of fit of the models

Unit	Description	Hours	K-level	CLO
I	Uses, Scope and limitation of Statistics, Collection, Classification and Tabulation of data, Diagramatic and Graphical representation, Measures of location, dispersion, Skewness and Kurtosis – Correlation and regression	12	K4	1
II	Probability - Addition, Multiplication, Probability distributions – Binomial, Poisson, Geometric and Hypergeometric. Continuous distributions – Uniform, exponential and normal. Sampling distributions and standard error	14	K4	2
III	Estimation – Point estimation – properties of estimates Neyman – Fisher Factorization theorem(without proof) Cramer – Rao inequality, Rao – Blackwell theorem – MLE and method of Moments estimation	12	K4	3
IV	Simple random sample – stratified, systematic, Sample Survey – Organisation – CSO and NSSO – Sampling and Non-Sampling errors.	10	K4	4
V	Tests of Hypothesis – Null and Alternative – Types of errors – Power of test, Neyman – Pearson lemma, UMP and Likelihood ratio tests, Test procedures for large and small samples – Independence of attributes, Chi-square test – Goodness of fit	12	K4	5

Books for study:

1. S.C. Gupta and V.K. Kapoor (2014) Fundamentals of Mathematical Statistics, Sulthan Chand & Sons, New Delhi.
2. S.C. Gupta and V.K. Kapoor (2014) Fundamentals of Applied Statistics, (Edition-4), Sulthan Chand & Sons, New Delhi.

Books for References:

1. B.L. Agarwal (2021), Programmed Statistics (Question-Answers) Fourth Edition, New Age International Private Limited

Rationale for Nature of the course

This course enables to prepare for the TNPSC and ISS competitive exams.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Assignment, Group Discussion

Pedagogy

Chalk & Talk with PPT, Assignment, Group Discussion, Seminar and Quiz

Course Designer(s):

1. **Dr. R. Madhanagopal**
2. **Dr. M. Venkateswaran**
3. **Dr. M. Rabert**

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Uses, Scope and limitation of Statistics, Collection, Classification and Tabulation of data	2	Chalk & Talk, test, quiz, seminar and problem solving
	Diagramatic and Graphical representation,	2	
	Measures of location, dispersion	2	
	Skewness and Kurtosis	2	
	Correlation and regression	4	
Unit II	Probability - Addition, Multiplication, Probability distributions	4	Chalk & Talk, test, quiz, seminar and problem solving
	Binomial, Poisson, Geometric and Hypergeometric	4	
	Continuous distributions – Uniform, exponential and normal	4	
	Sampling distributions and standard error	2	
Unit III	Estimation – Point estimation – properties of estimates Neyman	4	Chalk & Talk, test, quiz, seminar and problem solving
	Fisher Factorization theorem(without proof) Cramer – Rao inequality	4	
	Rao – Blackwell theorem – MLE and method of Moments estimation	4	
Unit IV	Simple random sample – stratified, systematic	4	Chalk & Talk, test, quiz, seminar and problem solving
	Sample Survey – Organisation – CSO and NSSO	4	
	Sampling and Non-Sampling errors.	2	
Unit V	Tests of Hypothesis – Null and Alternative – Types of errors –	3	Chalk & Talk, assignment quiz, seminar
	Power of test, Neyman – Pearson lemma, UMP and Likelihood ratio tests,	5	
	Test procedures for large and small samples – Independence of attributes, Chi-square test – Goodness of fit	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand about descriptive statistics	Up to K4
CLO2	Apply the various probability distributions	Up to K4
CLO3	Create inference on various data sets	Up to K4
CLO4	Analyse the official statistics process in the present scenario	Up to K4
CLO5	Predict the price of the present market	Up to K4

Mapping of CLOs with PSOs

_#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	2	3	3	3	3
CLO2	2	3	3	2	2	2
CLO3	3	2	3	3	3	2
CLO4	3	3	3	3	2	2
CLO5	3	2	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (10 Marks)
			MCQs		Short answers (5)		
			No. of Questions	K-Level	No. of Questions	K-Level	
1	CLO1	Upto K4	6	K3/ K4	1	K1/ K2	1 (K2/ K3)
2	CLO2	Upto K4	6	K3/ K4	1	K1/ K2	1 (K2/ K3)
3	CLO3	Upto K4	6	K3/ K4	1	K1/ K2	1 (K2/ K3)
4	CLO4	Upto K4	6	K3/ K4	1	K1/ K2	1 (K2/ K3)
5	CLO5	Upto K4	6	K3/ K4	1	K1/ K2	1 (K2/ K3)
No. of Questions to be asked			30		5		5
No. of Questions to be answered			30		3		3
Marks for each question			1		5		10
Total marks for each			30		15		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B	Section C	Total Marks	% of Marks with choice	Consolidated
K1		10		10	9.52	43%
K2		15	20	35	33.33	
K3	15		30	45	42.85	43%
K4	15			15	14.28	14%
Total Marks	30	25	50	105	100	100

DEPARTMENT OF STATISTICS				CLASS : II M.Sc.				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Extension	23P4SEXTN	Extension Activity	1	-	-	-	-

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

- To motivate students to take up community driven activities and projects.
- To develop the societal awareness of students.
- To promote environmental, sustainability and G20 High-Level Principles on Lifestyles for Sustainable Development (LiFE) among students.

During the duration of the programme, students shall undertake extension activities for a minimum duration of 15 hours including preparation and submit a work diary and report of activities along with certificates (if any) from trusts/ NGOs/ public offices / schools.

At the end of the programme, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in extension activities and community projects	K4
CLO 2	Develop into dutiful and morally upright citizens of the country with an understanding of the problems of the society	K5
CLO 3	Suggest and implement out of the box solutions to the problems of the society from their domain knowledge and through their learning.	K4
CLO 4	Survey and understand the problems of the society and humanity as a whole.	K2
CLO 5	Communicate the problems of the society to civil administration/government forums for finding solutions to the problems of the locality.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation Schema for Extension Activity

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMENT OF STATISTICS				CLASS: II M.Sc., Statistics			
Course Type	Course Code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
Add on Course		Research and Publication Ethics	2	30	50	50	100

Nature of Course					
Skill Oriented	✓	Employability Oriented	✓	Entrepreneurship Oriented	✓

Unit	Description	Hours
I	Introduction of Research Methodology: Meaning, Objectives, Motivation, Types of Research, Research Methods versus methodology.	6
II	Defining the Research Problem: Selecting the Problem, Necessity of Defining the Problem, Techniques in Defining the Problem.	6
III	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Different Research Designs.	6
IV	Interpretation of Data and Paper Writing: Layout of a Research Paper, Impact factor of Journals, When and where to publish? Ethical issues related to publishing	6
V	Plagiarism: what is Plagiarism, consequences of Plagiarism, Software for detection of Plagiarism	6

Books for references:

1. C.R.Kothari (1990) Research Methodology, New Age International (P) Limited, Publishers.
2. Nicholas Walliman (2011) Research Methods the basics , Routledge.
3. Michael P.. Marder (2011), Research Methods for Science –, Cambridge University Press.
4. Tomas Foltynek et al.(2020), How to Avoid Plagiarism- Charles University, Karolinum Press.

Course Designer:

Dr.A.SABERUNNISA



THE MADURA COLLEGE (AUTONOMOUS), MADURAI
DEPARTMENT OF STATISTICS
PG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course (Employability / Entrepreneurship / Skill development)				Scope of focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision / New
					Emp	Ent	Skill	Kno	Local	National	Global	
I	23P1SCCT1	Real Analysis & Linear Algebra	6	5			Yes	Yes			Yes	80
	23P1SCCT2	Sampling Methods	6	5	Yes		Yes	Yes			Yes	100
	23P1SCCT3	Distribution Theory	6	4	Yes		Yes	Yes			Yes	65
	23P1SECT1 (A)	Categorical Data Analysis	5	3	Yes		Yes	Yes			Yes	80
	23P1SECT1 (B)	Population Studies			Yes		Yes	Yes			Yes	New
	23P1SECT2 (A)	Bayesian Inference	3	2	Yes		Yes	Yes			Yes	New
	23P1SECT2 (B)	Clinical Trails			Yes		Yes	Yes			Yes	New
	23P1SECP1(A)	Practical in R (Core II &III based)	2	1	Yes	Yes	Yes	Yes			Yes	New
	23P1SECP1(B)	Data analysis in MS Excel (Core II &III based))			Yes	Yes	Yes	Yes			Yes	New
	23P1SECP2	Statistical Practical-I (Calculator based)	2	2	Yes	Yes	Yes	Yes			Yes	New
Total number of hours and credits			30	22								

II	23P2SCCT4	Estimation Theory	6	5	Yes		Yes	Yes			Yes	0
	23P2SCCT5	Measure and Probability Theory	6	5	Yes		Yes	Yes			Yes	20
	23P2SCCT6	Time Series Analysis	6	4	Yes		Yes	Yes			Yes	New
	23P2SECT3 (A)	Actuarial Statistics	5	3	Yes	Yes	Yes	Yes			Yes	0
	23P2SECT3 (B)	Simulation Analysis			Yes		Yes	Yes			Yes	New
	23P2SECT4 (A)	Survival Analysis	3	2	Yes		Yes	Yes			Yes	New
	23P2SECT4 (B)	Econometrics			Yes		Yes	Yes			Yes	0
	23P2SECP3 (A)	Practical in R (Core IV & VI based)	2	1	Yes	Yes	Yes	Yes			Yes	New
	23P2SECP3 (B)	Data Analysis in SPSS (Core IV & VI based)			Yes	Yes	Yes	Yes			Yes	New
	23P2SSEN1	Skill Enhancement Course (NME) – Statistical Survey	2	2	Yes	Yes	Yes	Yes			Yes	New
	Total number of hours and credits		30	22								
III	23P3SCCT7	Testing of Statistical Hypothesis	6	5	Yes		Yes	Yes			Yes	20
	23P3SCCT8	Linear Models	6	5	Yes		Yes	Yes			Yes	New
	23P3SCCT9	Multivariate Analysis	6	4	Yes	Yes	Yes	Yes			Yes	55
	23P3SCCT10	Design of Experiments	5	3	Yes	Yes	Yes	Yes			Yes	40
	23P3SMDC1	Operations Research and Cost Analysis	5	3	Yes	Yes	Yes	Yes			Yes	60
	23P3SSEN2	NME: Elements of Operations Research	2	2	Yes		Yes	Yes			Yes	0
	23P3SINTR	Internship / Industrial activity [credits]	-	2	Yes	Yes	Yes	Yes			Yes	New
	Total number of hours and credits		30	24								

IV	23P4SCCT11	Stochastic Processes	6	5	Yes		Yes	Yes			Yes	0
	23P4SCCT12	Machine Learning techniques	6	4	Yes		Yes	Yes			Yes	New
	23P4SPROV	Project with Viva Voce	8	8	Yes		Yes	Yes			Yes	-
	23P4SECT5 (A)	Statistical Quality Control	4	2	Yes	Yes	Yes	Yes			Yes	0
	23P4SECT5 (B)	Reliability Theory			Yes	Yes	Yes	Yes			Yes	26
	23P4SECP4 (A)	Practical in Python	2	1	Yes	Yes	Yes	Yes			Yes	10
	23P4SECP4 (B)	Practical in JASP			Yes	Yes	Yes	Yes			Yes	New
	23P4SSED2	Statistics for Competitive Examination	4	2	Yes	Yes	Yes	Yes			Yes	New
	23P4SEXTN	Extension Activity	-	1	Yes	Yes	Yes	Yes			Yes	New
	Ad-on Course	Research and Publication Ethics	-	2	Yes	Yes	Yes	Yes			Yes	0
	Total number of hours and credits		30	23								
	Grand Total number of hours and Credits		120	91								

Emp-Employability;

Ent-Entrepreneurship;

Skill-Skill Development

Kno-Knowledge



DEPARTMENT OF PHYSICS

Revised Curriculum

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION (TANSCHÉ)
(Choice Based Credit system with Outcome Based Education)**

Academic Year 2023-2024 onwards

III and IV semesters (B.Sc. Physics)

Allied Courses

III and IV semesters (M.Sc. Physics)



The Madura College (Autonomous), Madurai – 625 011

Department of Physics

Programme Structure for B.Sc. Physics

Semester	Course Code	Title of the Course	Hours	Credits
III	23U3TLAN3 / 23U3HLAN3 / 23U3SLAN3	Language – I Tamil / Hindi / Sanskrit	6	3
	23U3NENG3	Language – II English	6	3
	23U3PCCT3	Mechanics	4	4
	23U3PCCP3	Core – Practical	3	3
	23U3CGET1	Ancillary – Theory	4	4
	23U3CGEP1	Ancillary – Practical	2	1
	23U3PSED4	Electrical wiring	2	2
	23U3PSED5	Biomedical Instrumentation	2	2
	23U3EVST1	E.V.S.1	1	
Total			30	22

Semester	Course Code	Title of the Course	Hours	Credits
IV	23U4TLAN4 / 23U4HLAN4 / 23U4SLAN4	Language – I Tamil / Hindi / Sanskrit	3	6
	23U4NENG4	Language – II English	3	6
	23U4PCCT4	Optics and LASER Physics	4	4
	23U4PCCP4	Core – Practical	3	3
	23U4CGET2	Ancillary - Theory	4	4
	23U4CGEP2	Ancillary - Practical	2	1
	23U4PSED6	Energy Physics	2	2
	23U4PSED7	Science of Materials	2	2
	23U4EVST2	E.V.S 2	1	2
Total			24	30



The Madura College (Autonomous), Madurai – 625 011
Department of Physics
Generic Elective Courses offered to students of B.Sc. Mathematics

Semester	Course Code	Title of the Course	Hours	Credits
III	23U3PGET1	Ancillary Physics - I	4	4
	23U3PGEP1	Ancillary Physics Practical - I	2	1
IV	23U4PGET2	Ancillary Physics - II	4	4
	23U4PGEP2	Ancillary Physics Practical - II	2	1
Total			12	10



The Madura College (Autonomous), Madurai – 625 011
Department of Physics
Generic Elective Courses offered to students of B.Sc. Chemistry

Semester	Course Code	Title of the Course	Hours	Credits
I	23U1PGET1	Ancillary Physics - I	4	4
	23U1PGEP1	Ancillary Physics Practical - I	2	1
II	23U2PGET2	Ancillary Physics - II	4	4
	23U2PGEP2	Ancillary Physics Practical - II	2	1
Total			12	10



The Madura College (Autonomous), Madurai – 625 011
Department of Physics
Add-On courses offered to students of B.Sc. Physics

Semester	Course Code	Title of the Course	Hours	Credits
III	21U3PADD1	How stuff works	2	2
IV	21U4PADD2	Problem solving in Physics in selected topics	2	2

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	CC	23U3PCCT3	MECHANICS	4	4	25	75	100

Nature of course								
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented				

Objectives:

This course allows the students

- To have a basic understanding of the laws and principles of mechanics;
- To apply the concepts of forces existing in the system;
- To understand the forces of physics in everyday life; To visualize conservation laws;
- To apply Lagrangian equation to solve complex problems.

Unit	Description	Hours	K-level	CLO
I	Laws of Motion: Newton's Laws of motion – Friction – Static and dynamic friction – Laws of friction. Gravitation: Kepler's laws- Newton's law of gravitation – Determination of G by Boy's method – Mass and density of earth - Gravitational potential – Gravitational field – Gravitational potential and field at a point due to a Spherical shell – satellites – Orbital velocity – Escape velocity.	15	K3	1
II	Conservation Laws of Linear and Angular Momentum: Conservation of linear momentum – Center of mass – Motion of Velocity of centre of mass - Acceleration of centre of mass- collision – System with variable mass – Rocket– Conservation of angular momentum –Torque due to internal forces – Torque due to gravity.	15	K2	2
III	Conservation Laws of Energy: Introduction – Significance of conservation laws – Law of conservation of energy concepts of Work- Power – Energy – Conservative forces – Non-conservative forces – General law of conservation of energy.	15	K3	3
IV	Rigid Body dynamics: Translational and rotational motion – Angular momentum – Moment of inertia – Parallel and perpendicular axes theorems of moment of inertia –Moment of inertia of a rod - Moment of inertia of a circular disc and Moment of inertia of a solid sphere – Kinetic energy of rotation – Kinetic energy of a body rolling along a horizontal plane surface – Acceleration of a body rolling down an inclined plane.	15	K4	4

V	Lagrangian Mechanics: Degrees of freedom – Constraints - Generalized coordinates - Principle of virtual work and D’ Alembert’s Principle – Lagrange’s equation from D’ Alembert’s principle – Application – Simple pendulum – Atwood’s machine.	15	K3	5

Books for study:

1. Brijlal and N. Subramanyam, 2001, Properties of Matter, Eurasia Publishing House Ltd., New Delhi.
Unit I : Chapter 2.10, 2.11, 2.13, 5.2, 5.4, 5.6, 5.22, 5.23, 5.25, 5.29, 5.31
Unit II : Chapter 2.14
Unit IV: Chapter 2.18, 2.19, 3.2, 3.4, 3.9(a), 3.10, 3.11, 3.17, 3.20, 3.27, 3.28.
2. D. S. Mathur and P. S. Hemne, 2000, Mechanics, Revised Edition, S. Chand & Co.
Unit II: Chapter 6.1-6.3, 6.12, 6.14
Unit III: Chapter 5.1, 5.2, 5.3, 5.4, 5.10
3. J. C. Upadhyaya, 2018, Classical Mechanics, Himalaya Publishing house, Mumbai.
Unit V : Chapter 2.2, 2.3, 2.3.1, 2.3.2, 2.4, 2.5, 2.6, 2.7, Example 2 and 3.

Books for References:

1. Goldstein Herbert, 1980, Classical Mechanics. U.S.A: Addison and Wesley.
2. Halliday, David and Robert, Resnick, 1995, Physics Vol.I. New Age, International, Chennai.
3. Halliday, David Robert Resnick and Walker Jearl, 2001, Fundamentals of Physics, John Wiley, New Delhi.
4. P. Durai Pandian, Laxmi Durai Pandian, Muthamizh Jayapragasam, 2005, Mechanics, 6th revised edition, S. Chand & Co.
5. M. Narayanamurthi and N. Nagarathnam, 1998, Dynamics. The National Publishing, Chennai.
6. M. Narayanamurthi and N. Nagarathnam, 1982, Statics, Hydrostatics and Hydrodynamics, The National Publishers, Chennai.

Web Resources

1. <https://nptel.ac.in/courses/115103115>
2. https://onlinecourses.nptel.ac.in/noc22_me96/preview
3. https://onlinecourses.nptel.ac.in/noc21_me70/preview

Rationale for Nature of the course

This course will enable the students to comprehend the theory and concepts like moment of inertia, law of gravitation and their applications in mechanics.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Acquire knowledge in physics concepts and related problem solving skills.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. V Meenakshi Sundaram

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Newton's Laws of motion, Friction	2	PPT, Chalk and talk, Quiz, Seminar, and Test
	Static and dynamic friction, Laws of friction.	2	
	Kepler's laws- Newton's law of Gravitation – Determination of G by Boy's method	3	
	Mass and density of earth, Gravitational potential, Gravitational field	2	
	Gravitational potential and field at a point due to a Spherical shell	3	
	satellites, Orbital velocity, Escape velocity.	3	
Unit II	Conservation of linear momentum, Center of mass, motion of velocity of centre of mass.	3	Chalk and talk, Quiz, Seminar, and Test
	Acceleration of centre of mass, collision	4	
	System with variable mass, Rocket	3	
	Conservation of angular momentum	2	
	Torque due to internal forces, Torque due to gravity	3	
Unit III	Introduction, Significance of conservation laws	3	Chalk and talk, Quiz, Seminar and Assignment
	Law of conservation of energy, concepts of Work, Power, Energy, Conservative forces.	4	
	Non-conservative forces, General law of conservation of energy.	4	
		4	
Unit IV	Translational and rotational motion, Angular momentum	1	PPT, Chalk and talk, Quiz, Seminar, Group discussion and Test
	Moment of inertia, Parallel and perpendicular axes theorems of moment of inertia	4	
	Moment of inertia of a rod, Moment of inertia of a circular disc, Moment of inertia of a solid sphere	4	
	Kinetic energy of rotation, Kinetic energy of a body rolling along a horizontal plane surface	3	
	Acceleration of a body rolling down an inclined plane and problems	3	
Unit V	Degrees of freedom, Constraints	3	PPT, Chalk and talk, Quiz, Seminar and Test
	Generalized coordinates, Principle of virtual work	3	
	D'Alembert's Principle	2	
	Lagrange's equation from D'Alembert's principle –	4	
	Application – Simple pendulum – Atwood's machine	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Understand the Newton's Law of motion understand the Kepler's laws and Realize the basic principles behind planetary motion.	K3
2	Acquire the knowledge on the conservation laws	K2
3	Apply conservation law and calculate energy of various systems, understand and differentiate conservative and non-conservative forces	K3
4	Gain knowledge on rigid body dynamics and solve problems based on this concept	K4
5	Appreciate Lagrangian system of mechanics, apply D' Alemberts principle	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	3	2
CLO-2	3	2	2	2	1
CLO-3	3	3	2	1	1
CLO-4	3	3	3	3	3
CLO-5	3	2	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	1	2	2
CLO2	3	3	2	2	2	1
CLO3	3	2	2	2	2	1
CLO4	3	2	3	1	1	1
CLO5	3	2	2	1	2	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section-A		Section-B		Sec-C	Sec-D
			MCQs.		Short Answers		(Either OR)	Open Choicee
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO1	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
2	CLO2	Upto K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
3	CLO3	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO4	Upto K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
5	CLO5	Upto K3	2	K1&K2	1	K1	2(K3&K3)	1(K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each section			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	SectionA (No Choice)	SectionB (No Choice)	Section C (Either/or)	SectionD (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Core practical	23U3PCCP3	Practical – II	3	3			

Nature of course								
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented				

Objectives:

Apply various Physics concepts to understand concepts of Light, electricity and Magnetism set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results.

Course Details
1. Refractive Index :Spectrometer A and D 2. Air Wedge : Thickness of wire 3. Carey Foster Bridge :Resistance and specific resistance 4. Carey Foster Bridge :Temperature coefficient 5. Potentiometer: Calibration of low range voltmeter 6. Potentiometer :Calibration of ammeter 7. Potentiometer :Comparison of EMF's 8. Spot Galvanometer : Figure of Merit 9. Spot Galvanometer : Charge sensitivity 10. Spot Galvanometer :Comparison of EMF's 11. Spot Galvanometer :Comparison of capacities 12. Owen's Bridge : C1/C2 13. DeSauty's Bridge : C1/C2 14. Long focus convex lens. 15. LCR :Series Resonance circuit-L and Q 16. LCR :Parallel Resonance circuit- L and Q 17. Spot Galvanometer : Determination of mutual inductance 18. Spot Galvanometer : Comparison of mutual inductance

Books for study:

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
3. Electronic lab manual Vol I, K ANavas, Rajath Publishing

Books for References:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd
3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.

Course Designer(s):

1. Mr.T.Vivekanandan
2. Dr.M. Kavitha

Course Learning Outcomes:

At the end the course, student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Upto K2
CLO-2	Apply knowledge of physics and able to construct the relevant circuits.	Upto K3
CLO-3	Complete the experiment and the relevant data can be recorded.	Upto K3
CLO-4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Upto K4
CLO-5	Interpret the results and proper views can be expressed.	Upto K2

Mapping of CLOs with PSOs**MAPPING WITH PROGRAM OUTCOMES:**

Map course outcomes (CO) for each course with program outcomes (PO) and program specific outcomes (PSO) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	3	3
CO2	2	2	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	SEC	23U3PSED4	ELECTRICAL WIRING	2	2	25	75	100

Nature of course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓	

Objectives:

In this course, the student will understand

- The basics of AC circuits and learn about Electrical Installations.
- To acquire the knowledge of Design of Simple Electrical Circuits.
- They will know about the guidelines for sub-circuits, fittings and Simple Wiring Schemes.
- To know about electrical protective devices and electrical estimation.

Unit	Description	Hours	K-level	CLO
I	Basic Concepts : Ohm's law – Kirchhoff's law – Superposition theorem – Thevenin's theorem – Norton's theorem - Reciprocity theorem .	6	K2	1
II	Design Considerations of Electrical Installations: Electric supply system – Three Phase four wire distribution system – Protection of electric installation against overload, short circuit, earth fault and electric shock – Single phase supply .	6	K3	2
III	Electrical Wiring: Introduction - List of Symbols - Supply Voltages- Service Connection - Interior wiring- Guidelines for sub-circuits and fittings - Simple Wiring Schemes -Two way controls of lamps -Three way control of lamps.	6	K4	3
IV	Design of Simple Electrical Circuits: Electrical diagram – Methods of representation for wiring diagram – Introduction to simple light and fan circuits – System of connection of appliances and accessories – Examples of circuit wiring diagram of light and fan circuits.	6	K3	4
V	Electrical protective devices and Electrical estimation : Fuses- Miniature circuit breaker (MCB) - Earth Leakage Circuit Breaker (ELCB) - Earthing- Computation of Energy consumed.	6	K2	5

Books for study

1. **“Basic Electrical Engineering”** by K. Uma Rao and A.Jayalakshmi, Sanguine Technical Publishers, Bangalore. 2014.
Unit I – 1.3, 1.5, 3.6-3.8, 3.10. (No problems)
Unit III – 6.1 – 6.9
Unit V – 6.11 – 6.15
2. **“Electrical Design Estimating and Costing”** by K. B. Raina and S.K. Bhattacharya, New Age International (P) Ltd Publishers, New Delhi, 2007
Unit II – 4.1,4.2,4.3,4.3.1,4.3.2, 4.3.3, 4.3.5, 4.5.7..
Unit IV–1.3, 1.4, 2.1, 2.2, 2.3, 2.3.1, 2.3.3, 2.3.4, 2.3.9, 2.3.10.

Books for References:

1. V.K. Metha, “Principles of Electrical Engineering and Electronics”, S. Chand & Company Ltd, 2012.
2. Uppal S.L, “Electrical Wiring - Estimating and Costing”, Khanna Publishers, Sixth edition 2011.

Web Resources

1. <https://www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/a/ee-kirchhoffs-laws>
2. https://www.electronics-tutorials.ws/dccircuits/dcp_7.html
3. <https://testbook.com/electrical-engineering/nortons-theorem-statement-proof-and-problems>
4. <https://www.electrical4u.com/delta-star-transformation-star-delta-transformation/>
5. <https://www.sciencedirect.com/topics/engineering/three-phase-four-wire-system>
6. <https://byjus.com/physics/difference-between-earth-and-neutral/>
7. <https://www.pinterest.com/pin/simple-home-electrical-wiring-diagrams--307722587036415821/>
8. <http://www.faadooengineers.com/online-study/post/eee/electrical-system-design-and-estimation/700/methods-for-representation-for-wiring-diagrams#:~:text=A%20wiring%20diagram%20may%20be,as%20shown%20in%20fig%202>

Rationale for Nature of the course

The student will be able to learn effectively single phase and three phase wiring distribution system for the construction of house. Understand the working of MCB and proper earthing of electrical house appliances. May design and connection of simple light and fan circuits of his own.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students learned the connection of single phase and three phase supply for house appliances and simple electrical circuit diagram for light and fan.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Group discussion, interaction and field visit.

Course Designer(s):

Mr. V. Meenakshi Sundaram

Course Schedule

Unit	Topics	Hrs	Mode
I	Ohm's law, Kirchhoff's law	2	PPT, Chalk and talk, Quiz, Seminar, and Test
	Superposition theorem, Thevenin's theorem	2	
	Norton's theorem, Reciprocity theorem,	2	
II	Electric supply system, Three Phase four wire distribution system.	2	Chalk and talk, Quiz, Seminar, and Test
	Protection of electric installation against overload, short circuit, earth fault and electric shock	3	
	Single phase supply	1	
III	Introduction, List of Symbols, Supply Voltages, Service Connection.	2	PPT, Chalk and talk, Quiz, Seminar, and Test
	Interior wiring, Guidelines for sub-circuits and fittings.	2	
	Simple Wiring Schemes, Two way control of lamps, Three way control of lamps.	2	
IV	Electrical diagram, Methods of Representation for wiring diagram.	2	PPT, Chalk and talk, Quiz, Seminar, and Test
	Introduction to simple light and fan circuits.	1	
	System of connection of appliances and accessories, Solved examples of light and fan circuits.	3	
V	Fuses, Miniature circuit breaker (MCB)	2	PPT, Chalk and talk, Quiz, Seminar, and assignment
	Earth Leakage Circuit Breaker (ELCB).	2	
	Earthing, Computation of Energy consumed	2	

Course Learning Outcomes:

At the end of the course, student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Understand the basic laws and theorems of electrical circuits.	K2
2	Explain the details of single phase, three phase supply system	K3
3	Illustrate the simple wiring connections for two ways, three way control lamp circuits.	K4
4	Express the simple electrical wiring diagram for light and fan circuits.	K3
5	Explain the working of electrical accessories and compute the consumer energy.	K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	1	1
CLO-2	3	2	3	1	2
CLO-3	3	2	3	2	2
CLO-4	3	2	3	1	2
CLO-5	3	2	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	2	2
CLO2	3	2	2	2	1	1
CLO3	3	2	2	2	1	2
CLO4	3	2	2	2	1	1
CLO5	3	2	2	1	1	1

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Unit	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	SectionD (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K2	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1 (K3)
3	CLO 3	Up to K4	2	K1 & K2	1	K1	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K3)
5	CLO 5	Up to K2	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K2)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each question			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	SectionA (No Choice)	SectionB (No Choice)	Section C (Either/or)	SectionD (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	SEC	23U3PSED5	BIO MEDICAL INSTRUMENTATION	2	2	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented

Objectives:

- To make students to understand medical instruments and components of the Biomedical instrument system
- To understand the basics of various biomedical instruments like ECG and EEG.

Unit	Description	Hours	K-level	CLO
I	Design of medical instruments – Components of the Biomedical instrument system –Electrodes- Half cell potential – Purpose of electrode paste- Types of electrodes –Transducers–Active transducers – Magnetic induction type transducers – Piezoelectric type transducers	6	K2	1
II	Biopotential recorders – Characteristics of recording system – Writer and Pen damping system –Electrocardiography – Origin of cardiac potential – ECG lead configurations – Practical considerations for ECG recording.	6	K4	2
III	Electroencephalography – Origin of EEG – Brain waves– Placement of electrodes – Recording setup – Analysis of EEG.	6	K3	3
IV	Computers in medicine – Lasers in medicine – Endoscopes.	6	K2	4
V	Computer Tomography – Magnetic resonance Imaging – Magnetic resonance phenomenon - Magnetic resonance spectroscopy in vivo– Magnetic resonance imaging .	6	K3	5

Book for study:

“Biomedical instrumentation” by Dr. M. Arumugam, Anuradha publications, Chennai, 2008 Reprint”

Unit I: Chapter II – Sections 2.2, 2.3, 2.4 (2.4.1 - 2.4.3), 2.4.4, 2.5 (2.5.1-2.5.3)

Unit II: Chapter IV – Sections 4.2, 4.2.1, 4.3 (4.3.1, 4.3.2, 4.3.4)

Unit III: Chapter IV – Sections 4.4, 4.4.1 – 4.4.5

Unit IV: Chapter X – Sections 10.2, 10.3, 10.4

Unit V: Chapter X – Sections 10.7, 10.10, 10.10.1- 10.10.3

Books for References:

1. Handbook of Biomedical instrumentation by R.S. Khandpur and Raghbir Khandpur, TMH, Second edition, 1987
2. Biomedical instrumentation and measurements by R. Ananda Natarajan, PHI India, Second edition, 1995

Web Resources

1. <https://www.coursera.org/courses?query=biomedical%20engineering>
2. <https://www.edx.org/learn/biomedical-engineering>
3. <https://www.classcentral.com/course/swayam-biomedical-instrumentation-sensors-204236>
4. <https://nptel.ac.in/courses/108105101>

Rationale for Nature of the course

This course will enhance the skill and knowledge of various medical instruments and components.

Activities having direct bearing on Skill development / Employability Entrepreneurship

In this course, the student will get idea about design of medical instruments and components of the Biomedical instrument system and get knowledge about characteristics of bio potential recording system. Student will understand the operation and uses of ECG, EEG equipments and understand the application of Lasers and Computers in the field of medicine.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer:

Dr. J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Design of medical instruments – Components of the Biomedical instrument system –Electrodes- Half cell potential – Purpose of electrode paste- Types of electrodes	3	PPT, Chalk and talk, Quiz, test and seminar
	Transducers–Active transducers – Magnetic induction type transducers – Piezoelectric type transducers	3	
II	Bio-potential recorders – Characteristics of recording system – Writer and Pen damping system –	3	PPT, Chalk and talk, Quiz, test and seminar
	Electrocardiography – Origin of cardiac potential – ECG lead configurations – Practical considerations for ECG recording.	3	
III	Electroencephalography – Origin of EEG – Brain waves	3	PPT, Chalk and talk, Quiz, test and seminar
	Placement of electrodes – Recording setup – Analysis of EEG.	3	
IV	Computers in medicine – Lasers in medicine	3	PPT, Chalk and talk, Quiz, test and seminar
	Endoscopes.	3	
V	Computer Tomography – Magnetic resonance Imaging – Magnetic resonance phenomenon.	3	PPT, Chalk and talk, Quiz, test assignment and seminar
	Magnetic resonance spectroscopy in vivo– Magnetic resonance imaging.	3	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Understand the Design of medical instruments and Components of the Biomedical instrument system.	K2
2	Apply the knowledge of Origin of cardiac potential and Practical considerations for ECG recording.	K4
3	Understand Origin of EEG , Brain waves and Placement of electrodes conversion	K3
4	Analyze the uses of Computers and Lasers in medicine	K2
5	Understand the basics of Magnetic resonance Imaging.	K3

Mapping of CLOs with PSOs

CLO	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
1	3	2	3	3	2
2	2	3	3	3	2
3	3	3	2	3	3
4	3	3	3	3	3
5	3	2	3	3	2

Mapping of CLOs with POs

CLO	PO1	PO2	PO3	PO4	PO5	PO6
1	2	3	3	3	3	3
2	3	2	3	3	3	3
3	3	2	3	3	3	3
4	3	3	3	2	2	3
5	3	3	2	3	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Assessment Scheme
Blue print for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation Mapping-K Levels
with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K4	2	K3&K3	1	K1	2 (K4&K4)	1(K4)
3	CLO 3	Up to K3	2	K2&K2	1	K2	2 (K2&K2)	1(K3)
4	CLO 4	Up to K2	2	K2&K2	1	K2	2 (K2&K2)	1(K2)
5	CLO 5	Up to K3	2	K3&K3	1	K2	2(K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1-Rememberingandrecallingfactswithspecific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3-Applicationoriented–SolvingProblems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Core	23U4PCCT4	Optics and LASER Physics	4	4	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To provide an in-depth understanding of the basics of various phenomena in geometrical and wave optics
- To explain the behaviour of light in different mediums
- To understand the differences in the important phenomena namely interference, diffraction and Polarization and apply the knowledge in day to day life;
- To understand the design of optical systems and methods to minimis aberrations
- To understand the working and applications of laser

Unit	Description	Hours	K-level	CLO
I	Lens and Prisms: Fermat's principle of least time – thin lens – terminology –lens maker's formula. Prism: dispersion – dispersive power –deviation without dispersion – direct vision spectroscopy. Aberrations: spherical aberration – chromatic aberrations – curvature of the field – distortion – chromatic aberrations methods. Eyepieces – Huygens and Ramsdens eyepieces – construction and working – merits and demerits of the eyepiece. Resolving power: Rayleigh's criterion for resolution – limit of resolution for the eye – resolving power of Prism	12	K2	1
II	Interference Introduction – superposition of waves – Interference – conditions for interference – techniques – Fresnel's biprism – fringes with white light: interference in thin films due to reflected light and transmitted light – colors of thin films applications – air wedge – Newton's rings. Michelson's interferometer – applications: determination of the wavelength of a monochromatic source of light, determination of the wavelength and separation D1 and D2 lines of sodium light, determination of a thickness of a mica sheet.	12	K3	2

III	Diffraction: Fresnel's assumptions – zone plate – action of zone plate for an incident spherical wave front – differences between a zone plate and a convex lens – difference between interference and diffraction – diffraction pattern due to a straight edge – positions of maximum and minimum intensities – diffraction due to a narrow slit – Fraunhofer type of diffraction – Fraunhofer diffraction at a single slit – plane diffraction grating– experiment to determine wavelengths – width of principal maxima.	12	K4	3
IV	Polarization: Polarization – Polaroid's and applications – polarizer and analyzer – double refraction – Huygens 's explanation of double refraction in uniaxial crystals – phase difference between e and o ray – quarter wave plate – half wave plate – production and detection of circularly and elliptically polarized lights.	12	K3	4
V	LASER: Interaction of light with matter – spontaneous and stimulated emission –LASING action – He-Ne laser – CO ₂ laser semiconductor laser – laser applications – holography: Introduction, principle, recording and reconstruction of the image.	12	K3	5

Books for study:

1. A textbook of Optics Subramanyam, BrijLal, & Avadhanalu 2016, Optics, 25th Edn, S.Chand and Co.
Unit 1: Chapter: 2.1, 4.1,4.2,4.3,4.8-4.10, 8.1, 8.4,8.6,8.8,9.2,9.5,9.8,-9.10, 10.8, 10.10,10.11, 19.1,19.2,19.3,19.11.
Unit 2: Chapter: 14.1,14.3,14.4,14.7,14.8,14.9,14.9.3,15.2,15.3,15.5,15.6 (only), 15.7,15.8
Unit 3: Chapter: 17.3,17.5,17.6, 17.10,17.10.1,17.11,18.2 only, 18.7, 18.7.1, 18.7.2, 18.7.6
Unit 4: Chapter: 20.7,20.8,20.11,20.11.1,20.17,20.19,20.20,20.21,
Unit 5: Chapter: 22.4, 22.9,22.14.3 -22.14.5, 23.1,23.2,23.2.1,23.2.2.

Books for References:

1. Sathyaprakash, 1990, Optics, VII edition, Ratan Prakashan Mandhir, New Delhi.
2. Ajoy Ghatak, 2009, Optics, 4th edition, PHI Pvt Ltd, New Delhi.
3. D.Halliday, R.Resnick and J. Walker, 2001, Fundamentals of Physics, 6th edition, Willey, New York.
4. Jenkins A.Francis and White, 2011, Fundamentals of Optics, 4th edition, McGraw Hill Inc., New Delhi.
5. P.R.Sasikumar, 2012, Photonics, PHI Pvt, Ltd, New Delhi.
6. V.Rajendran, 2012, Engineering Physics, Tata McGraw Hill.

Web Resources

1. <https://science.nasa.gov/ems/>
2. <https://imagine.gsfc.nasa.gov/educators/gammaraybursts/imagine/index.html>
3. <http://www.thephysicsmill.com/2014/03/23/sky-blue-lord-rayleigh-sir-raman-scattering/>

Rationale for Nature of the course

Through the study of optics, we can obtain cutting-edge themes for contemporary research. It's there in everything we do, from fibre-optic communication to contact lenses.

Activities having direct bearing on Skill development / Employability Entrepreneurship

In physics, optics is significant because it clarifies the characteristics and behaviour of light. By comprehending the processes of light generation, propagation, and detection, scientists and specialists can uncover a multitude of uses. Its uses can be found in a variety of fields, including communication, medicine, and photography.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. Dr.M.Kavitha
2. Dr.S.Ramakrishnan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Fermat's principle of least time – thin lens – terminology –lens maker's formula	2	PPT, Chalk and talk, Quiz and seminar,Test
	Prism: dispersion – dispersive power –deviation without dispersion – direct vision spectroscope	3	
	Aberrations: spherical aberration – chromatic aberrations – curvature of the field – distortion – chromatic aberrations methods.	3	
	Eyepieces – Huygens and Ramsdens eyepieces – construction and working – merits and demerits of the eyepiece.	2	
	Rayleigh's criterion for resolution – limit of resolution for the eye – resolving power of Prism	2	

Unit II	Introduction – superposition of waves – Interference – conditions for interference – techniques	3	PPT, Chalk and talk, Quiz and seminar, test
	Fresnel's biprism – fringes with white light: interference in thin films due to reflected light and transmitted light	3	
	Colours of thin films applications – air wedge – Newton's rings.	3	
	Michelson's interferometer – applications: determination of the wavelength of a monochromatic source of light, determination of the wavelength and separation D1 and D2 lines of sodium light, determination of a thickness of a mica sheet.	3	
Unit III	Fresnel's assumptions – zone plate – action of zone plate for an incident spherical wave front	3	Chalk and talk, Quiz and seminar, test
	differences between a zone plate and a convex lens – difference between interference and diffraction – diffraction pattern due to a straight edge	3	
	positions of maximum and minimum intensities – diffraction due to a narrow slit	2	
	Fraunhofer type of diffraction – Fraunhofer diffraction at a single slit – plane diffraction grating–	3	
	Experiment to determine wavelengths – width of principal maxima.	1	
Unit IV	Polarization – Polaroid's and applications – polarizer and analyzer	3	Chalk and talk, Quiz and seminar, test.
	double refraction – Huygens 's explanation of double refraction in uniaxial crystals	3	
	phase difference between e and o ray – quarter wave plate – half wave plate	3	
	Production and detection of circularly and elliptically polarized lights.	3	
Unit V	Interaction of light with matter – spontaneous and stimulated emission –LASING action	3	PPT, Chalk and talk, Quiz, seminar and assignment
	He-Ne laser	3	
	CO ₂ laser semiconductor laser – laser applications	3	
	Holography – introduction – principle – recording – reconstruction of the image.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Outline basic knowledge of methods of rectifying different defects in lenses, articulate technological applications of eyepieces	K2
CLO-2	Discuss the principle of superposition of wave, use these ideas to understand the wave nature of light through working of interferometer	K3
CLO-3	Extend the knowledge about nature of light through diffraction techniques; apply mathematical principles to analyse the optical instruments	K4
CLO-4	Interpret basic formulation of polarization and gain knowledge about polarimeter, appraise its usage in industries	K3
CLO-5	Develop the principles of optics to various fields of IR, Raman and UV spectroscopy and understand their instrumentation and application in industries	K3
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	2	2
CLO-2	3	3	3	2	2
CLO-3	3	3	3	2	2
CLO-4	3	3	3	2	2
CLO-5	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	1	1
CLO2	3	3	2	2	1	1
CLO3	3	3	2	2	2	1
CLO4	3	3	2	2	1	2
CLO5	3	3	2	2	2	1

Advance application– 3; Intermediate level–2; Basic level–1

Assessment Scheme
Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs)
Blueprint for Semester Examination

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Upto K2	2	K1 & K2	1	K1	2 (K1&K1)	1 (K2)
2	CLO2	Upto K3	2	K1 & K2	1	K2	2 (K2&K2)	1 (K3)
3	CLO3	Upto K4	2	K1 & K2	1	K2	2 (K4&K4)	1 (K4)
4	CLO4	Upto K3	2	K1 & K2	1	K1	2 (K3&K3)	1 (K3)
5	CLO5	Upto K3	2	K1 & K2	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	SectionA (No Choice)	SectionB (No Choice)	Section C (Either/or)	SectionD (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Core Practical	23U4PCCP4	Practical – IV	3	3	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

Apply various Physics concepts to understand concepts of Light, electricity and Magnetism set up experimentation to verify theories, quantify and analyse, able to do error analysis and correlate results

Course Details
1. M.G.Thermocouple – Determination of thermo-emf 2. Anderson's bridge-Determination of self induction of a given coil 3. Determination of M and B_H : Tan C method 4. Grating :Spectrometer - N and λ 5. Newton's Rings: Radius and Wavelength measurements 6. Field along the axis of the coil 7. Rayleigh's Bridge :Self Inductance 8. Maxwell's Bridge :Self Inductance 9. Spectrometer : i –d curve 10. Impedance and power factor : LR circuit 11. Impedance and power factor : CR circuit 12. Long focus concave lens

Books for study:

1. Practical Physics, Gupta and Kumar, Pragati Prakasan

Books for References:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd
3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.

Course Designer(s):

1. Mr.T.Vivekanandan
2. Dr.M. Kavitha

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the basic laws of physics that can be used to determine the various physical parameters.	Upto K2
CLO-2	Apply knowledge of physics and able to construct the relevant circuits.	Upto K3
CLO-3	Complete the experiment and the relevant data can be recorded.	Upto K3
CLO-4	Analyse the collected data from the experiment and relevant graphs can be drawn.	Upto K4
CLO-5	Interpret the results and proper views can be expressed.	Upto K2

Mapping of CLOs with PSOs**MAPPING WITH PROGRAM OUTCOMES:**

Map course outcomes (**CO**) for each course with program outcomes (**PO**) and program specific outcomes (**PSO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	3	2
CO2	2	2	3	3	3	2
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

DEPARTMENT OF PHYSICS				CLASS: II BSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	SEC	23U4PSED6	ENERGY PHYSICS	2	2	25	75	100

Nature of course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓	

Objectives:

- To make students to understand different energy sources.
- To understand the basics of conventional and non-conventional energy sources.

Unit	Description	Hours	K-level	CLO
I	INTRODUCTION TO ENERGY SOURCES Renewable Energy – Non Renewable Energy - energy sources and their availability – conventional energy sources – non-conventional and renewable energy sources – comparison – merits and demerits.	6	K2	1
II	SOLAR ENERGY Solar energy Introduction – solar constant – solar radiation at the Earth's surface – solar radiation geometry – Solar radiation measurements – solar cooker – solar water heater – greenhouse effect – solar cells.	6	K4	2
III	WIND ENERGY Introduction – nature of the wind – basic principle of wind energy conversion – basic components of Wind Energy Conversion Systems (WECS) – advantages and disadvantages of WECS – applications – tidal energy	6	K3	3
IV	BIOMASS ENERGY Introduction – classification – biomass conversion technologies – photosynthesis – fermentation - biogas generation – classification of biogas plants – advantages and disadvantages.	6	K4	4
V	ENERGY STORAGE Importance of energy storage- batteries - lead acid battery - nickel-cadmium battery – fuel cells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells - hydrogen storage.	6	K3	5

Books for study:

1. G.D. Rai, Non-Conventional Sources of Energy, Khanna Publishers, 2009, 4th Edn.
2. S.P. Sukhstme, J K Nayak, Solar Energy, Principles of Thermal Collection and Storage, McGraw Hill, 2008, 3rd Edn.
3. D.P. Kothari, K P Singal, Rakesh Rajan, PHI Learning Pvt Ltd, 2011, 2nd Edn.

Books for References:

1. John Twidell and Tony Weir, Renewable Energy Resources, Taylor and Francis, 2005, 2nd Edn.
2. S.A. Abbasi and Nasema Abbasi, Renewable Energy sources and their environmental impact, PHI Learning Pvt. Ltd, 2008.
3. M. P. Agarwal, Solar Energy, S. Chand and Co. Ltd., New Delhi, 1982
4. H. C. Jain, Non-Conventional Sources of Energy, Sterling Publishers, 1986.

Web Resources

1. <https://nptel.ac.in/courses/103103206>
2. https://onlinecourses.nptel.ac.in/noc23_ph35/preview
3. <https://mnre.gov.in/annual-reports-2021-22/>
4. <https://pib.gov.in/FeaturesDeatils.aspx?NoteId=151141&ModuleId%20=%2020>

Rationale for Nature of the course

This course will enhance the skill and knowledge of various energy conversion and storage devices

Activities having direct bearing on Skill development / Employability Entrepreneurship

Energy Physics give an in-depth introduction to understand different energy sources. This course will help to understand the basics of conventional and non-conventional energy sources like Oil, Natural gas, Coal and Solar energy, wind energy, Biomass energy respectively. Further this course will give knowledge about various energy storage systems.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

Dr. J.Sivasubramanian

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Renewable Energy –Non Renewable Energy - energy sources and their availability	3	PPT, Chalk and talk, Quiz, test and seminar
	Conventional energy sources – non-conventional and renewable energy sources – comparison – merits and demerits.	3	
II	Solar energy Introduction – solar constant – solar radiation at the Earth's surface – solar radiation geometry	3	PPT, Chalk and talk, Quiz, test and seminar
	Solar radiation measurements – solar cooker – solar water heater – greenhouse effect – solar cells.	3	
III	Introduction –nature of the wind – basic principle of wind energy conversion	3	PPT, Chalk and talk, Quiz, test and seminar
	basic components of Wind Energy Conversion Systems (WECS) – advantages and disadvantages of WECS – applications – tidal energy	3	
IV	Introduction – classification – biomass conversion technologies –photosynthesis – fermentation	3	PPT, Chalk and talk, Quiz, test and seminar
	Biogas generation – classification of biogas plants – advantages and disadvantages.	3	
V	Importance of energy storage - batteries - lead acid battery - nickel-cadmium battery	3	PPT, Chalk and talk, Quiz, test, assignment and seminar
	Fuel cells – types of fuel cells – advantages and disadvantages of fuel cells – applications of fuel cells- hydrogen storage.	3	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Understand the world energy future and energy sources and their availability.	K2
CLO2	Apply the knowledge of Solar energy in various storage systems.	K4
CLO3	Understand nature of the wind and basic principle of wind energy conversion	K3
CLO4	Analyze the biomass conversion technologies and classify the advantages and disadvantages	K4
CLO5	Understand the basics of fuel cells.	K3

Mapping of CLOs with PSOs

CLOs	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	2	3	2
CLO-2	3	3	3	3	3
CLO-3	3	3	3	2	3
CLO-4	3	3	2	3	2
CLO-5	3	2	2	3	3

Mapping of CLOs with POs

CLOs	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	2	3	2	2
CLO2	3	3	3	2	3	3
CLO3	2	2	3	2	3	3
CLO4	3	3	2	3	3	3
CLO5	3	2	3	3	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Assessment Scheme
Blue print for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation Mapping-K Levels
with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K4	2	K3&K3	1	K1	2 (K4&K4)	1(K4)
3	CLO 3	Up to K3	2	K2&K2	1	K2	2 (K2&K2)	1(K3)
4	CLO 4	Up to K4	2	K4&K4	1	K3	2 (K4&K4)	1(K4)
5	CLO 5	Up to K3	2	K3&K3	1	K2	2(K3&K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1-Rememberingandrecallingfactswithspecific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3-Applicationoriented–SolvingProblems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00

DEPARTMENT OF PHYSICS					CLASS: II B. Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	SEC	23U4PSED7	Science of Materials	2	2	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To learn imperfections in crystals, deformation of materials and testing of materials.
- To get knowledge on behavior of a material, under the action of light and their applications.
- To know the applications of crystal defects.

Unit	Description	Hours	K-level	CLO
I	Crystal Imperfections: Point defects: Vacancies, interstitials, impurities, electronic defects – Application of point defects – Line defects: Edge dislocation, Screw dislocation.	6	K3	1
II	Material Deformation: Elastic behavior of materials – Atomic model of elastic behavior – Modulus as a parameter in design – Rubber like elasticity.	6	K2	2
III	Permanent Deformation And Strengthening Methods Of Materials: Plastic deformation: Tensile stress-strain curve – Plastic deformation by slip – Creep: Mechanism of creep – Creep resistant materials.	6	K3	3
IV	Optical Materials: Nonlinear Optical materials – Applications of nonlinear optical materials: Optical gratings – Self phase modulation – Dispersion free optical fibers – Optical solitons – Parametric amplifiers.	6	K3	4
V	Mechanical Testing: Destructive testing: tensile test, compression test – Nondestructive testing (NDT): Ultrasonic methods – Thermal methods of NDT: Metallurgical microscope	6	K4	5

Books for study:

1. Materials Science, Dr. M. Arumugam, Anuradha Publications, Reprint 2011.
Unit I : Chapter 3 – 3.9, 3.9.1, 3.9.2.
Unit IV : Chapter 10 – 10.3, Applications (ii, iii, iv, vi, vii)
Unit V : Chapter 12 – 12.6(1, 2), 12.6.1, 12.6.8, 12.6.9, 12.7 only.
2. Material science and Engineering, Raghavan V, Prentice Hall of India, Sixth Edition, 2015
Unit II : Chapter 10 – 10.1, 10.2, 10.3
Unit III : Chapter 11 – 11.1, 11.2, 11.12, 11.13

Books for References:

1. Materials science, V. Rajendran, McGraw Hill publications 2011.
2. William D. Callister, Jr., Material Science and Engineering – An Introduction, 8th Edition, John Wiley and Sons, Inc., 2007
3. W. Bolton, “Engineering materials technology”, 3rd Edition, Butterworth and Heinemann, 2001.
4. Donald R. Askeland, Pradeep P. Phule, “The Science and Engineering of Materials”, 5th Edition, Thomson Learning, First Indian Reprint, 2007.
5. William F. Smith, “Structure and Properties of Engineering Alloys”, Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.

Web Resources

1. <https://ocw.ui.ac.id/mod/resource/view.php?id=8963>
2. <https://onlinelibrary.wiley.com/journal/21951071>
3. <https://www.rapiddirect.com/blog/what-is-mechanical-testing>

Rationale for Nature of the course

It renders the knowledge about materials and various properties like defects, elastic limit and testing methods etc.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Material science is an interdisciplinary field of researching and discovering materials and also focusing on a better understanding of how we can control the basic building blocks of materials, the materials' atomic and electronic configurations, in order to develop new and improved products, such as more energy efficient and environmentally friendly materials.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

1. **Dr. S.Angayarkanni**
2. **Dr. M. Revathi**

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Point defects: Vacancies (problems), interstitials, impurities, electronic defects.	3	PPT, Chalk and talk,
	Application of point defects – Line defects – Edge dislocation, Screw dislocation	3	Quiz, test and seminar
Unit II	Elastic behavior of materials – Atomic model of elastic behavior.	3	PPT, Chalk and talk, Quiz, test and seminar
	Modulus as a parameter in design – Rubber like elasticity	3	
Unit III	Plastic deformation: Tensile stress-strain curve – Plastic deformation by slip	3	PPT, Chalk and talk, Quiz, test and seminar
	Creep: Mechanism of creep – Creep resistant materials.	3	
Unit IV	Nonlinear Optical materials – Applications of nonlinear optical materials: Optical gratings.	3	PPT, Chalk and talk, Quiz, test and seminar
	Self phase modulation – Dispersion free optical fibers – Optical solitons – Parametric amplifiers.	3	
Unit V	Destructive testing: tensile test, compression test.	3	PPT, Chalk and talk, Quiz, test, assignment and seminar
	Non destructive testing (NDT): Ultrasonic methods – thermal methods of NDT: Metallurgical microscope.	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Apply the complete idea about the dislocations and the mechanisms of defects.	K3
CLO-2	Illustrate the role of elastic and inelastic behavior of Materials.	K2
CLO-3	Develop the possible cause of plastic deformation, Creep and the strengthening mechanisms.	K3
CLO-4	Identify the nature of optical properties of material and its applications.	K3
CLO-5	Categorize the various types of testing methods in materials.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	1	2	3
CLO-2	3	1	3	1	2
CLO-3	3	1	2	2	3
CLO-4	3	2	2	3	3
CLO-5	3	3	2	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	3
CLO2	3	2	2	1	2	3
CLO3	3	2	2	2	3	3
CLO4	3	2	3	2	3	3
CLO5	3	2	3	2	3	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Assessment Scheme
Blue print for Semester Examination
Learning Outcome Based Education (LOBE) & Assessment Articulation Mapping-K Levels
with Courses Learning Outcomes (CLOs)

Units	CLOs	K-Level	Section A		Section B		Section C(Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO1	Upto K3	2	K1&K2	1	K2	2(K2&K2)	1(K3)
2	CLO2	Upto K2	2	K1&K2	1	K1	2(K1&K1)	1(K2)
3	CLO3	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
4	CLO4	Upto K3	2	K1&K2	1	K2	2(K3&K3)	1(K3)
5	CLO5	Upto K4	2	K1&K2	1	K2	2(K4&K4)	1(K4)
No. of Questions to be Asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

K1-Rememberingandrecallingfactswithspecific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3-Applicationoriented–SolvingProblems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%



The Madura College (Autonomous), Madurai – 625 011
Department of Physics
UG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course			Scope of Focus			Percentage of Revision/ New
					Empl	Ent	Skill	Local	National	Global	
III	23U3PCCT3	Mechanics	4	4			Y			Y	39.6
	23U3PCCP3	Core – Practical	3	3			Y		Y		66.6
	23U3PSED4	Electrical wiring	2	2	Y		Y	Y			New
	23U3PSED5	Biomedical Instrumentation	2	2			Y		Y		10
	23U3EVST1	E.V.S.1	1						Y		
IV	23U4PCCT4	Optics and LASER Physics	4	4			Y		Y		55
	23U4PCCP4	Core – Practical	3	3			Y		Y		50
	23U4PSED6	Energy Physics	2	2			Y			Y	7
	23U4PSED7	Science of Materials	2	2			Y			Y	New
	23U4EVST2	E.V.S 2	2	1					Y		

***Empl - Employability; Ent - Entrepreneurship; Skill - Skill Development**



The Madura College (Autonomous), Madurai – 625 011
Department of Physics
PG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits
III	23P3PCCT5	Quantum Mechanics –II	6	5
	23P3PCCT6	Condensed Matter Physics	6	5
	23P3PCCP3	Practical III	6	4
	23P3PECT5	Electromagnetic theory	5	3
	23P3PECT5	Microprocessor 8086 and Microcontroller 8051	5	3
	23P3PMDC1	Material science	5	3
	23P3PSEN2	NME	2	2
	23P3PINTR	Internship / Industrial activity		2
Total			30	24

Semester	Course Code	Title of the Course	Hours	Credits
IV	23P4PCCT7	Nuclear and Particle Physics	6	5
	23P4PCCP4	Practical IV	6	4
	23P4PPROV	Project with Viva-Voce	8	8
	23P4PECT6	Spectroscopy	6	3
	23P4PECT6	Analysis of Crystal structure	6	3
	23P4PSED2	NET/SET/TNPSC Coaching	4	2
	23P4PEXTN	Extension activity		1
Total			30	23

NME course offered by the department

Semester	Course Code	Title of the Course	Hours	Credits
III	23P3PSEN2	Astrophysics	2	2

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	CC	23P3PCCT5	Quantum Mechanics - II	5	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To impart the theory and the properties of angular momenta, both orbital and spin
- To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Born approximation.
- To expose the time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
- To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts.
- To introduce the concept of quantization in classical fields and to expose second quantization in K.G and Dirac fields.

Unit	Description	Hours	K-level	CLO
I	SCATTERING THEORY Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame.	18	K3	1
II	PERTURBATION THEORY Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation.	18	K4	2
III	RELATIVISTIC QUANTUM MECHANICS Klein – Gordon Equation – Charge and Current Densities – Dirac Equation – Dirac Matrices – Covariant form of Dirac equation – Plane Wave Solutions – Interpretation of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment of an Electron due to spin.	18	K4	3

IV	CLASSICAL FIELDS AND QUANTIZATION Classical fields – Euler Lagrange equation – Hamiltonian formulation – Classical theory of electromagnetic fields – Quantization of electromagnetic field.	18	K3	4
V	SECOND QUANTIZATION Quantization of Schrodinger equation: Creation, Annihilation and Number operators – Relativistic fields - Second Quantization of K.G field – Dirac field.	18	K3	5

Books for study:

- G. Aruldas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
Unit 1 : Sections 14.1 – 14.4, 14.7 – 14.14
Unit 2 : Sections 12.1 – 12.7
Unit 3 : Sections 15.1, 15.2, 15.4, 15.5, 15.7-15.11
Unit 4 : Sections 16.1 – 16.4, 16.9- 16.10
Unit 5 : Sections 16.5 – 16.8
- Satyaprakash, Advanced Quantum mechanics, 5th Edition, Kedar nath Ram nath & Co., Meerut , 2016
Unit 2 : Section 9.2, 9.3

Books for References:

- P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973.
- B. K. Agarwal & Hari Prakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
- Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics, 1st edition, I.K. International Publishing house Pvt. Ltd., 2006
- Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
- L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968
- P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.

Web Resources

- [https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf](https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture-notes/MIT8_05F13_Chap_09.pdf)
- http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
- <http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf>
- <https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf>
- <https://web.mit.edu/dikaizer/www/FdsAmSci.pdf>

Rationale for Nature of the course:

Students will be able to apply principles of Advanced Quantum Mechanics including principles of relativity and field theory to particle and fields.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Students acquire the skills to solve problems involving quantum mechanical systems

Pedagogy

Chalk and Board, PPT, Group discussion, Assignment, Seminar, Quiz.

Course Designer(s):

1. **Mr.S.Sivaramakrishnan**
2. **Dr.G.Gowri**

Course Schedule

Unit	Topics	Hrs	Mode
I	Scattering amplitude – Cross sections – Born approximation and its validity- Scattering by a screened coulomb potential –	7	Chalk and Board, PPT, Seminar, Test, Quiz
	Partial wave analysis – Scattering length and Effective range theory for s wave	6	
	Optical theorem – Transformation from centre of mass to laboratory frame.	5	
II	Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule	6	Chalk and Board, PPT, Seminar, Test, Quiz
	Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation	6	
	Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation.	6	
III	Klein – Gordon Equation – Charge and Current Densities	5	Chalk and Board, Quiz, Test, Seminar
	Dirac Matrices – Dirac Equation - Covariant form of Dirac Equation – Plane Wave Solutions – Interpretation Of Negative Energy States	7	
	Antiparticles – Spin of Electron – Magnetic Moment Of An Electron Due To Spin.	6	
IV	Classical fields – Euler Lagrange equation	6	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Hamiltonian formulation.	7	
	Classical electromagnetic fields	5	

V	Second quantization of schrodinger equation	7	Chalk and Board, Seminar, Quiz, Assignment
	K-G Field	6	
	Dirac field	5	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
1	Apply the kinematics of scattering theory to quantum mechanical problems	K3
2	Obtain and analyze approximate solutions to time-dependent physical problems	K4
3	Solve relativistic wave equation for quantum mechanical systems.	K4
4	Apply Dirac equation to quantum mechanical system moving at high speeds. Also use the concept of co-variance and Feynmann graphs for depicting particle interaction.	K3
5	Understand field quantization and apply second quantization to the case of KG field.	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	2	2	2	2
CLO-2	3	2	2	2	3
CLO-3	3	2	2	2	2
CLO-4	3	2	2	2	3
CLO-5	2	2	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	3	2	2	3
CLO2	3	2	3	2	2	2
CLO3	3	2	3	2	2	3
CLO4	3	2	3	2	2	2
CLO5	3	2	3	2	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	1	Up to K3	2	K1 & K1	1	K1	2 (K1&K1)	1 (K3)
2	2	Up to K4	2	K3& K4	1	K2	2 (K4&K4)	1 (K4)
3	3	Up to K4	2	K3& K4	1	K1	2 (K4&K4)	1 (K4)
4	4	Up to K3	2	K2 & K3	1	K3	2 (K2&K2)	1 (K3)
5	5	Up to K3	2	K2 & K3	1	K2	2 (K3&K3)	1 (K3)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total marks for each			10			10	25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS					CLASS: II M.Sc			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Core	23P3PMC8	Condensed Matter Physics	5	6	25	75	100

Nature of course				
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented

Objectives:

- To describe various crystal structures, symmetry and to differentiate different types of bonding.
- To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat.
- To critically assess various theories of electrons in solids and their impact in distinguishing solids.
- Outline different types of magnetic materials and explain the underlying phenomena.
- Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

Unit	Description	Hours	K-level	CLO
I	Crystal Physics Types of lattices – Miller indices – Simple crystal structures: Sodium chloride structure – Hexagonal close-packed structure – Diamond structure – Cubic Zinc Sulphide Structure – Atomic Packing Factor – Crystal diffraction – Bragg's law – Brillouin zone – Reciprocal Lattice (sc, bcc, fcc) – Structure factor (sc, bcc, fcc) – Atomic form factor – Cohesive energy of ionic crystals – Madelung constant.	18	K2	1
II	Lattice Dynamics Phonons: Vibrations of crystals with monoatomic basis – First Brillouin zone – Group velocity – Quantization of elastic waves – Phonon momentum – Inelastic scattering by phonons – Debye model for density of states – Thermal Conductivity.	18	K3	2
III	Theory Of Metals And Semiconductors Free electron gas in three dimensions - Heat capacity of the electron gas – Hall effect – Wiedemann-Franz law - Energy Bands - Nearly free electron model – Bloch Functions - Kronig-Penney model – Semiconductors: Intrinsic carrier concentration – Mobility – Impurity conductivity – Impurity states – Construction of Fermi surfaces – Quantization of orbits in a magnetic field – De Hass-van Alphen effect .	18	K3	3

IV	Magnetism Diamagnetism – Quantum theory of paramagnetism – Hund's rule - Quenching of orbital angular momentum – Adiabatic demagnetization – Ferromagnetic order – Curie point – Exchange integral – Ferrimagnetic order – Curie temperature and susceptibility of ferrimagnets – Antiferromagnetic order – Susceptibility Below the Neel temperature – Ferromagnetic domains – Bloch wall.	18	K4	4
V	Superconductivity Experimental facts: Occurrence of superconductivity – Meissner effect – Critical field – Type I and II Superconductors – Heat capacity – Energy gap – Isotope effect. Theoretical Explanation: Thermodynamics of super conducting transition – London equation – Coherence length – BCS theory of superconductivity — Single particle tunneling – Josephson tunneling – DC and AC Josephson effects – High temperature Superconductors.	18	K4	5

Books for study:

1. C. Kittel, 1996, *Introduction to Solid State Physics*, 7th Edition, Wiley, New York.
Unit I: Chapter 1, 2 & 3 (page no: 8 – 20, 29-30, 37-42, 45-48, 66-72)
Unit II: Chapter 4, 5 (page no: 99 – 103, 107 – 111, 122 – 124, 131 – 133)
Unit III: Chapter 6, 7, 8, 9 (page no: 146 – 155, 164 – 167, 174 – 177, 179 – 182, 216 – 226, 238 – 240, 255 – 262)
Unit IV: Chapter 14, 15 (page no: 416-423, 424 -429, 431 – 432, 442 – 446, 458 – 466, 468 – 473)
Unit V: Chapter 12 (page no: 335 – 355, 364 – 372)

Books for References:

1. Rita John, *Solid State Physics*, Tata Mc-Graw Hill Publication.
2. M. Ali Omar, 1974, *Elementary Solid State Physics – Principles and Applications*, Addison - Wesley
3. H. P. Myers, 1998, *Introductory Solid State Physics*, 2nd Edition, Viva Book, New Delhi.
4. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.

Web Resources

1. <http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html>
2. <http://www.cmmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html>
3. <https://www.britannica.com/science/crystal>
4. <https://www.nationalgeographic.org/encyclopedia/magnetism/>
5. https://www.brainkart.com/article/Super-Conductors_6824/

Rationale for Nature of the course

Condensed matter physics course will educate students the basics and advanced concepts of condensed matter physics to identify the crystals encountered in real life and to understand the free electron gas, semiconductors, magnetic materials and Superconductors which will lead to very good employability.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Crystallographic systems and their properties will be understood. Research in this area has led to fundamental breakthroughs in our understanding of metals, semiconductors and superconductors, as well as to the inventions of the transistor, diode laser, and integrated circuit. Condensed matter physics thus comprises the technological underpinning for the entire modern computer and communications industry. For these reasons, worldwide, this branch of physics commands the largest number of researchers, who work in academic institutions, major industrial and government laboratories, and small entrepreneurial enterprises. Hence a suitable opportunity for employment is obvious.

Pedagogy

Chalk and talk , materials, PPT, Quiz , Assignment , Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

1. **Dr. M. Prema Rani**
2. **Dr. M. Revathi**
3. **Mr. K. Karthick Kumar**

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Types of lattices – Miller indices – Simple crystal structures: Hexagonal close-packed structure – Diamond structure – Cubic Zinc Sulphide Structure	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Atomic Packing Factor – Crystal diffraction – Bragg's law.	3	
	Brillouin zone – Reciprocal Lattice (sc, bcc, fcc).	5	
	Structure factor - Atomic form factor – Cohesive energy of ionic crystals – Madelung constant.	5	
Unit II	Phonons: Vibrations of crystals with monoatomic basis – First Brillouin zone.	5	Chalk and Board, PPT, Seminar, Test, Quiz
	Group velocity – Quantization of elastic waves.	5	
	Phonon momentum – Inelastic scattering by phonons.	5	
	Debye model for density of states – Thermal Conductivity.	3	
Unit III	Free electron gas in three dimensions – Heat capacity of the electron gas – Hall effect – Wiedemann-Franz law.	5	Chalk and Board, Quiz, Test, Seminar
	Energy bands – Nearly free electron model – Bloch Functions – Kronig-Penney model.	4	
	Semiconductors: Intrinsic carrier concentration – Mobility – Impurity conductivity – Impurity states.	4	
	Construction of Fermi surfaces – Quantization of orbits in a magnetic field – De Hass-van Alphen effect	5	

Unit IV	Diamagnetism – Quantum theory of paramagnetism.	4	Chalk and Board, PPT, group discussion, Seminar, Test, Quiz
	Hund's rule – Quenching of orbital angular momentum – Adiabatic demagnetization.	4	
	Ferromagnetic order – Curie point – Exchange integral – Ferrimagnetic order – Curie temperature and susceptibility of ferrimagnets.	5	
	Antiferromagnetic order – Susceptibility below the Neel temperature – Ferromagnetic domains – Bloch wall.	5	
Unit V	Occurrence of superconductivity – Meissner effect – Critical field.	4	Chalk and Board, Seminar, Quiz, Assignment
	Type I and II Superconductors – Heat capacity – Energy gap – Isotope effect.	5	
	Thermodynamics of super conducting transition – London equation – Coherence length – BCS theory of superconductivity.	4	
	Single particle tunneling – Josephson tunneling – DC and AC Josephson effects – High temperature Superconductors.	5	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	List out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure	K2
CLO-2	Visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.	K3
CLO-3	Comprehend the heat conduction in solids	K3
CLO-4	Generalize the electronic nature of solids from band theories.	K4
CLO-5	Compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	2	3
CLO-2	3	2	3	2	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	2	3	2	3

Mapping of CLOs with Pos

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	3	2
CLO2	3	3	1	2	3	2
CLO3	3	3	2	2	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	2	3	2

Advance application– 3; Intermediate level–2; Basic level–1

Assessment scheme

Distribution of Section-wise Marks with K Levels

Blueprint for Semester Examination

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K2&K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K3	2	K3&K3	1	K2	2 (K3&K3)	1(K3)
4	CLO 4	Up to K4	2	K3&K4	1	K2	2 (K4&K4)	1(K4)
5	CLO 5	Up to K4	2	K3&K4	1	K3	2(K4&K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Practical	23P3PCCP3	Practical – III	4	6	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language.
- To equip the computational skill using various mathematical tools.
- To apply the software tools to explore the concepts of physical science.
- To approach the real time activities using physics and mathematical formulations.

Course Details
(Minimum of Twelve Experiments from the list) 1. Lagrange interpolation with Algorithm, Flow chart and output. 2. Newton forward interpolation with Algorithm, Flow chart and output. 3. Newton backward interpolation with Algorithm, Flow chart and output. 4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output. 5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output. 6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output. 7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output. 8. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output. 9. Finding Roots of a Polynomial - Bisection Method 10. Finding Roots of a Polynomial - Newton Raphson Method 11. Solution of Simultaneous Linear Equation by Gauss elimination method. 12. Solution of Ordinary Differential Equation by Euler 13. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations 14. Trapezoidal rule 15. Simpson's 1/3 rule 16. Simpson's 3/8 rule 17. Gaussian quadrature method (2 point and 3 point formula) 18. Gauss's Siedal Method

Books for study:

1. Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006
2. Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996
3. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi.
4. M.K. Jain, S.R. Iyengar and R.K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi.
5. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi

Books for References:

1. S.D. Conte and C. de Boor, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill).
2. B.F. Gerald and P.O. Wheatley, 1994, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA.
3. S.S. Kuo, 1996, Numerical Methods and Computers, Addison - Wesley, London.

Course Designer(s):

Dr. M. Kavitha

Course Learning Outcomes:

At the end of the course, student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Write a program using high level language.	K2
2	Use various numerical methods in describing/solving physics problems.	K4
3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems	K4
4	Enhance the problem-solving aptitude using various numerical methods.	K3
5	Apply various mathematical entities, facilitate to visualise any complicate tasks.	K3

Mapping of CLOs with PSOs

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes (**CO**) for each course with program outcomes (**PO**) and program specific outcomes (**PSO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	3	2
CO2	2	2	3	3	3	2
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Elective	23P3PECT5	Electromagnetic Theory	3	5	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables
- To understand Biot – Savart law and Ampere’s circuital law and their applications
- To comprehend the physical ideas contained in Maxwell’s equations
- To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves
- To grasp the concept of EM radiations

Unit	Description	Hours	K-level	CLO
I	Electrostatics Laplace Equations – Boundary conditions and uniqueness theorem –separation of variables - Cartesian and spherical polar coordinates – Multipole expansion – Polarization – linear dielectrics – Susceptibility, Permittivity, Dielectric constant – problems involving linear dielectrics – Dielectric sphere in a uniform field – Electrostatic energy in the presence of dielectric.	15	K2	1
II	Magneto statics Biot-Savart Law – divergence and curl B – applications of Ampere’s law - Magnetic vector potential – boundary conditions – Multipole expansion – torque and forces on magnetic dipoles – Magneto static energy – Uniformly magnetized sphere – Magnetic induction and magnetic field in macroscopic media.	15	K3	2
III	Maxwell Equations Faraday's laws of Induction – Maxwell's displacement current – Maxwell's equations – Vector and scalar potentials – Gauge invariance – Coulomb and Lorentz gauges – Energy and momentum of the field – Poynting theorem – Conservation of momentum.	15	K4	3

IV	EM Waves Wave equation in one dimension – Sinusoidal waves – Polarization – Boundary Conditions – plane waves in vacuum – propagation through linear media – reflection and transmission at normal and oblique incidence – monochromatic plane waves in a conducting media – Wave guides – Propagation of waves in a rectangular wave guide.	15	K3	4
V	EM Radiation Retarded potentials – Electric dipole radiation – magnetic dipole radiation – Radiation from an arbitrary distribution of charges – Lieneard – Wiechert Potentials – power radiated by a point charge.	15	K4	5

Books for study:

1. Introduction to Electrodynamics, David. J. Griffiths, 1997, 2nd Edition, Prentice-Hall of India private Ltd, New Delhi.
Unit 1: Chapter 3.1, 3.3, 3.3.1, 3.3.2, 3.4, 4.1, 4.4.1, 4.4.2, example 7, 4.4.3
Unit II: Chapter 5.2.1, 5.2.2, 5.3.2, 5.3.3, 5.4.1, 5.4.2, 5.4.3, 6.1.2, 6.2.1, example 1, 6.2.3,
Unit III: Chapter 7.2.1, 7.3, 7.4, 7.5.2, 7.5.4.
Unit IV: Chapter 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5, 8.3.2, 8.5.2.
Unit V: Chapter 9.1.1, 9.1.2, 9.1.3, 9.1.4, 9.2.1, 9.2.3

Books for References:

1. J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York.
2. B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata.
3. P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi.
4. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
5. Gupta, Kumar and Singh, Electrodynamics, S.Chand & Co., New Delhi
6. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi.

Web Resources

1. <http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html>
2. <http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html>
3. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/
4. <https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics>

Rationale for Nature of the course

The course is the learning of essential basis for understanding the theoretical methods and system used for electrical energy and power relies on key concepts from electromagnetic theory and to establish the skills of designing electrical and electronic circuits and solving real-life problems.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The test of all knowledge is theoretical results are illustrated by matching the experimental data in the activities and uses of electromagnetic theory.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Test, Problem solving, Group discussion, interaction and field visit.

Course Designer(s):

1. **Dr.M.Kavitha**
2. **Dr.S.Ramakrishnan**

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Laplace Equations – Boundary conditions and uniqueness theorem	4	PPT, Chalk and talk Quiz, Seminar, and Test
	separation of variables - Cartesian and spherical polar coordinates – Multipole expansion	4	
	Polarization – linear dielectrics – Susceptibility, Permittivity, Dielectric constant – problems involving linear dielectrics	4	
	Dielectric sphere in a uniform field – Electrostatic energy in the presence of dielectric.	3	
Unit II	Biot-Savart Law – divergence and curl B – applications of Ampere's law	4	Chalk and talk, , Quiz, Seminar, and Test
	Magnetic vector potential – boundary conditions – multipole expansion	4	
	Torque and forces on magnetic dipoles – Magneto static energy – Uniformly magnetized sphere –	4	
	Magnetic induction and magnetic field in macroscopic media.	3	
Unit III	Faraday's laws of Induction – Maxwell's displacement current – Maxwell's equations –	4	PPT, Chalk and talk Quiz, Seminar, and Test
	Vector and scalar potentials – Gauge invariance – Coulomb and Lorentz gauges	5	
	Energy and momentum of the field – Poynting theorem –	4	
	Conservation of momentum.	2	

Unit IV	Wave equation in one dimension – Sinusoidal waves – Polarization – Boundary Conditions	4	PPT, Chalk and talk, Quiz, Seminar, and Test
	plane waves in vacuum – propagation through linear media	4	
	reflection and transmission at normal and oblique incidence – Waves in a conducting medium	4	
	Wave guides – Propagation of waves in a rectangular wave guide.	3	
Unit V	Retarded potentials – Electric dipole radiation	5	PPT, Chalk and talk, Quiz, Seminar, and Assignment
	magnetic dipole radiation – Radiation from an arbitrary distribution of charges	5	
	Lineard – Wiechert Potentials	3	
	power radiated by a point charge	2	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Outline the basic idea of charge and boundary conditions in electrostatics	K2
2	Apply the idea of magnetic laws in real life problems	K3
3	Analyze the Maxwell's equation in various fields	K4
4	Apply the boundary conditions of wave guides in various medias	K3
5	Examine the EM potentials in real life problems	K4
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	2	2	1
CLO2	3	3	2	2	1
CLO3	3	3	2	2	2
CLO4	3	3	2	2	1
CLO5	3	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO-1	3	3	3	2	2	2
CLO-2	3	3	3	2	2	2
CLO-3	3	3	3	2	2	2
CLO-4	3	3	3	2	2	2
CLO-5	3	3	3	2	2	2

Advance application –3, Intermediate level –2, Basic level–1

Assessment Scheme
Blueprint for Semester Examination

Learning Outcome Based Education (LOBE) & Assessment Articulation Mapping-K Levels
with Courses Learning Outcomes (CLOs)

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO1	Upto K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
2	CLO2	Upto K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	CLO3	Upto K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
4	CLO4	Upto K3	2	K3 & K2	1	K2	2 (K3&K3)	1 (K3)
5	CLO5	Upto K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	SectionB (No Choice)	Section C (Either/ or)	SectionD (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Elective	23P3PECT5	Microprocessors 8085, 8086 and microcontroller 8051	3	5	25	75	100

Nature of course						
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented		

Objectives:

- To provide an understanding of the architecture and functioning of 8085 μ P, 8086 μ P and to the methods of interfacing I/O devices and memory to those microprocessors.
- To introduce 8085 μ P, 8086 μ P programming and applications and the architecture and instruction set of 8051 μ C.

Unit	Description	Hours	K-level	CLO
I	8085 μP PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme - I/O mapped I/O scheme - Memory and I/O interfacing - Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word - Programmable DMA controller –Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.	18	K2	1
II	8085 μP INTERFACING APPLICATIONS Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities (Voltage and current) - Measurement of physical quantities (Temperature and strain)	18	K3	2
III	8086 μP ARCHITECTURE AND PROGRAMMING Introduction- Architecture-Addressing modes-Instruction set- Pins and Signals - Assembler dependent instructions- Typical assembler pseudo instructions- Simple assembly language programs	18	K3	3

IV	8051 μC HARDWARE Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/ Output pins, Ports and Circuits – External data memory and program memory	18	K4	4
V	8051 μC INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.	18	K4	5

Books for study:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013).
2. Ram, Fundamentals of Microprocessors & Microcontrollers, Dhanpat Rai publications New Delhi (2016).
3. Microprocessors: Theory and applications: Intel and Motorola by Rafiquzzaman, Revised edition, PHI, New Delhi.

Books for References:

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, TMH Publications (2008)
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
4. J. Uffrenbeck, “The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications”, Prentice-Hall of India, New Delhi.
5. W. A. Tribel, Avtar Singh, “The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications”, Prentice-Hall of India, New Delhi.

Web Resources

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2. <http://www.electronicengineering.nbcafe.in/peripheral-mapped-io-interfacing/>
3. <https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/>
4. <http://www.circuitstoday.com/8051-microcontroller>
5. <https://www.elprocus.com/8051-assembly-language-programming/>

Rationale for Nature of the course:

The learners learn ALP using 8085, 8086 microprocessors and 8051 microcontroller and are trained to use I/ O features for interfacing.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

Learners learn to program the 8085, 8086 microprocessors and devise solutions to problems involving microprocessors.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designer(s):

Mr. T. Vivekanandan

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme - I/O mapped I/O scheme - Memory and I/O interfacing- Data transfer schemes - Interrupts of 8085	8	PPT, Chalk and talk Quiz, Seminar, and Test
	Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller–Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.	10	
II	Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface	10	Chalk and talk, , Quiz, Seminar, and Test
	Measurement of electrical quantities (Voltage and current) - Measurement of physical quantities (Temperature and strain).	8	
III	Introduction- Architecture-Addressing modes-Instruction set	8	PPT, Chalk and talk Quiz, Seminar, and Test
	Pins and Signals - Assembler dependent instructions- Typical assembler pseudo instructions- Simple assembly language programs	10	
IV	Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051	10	PPT, Chalk and talk, Quiz, Seminar, and Test
	Memory organization of 8051 – Input/ Output pins, Ports and Circuits – External data memory and program memory	8	

V	Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations	10	PPT, Chalk and talk , Quiz, Seminar, and Assignment
	Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.	8	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Explain the addressing modes of 8085 μ p	K2
CLO–2	Develop an ALP to interface 8085 μ p with seven segment display	K3
CLO–3	Use 8086 μ p in maximum and minimum mode configurations	K3
CLO–4	Comment on the features of 8051 μ C	K4
CLO–5	Analyze the instruction set of 8051 μ C	K4

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5
CLO–1	3	1	2	1	1
CLO–2	3	1	2	1	1
CLO–3	3	1	2	1	1
CLO–4	3	1	2	1	1
CLO–5	3	1	2	1	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	1	1	1	2
CLO2	3	2	1	1	1	2
CLO3	3	2	1	1	1	2
CLO4	3	2	1	1	1	2
CLO5	3	2	1	1	1	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	1	Upto K2	2	K1&K2	1	K2	2 (K4 & K4)	1 (K2)
2	2	Upto K3	2	K1&K2	1	K2	2 (K3 & K3)	1 (K3)
3	3	Upto K3	2	K1&K2	1	K1	2 (K1 & K1)	1 (K3)
4	4	Upto K4	2	K1&K2	1	K1	2 (K3 & K3)	1 (K4)
5	5	Upto K4	2	K1&K2	1	K2	2 (K2 & K2)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	20	40	33.33	33%
K4	-	-	10	20	30	25.00	25%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Multi-disciplinary course	23P3PMD1	MATERIAL SCIENCE	3	5	25	75	100

Nature of course								
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented				

Objectives:

- Acquire Knowledge about preparation of crystals.
- To impart knowledge on various thin film technologies used in various solid state applications.
- To expose the basic concepts in various characterization techniques.

Unit	Description	Hours	K – level	CLO
I	Crystal Growth Phenomena Crystal growth techniques – The Chemical Physics of Crystal Growth – Nucleation – Theories of Nucleation – Classical theory of Nucleation – Growth from Melt – The Bridgman and related techniques – Low temperature solution growth – Gel growth.	15	Upto K2	1
II	Thin films Introduction – Nature of thin film – Deposition technology – Resistance heating: thermal evaporation, flash evaporation – Low pressure sputtering – Reactive sputtering – RF sputtering – Chemical vapor deposition – Pyrolysis – Film growth.	15	Upto K2	2
III	Characterization Techniques: Scanning electron microscopy - Transmission electron microscopy – Energy-dispersive X-ray analysis - Atomic force microscopy - X-ray photoelectron spectroscopy - Diffuse reflectance spectra - Photoluminescence spectra - Raman spectroscopy.	15	Upto K2	3
IV	Chemistry of Nanomaterials Preparation of nanomaterials – Chemical synthesis-Reduction method - Use of capping reagents-Plasma arcing, CVD, sol-gel synthesis- Properties- Electronic-Optical and magnetic properties –Applications - Molecular Electronics and Nanoelectronics, Biological Applications of Nanoparticles- - Synthesis and applications of carbon nano tubes – Single and multi-wall nanotube.	15	Upto K2	4

V	Application of Mathematics - Random Process Markov process- Markov chain- Polya's urn model - Higher Transition probabilities - Generalization of independent Bernoulli Trials: Sequence of chains – Dependent Trails - Classification of states and chains – Determination of Higher transition probabilities – Stability of Markov chain – Problems	15	Upto K2	5

Text Books:

1. **Crystal Growth Processes and Methods, P. Santhana Raghavan & P.Ramasamy, KRU Publications**
Chapter 1: 1.4, 1.5
Chapter 2: 2.1 - 2.2 (Till 2.2.2.5)
Chapter 3: 3.1, 3.2, 3.3
Chapter 4: 4.1 (Till 4.1.3)
Chapter 5: 5.4
2. **Thin film fundamentals – Goswami A, New Age Interational Pvt. Ltd. , 2007**
Chapter 1: 1, 2, 3 (3.1), 4 (4.1, 4.2), 5, 6 (6.2, 6.3, 6.4), 7 (7.1)
Chapter 5: 6
3. **Nanoscienceand Nanotechnology: Fundamentals to Frontiers, M.S.RamachandraRao, Shubra Singh, Wiley India Pvt. Ltd., 2014 Reprint.**
Chapter 8: 8.2, 8.3, 8.4, 8.5, 8.7, 8.9, 8.12, 8.13, 8.14, 8.15.
4. **Nanostructures & Nanomaterials - synthesis, properties and applications, Guozhong Cao, Imperial College Press, London, 2004.**
5. **STOCHASTIC PROCESSES, Second Edition J.Medhi - New age International (P) Limited Publishers**
Chapter3: 3.1 –3.6

Books for Reference:

1. Crystal Growth Process, JC Brice, 1986, John Wiley and Sons, New York.
2. Instrumental methods of chemical analysis, Gurdeep R.Chatwal, Sham K. Anand, Himalaya Publishing House, 2012 Reprint.
3. Leo Breiman, Probability and Stochastic Processes, Houghton Mifflin, 2008.
4. Athanasios Papoulis., Probability Random Variable & Stochastic Process, McGraw Hill, International, II Edition, 2004.

Rationale for Nature of the course

Students learn various techniques for materials preparation and characterization along with novel applications for which the materials could be used.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Thin film preparation using vacuum coating unit, spin coating unit and spray pyrolysis units available at the department, Crystal growth using slow evaporation technique.

Analysis of characterized samples using various analytical techniques like XRD, EDX, SEM, etc.,

Web Resources:

1. <https://acadpubl.eu/hub/2018-119-12/articles/2/489.pdf>
2. https://serc.carleton.edu/msu_nanotech/methods/XRD.html
3. <https://www.coursera.org/learn/stochasticprocesses>
4. <https://www.vedantu.com/maths/stochastic-process>

Pedagogy:

Chalk and talk, Presentation, Quiz, Seminar, Assignment

Course Designed by:

Department of Physics
Department of Chemistry
Department of Mathematics

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Crystal growth techniques – The Chemical Physics of Crystal Growth	2	Chalk and talk, Presentation, Test, Quiz and seminar
	Nucleation – Theories of Nucleation	3	
	Classical theory of Nucleation	3	
	Growth from Melt	2	
	The Bridgman and related techniques – Low temperature solution growth	3	
	Gel growth.	2	
Unit II	Introduction - Nature of thin film	2	Chalk and talk, Test, Quiz and seminar
	Deposition technology – Resistance heating	3	
	Thermal evaporation, flash evaporation	2	
	Low pressure sputtering – Reactive sputtering – RF sputtering	3	
	Chemical vapor deposition – Pyrolysis	3	
	Film growth	2	
Unit III	Scanning electron microscopy	2	Chalk and talk, Test, Quiz and seminar
	Transmission electron microscopy	2	
	Energy-dispersive X-ray analysis - Atomic force microscopy	4	
	X-ray photoelectron spectroscopy -Diffuse reflectance spectra	3	
	Photoluminescence spectra - Raman spectroscopy	4	
Unit IV	Preparation of nanomaterials	2	Chalk and talk, Test, Quiz, Seminar
	Chemical synthesis-reduction method - use of capping reagents	2	
	Plasma arcing, CVD, sol-gel synthesis	2	
	Properties- electronic-optical and magnetic properties.	2	
	Applications-Molecular Electronics and Nanoelectronics	2	

	Biological Applications of Nanoparticles	2	
	Synthesis and applications of carbon nano tubes–single and multi-wall nanotube.	3	
Unit V	Markov Chains: Classification of States and Chains	2	Chalk and talk, Quiz, seminar, Presentation, Seminar, Assignment
	Determination of Higher transition probabilities	2	
	Stability of Markov system – Graph theoretic approach	3	
	Markov chain with denumerable number of states – Reducible chains.	3	
	Markov Process with continuous state space – Brownian motion	2	
	Weiner process – Differential equations for Weiner Process- Kolmogorov equations.	3	

Course learning Outcomes:

On the successful completion of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
1	Understand the fundamentals of <i>crystal growth</i> and nucleation	Upto K2
2	Appreciate and understand the various methods of thin film preparation and the advantages of low dimensional materials over traditional bulk materials.	Upto K2
3	Comprehend the fundamental concepts in various characterization techniques for analyzing materials properties.	Upto K2
4	Comprehends the synthesis, properties and applications of nanostructure in various fields.	UptoK2
5	Explain about Polya's urn model and classification of states and chain in solving stability of Markov chain problems.	Upto K2

Mapping of CLOs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	2	2	1	3	1
CLO2	3	2	2	3	3
CLO3	2	3	1	2	1
CLO4	2	3	1	2	1
CLO5	1	1	2	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	2	1	2	2
CLO2	3	3	2	1	3	2
CLO3	3	2	2	1	2	2
CLO4	3	1	3	3	2	3
CLO5	3	3	2	2	3	3

Advance application– 3; Intermediate level–2; Basic level–1

Learning Outcome Based Education & Assessment (LOBE) Summative - Blue Print Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

S.No	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short Answers		(Either/or Choice)		
			No of Questions	K - Level	No of Questions	K - Level	
1	CLO1	Up to K2	1	K1	1	K2& K2	1(K2)
2	CLO2	Up to K2	1	K1	1	K2& K2	1(K2)
3	CLO3	Up to K2	1	K1	1	K2& K2	1(K2)
4	CLO4	Up to K2	1	K1	1	K2& K2	1(K2)
5	CLO5	Up to K2	1	K1	1	K2& K2	1(K2)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

Distribution of Section – wise Marks with K Levels

K Levels	Section A (Short Answers)	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	-	10	7.69	8
K2	-	70	50	120	92.31	92
Total Marks	10	70	50	130	100	100%

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Skill Enhancement Course - NME	23P3PSEN2	Astrophysics	2	2	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To introduce principles of astrophysics describing the science of formation and evolution of stars.
- Interpretation of various heavenly phenomena.
- Provides an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research.

Unit	Description	Hours	K-level	CLO
I	Telescopes Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes – detectors and image processing– radio telescopes – Hubble space telescope.	6	K2	1
II	Solar System Bode’s law of planetary distances –meteors, meteorites, comets, asteroids – Kuiper belt – Oort-cloud –detection of gravitational waves – recent advancements in astrophysics.	6	K2	2
III	Eclipses Types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits.	6	K2	3
IV	Stellar Evolution H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae. Galaxies: classification of galaxies – galaxy clusters – interactions of galaxies, dark matter and super clusters – evolving universe.	6	K2	4

V	The Sun Physical and orbital data – solar atmosphere – photosphere – chromospheres – solar corona – prominences – sunspots – 11 year solar cycle – solar flares.	6	K2	5

Books for study:

1. Baidyanath Basu, An introduction to Astrophysics, Fourth printing, Prentice – Hall of India(P) Ltd, 2001, New Delhi.
2. K.S.Krishnaswamy, Astrophysics – a modern perspective, New Age International(P) Ltd, 2002, New Delhi.
3. B.S.Shylaja & H.R.Madhusudan, Eclipse: A Celestial Shadow Play, Orient Black Swan, 1999.

Books for References:

1. K.D.Abhyankar, Astrophysics, University press (India) Ltd., 2001, Hyderabad.
2. David Catling, Astrobiology: A very short introduction, Oxford University Press, 2013.

Web Resources

1. <https://www.space.com/2621>
2. <https://science.nasa.gov/astrophysics>

Rationale for Nature of the course

Fundamental knowledge provided in this course is highly essential for science students those who wish to apply and appear for recruitment procedures for vacancy positions in national observatories and space research organizations.

Activities having direct bearing on Skill development / Employability Entrepreneurship

1. Student can develop models to demonstrate eclipses/planetary motion
2. Student can conduct case study pertaining to any topic in this paper.

Pedagogy

Lecture, documentary screening, model making and display, seminar, assignment, quiz

Course Designer(s):

1. Mr.T.Vivekanandan

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes.	4	Lecture, Quiz, Test and seminar
	Detectors and image processing – radio telescopes – Hubble space telescope.	2	
II	Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oortcloud	4	Lecture, Assignment, Quiz, Test and seminar
	Detection of gravitational waves – recent advancements in astrophysics.	2	
III	Types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits.	6	Lecture, model making, quiz, Test and seminar
IV	H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae.	3	Lecture, Quiz, Test and seminar
	Galaxies: classification of galaxies – galaxy clusters – interactions of galaxies, dark matter and superclusters– evolving universe.	3	
V	Physical and orbital data – solar atmosphere – photosphere – chromospheres – solar corona.	3	Lecture, Chart, Quiz, Test and seminar Assignment
	Prominences – sunspots – 11 year solar cycle – solarflares.	3	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLO'S	Course Learning Outcomes	K-level
1	Classify the types of telescopes	K2
2	Explain Bode's law in estimating the planetary distances	K2
3	Discuss total and partial eclipses	K2
4	Describe H-R diagram for identifying the spectral classification of a star	K2
5	Explain the solar phenomena.	K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	1	2	1	1
CLO-2	3	1	2	1	1
CLO-3	3	1	2	1	1
CLO-4	3	1	2	1	1
CLO-5	3	1	2	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	2	1	1	1	3
CLO 2	3	2	1	1	1	3
CLO 3	3	2	1	1	1	3
CLO 4	3	2	1	1	1	3
CLO 5	3	2	1	1	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B (Either or Choice)	Section C (Open Choice)
			Short answers			
			No. of Questions	K-Level		
1	CLO 1	K2	1	K1	K2	K2
2	CLO 2	K2	1	K1	K2	K2
3	CLO 3	K2	1	K1	K2	K2
4	CLO 4	K2	1	K1	K2	K2
5	CLO 5	K2	1	K1	K2	K2
No. of Questions to be asked				5	5	5
No. of Questions to be answered				5	5	3
Marks for each question				2	7	10
Total marks for each				10	35	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5			10	10.5	100
K2		5	5	85	89.5	
Total Marks	10	35	50	95	100	

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Core	23P4PCCT7	Nuclear and Particle Physics	5	6	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- Introduces students to the different models of the nucleus in a chronological order
- Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles
- Provides students with details of nuclear decay with relevant theories
- Exposes students to the Standard Model of Elementary Particles .

Unit	Description	Hours	K-level	CLO
I	Nuclear Models Liquid drop model – Binding energy - Weizacker’s mass formula – Isobaric mass parabola – Bohr Wheeler theory of fission – assumptions and evidences of shell model – spin-orbit coupling – magic numbers – Predictions of shell model: angular momenta and parity of ground states.	18	K4	1
II	Nuclear Forces Ground state of deuteron – magnetic and dipole and electric quadrupole moments – Tensor forces – Exchange Forces – Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering: properties of nuclear forces spin dependence of nuclear forces – charge independence and charge symmetry.	18	K3	2
III	Nuclear Reactions Types of nuclear reactions – balance of mass and energy in nuclear reactions – Q equation – solution of Q equation – Rutherford scattering and estimation of nuclear size –Neutron induced fission- asymmetrical fission – Mass yield - Fission Chain reaction – neutron cycle in a thermal nuclear reactor (four factor formula).	18	K4	3
IV	Nuclear Decay Alpha decay – range of alpha particles – Gamow’s theory of alpha decay – Beta decay – Continuous Beta spectrum – Pauli’s neutrino hypothesis – Helicity – Parity violation- Fermi theory of beta decay - – Fermi Kurie Plot – selection rules – Gamma decay – Selection rules: angular momentum and parity – internal conversion – nuclear isomerism .	18	K3	4

V	Elementary Particles Classification of Elementary Particles – Types of Interaction and conservation laws – Isospin – Quantum Numbers – Strangeness – Hypercharge – Charge conjugation – Parity violation – Time reversal- combined inversion of CPT theorem – SU (3) symmetry – meson and baryon octet – Quark Model.	18	K2	5

Books for study:

1. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2013)
 Unit I: Chapter 5.1, 5.2, 5.3, 5.4, 5.5, 7.1-7.3, 7.7, 7.8
 Unit II: Chapter 8.1-8.3, 8.5 - 8.7
 Unit III: Chapter 3.1-3.5, 4.1.2, 6.2, 6.3, 6.7, 6.8
 Unit IV: Chapter 4.II.1, 4.II.3, 4.III.1 – 4. III.4, 4.IV.1 – 4.IV.4
2. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2020)
 Unit V: Chapter 18.2, 18.3, 18.4, 18.18, 18.19

Books for References:

1. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008)
2. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996)
3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)

Web Resources

1. <http://bubl.ac.uk/link/n/nuclearphysics.html>
2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces
3. <https://www.nuclear-power.net/nuclear-power/nuclear-reactions/>
4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html
5. <https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html>

Rationale for Nature of the course

Nuclear physics is the study of atomic nuclei, their constituents and interactions, by discovering, exploring, and understanding all forms of nuclear matter. Discoveries in nuclear physics have led to applications in many fields. This includes nuclear power, nuclear weapons, nuclear medicine and magnetic resonance imaging, industrial and agricultural isotopes, ion implantation in materials engineering, and radiocarbon dating in geology and archaeology.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Derivations and discussions on theories of nuclear physics and nuclear reactors will develop the analytical skill and employability in nuclear power plants.

Pedagogy

Chalk and talk, Presentation, Quiz, Seminar, Assignment, Group discussion.

Course Designer(s):

1. Dr. M.Prema Rani
2. Dr. S.Ramakrishnan

Course Schedule

Unit	Topics	Hrs	Mode
I	Liquid drop model – Binding energy	3	Chalk and talk, Quiz, Seminar and test
	Weizacker's mass formula – Isobaric mass parabola – Bohr Wheeler theory of fission	4	
	Assumptions and evidences of shell model	4	
	Spin-orbit coupling – magic numbers	4	
	Predictions of shell model: angular momenta and parity of ground states.	3	
II	Ground state of deuteron – magnetic and dipole and electric quadrupole moments -	4	Chalk and talk, Quiz, Seminar and test
	Tensor forces – Exchange Forces - Meson theory of nuclear forces – Yukawa potential –	5	
	nucleon-nucleon scattering: properties of nuclear forces spin dependence of nuclear forces -	5	
	Charge independence and charge symmetry.	4	
III	Types of nuclear reactions – balance of mass and energy in nuclear reactions – Q equation –solution of Q equation	5	Chalk and talk, & PPT, Quiz, Seminar and test
	Rutherford scattering and estimation of nuclear size	3	
	Neutron induced fission-asymmetrical fission- Mass yield —	4	
	Fission Chain reaction	3	
	Neutron cycle in a thermal nuclear reactor (four factor formula).	3	
IV	Alpha decay – Gamow's theory of alpha decay –	5	Chalk and talk, Quiz, Seminar and test
	Beta decay – Continuous Beta spectrum – Pauli's neutrino hypothesis – Helicity - Parity violation-	5	
	Fermi theory of beta decay - – Fermi Kurie Plot – selection rules	4	
	Gamma decay – Selection rules: angular momentum and parity - internal conversion – nuclear isomerism.	4	
V	Classification of Elementary Particles	3	Chalk and talk, Quiz, Seminar, Group discussion and Assignment
	Types of Interaction and conservation laws	4	
	Conservation laws – Iso spin – Quantum Numbers – Strangeness – Hypercharge - Charge conjugation – Parity violation – Time reversal-	4	
	combined inversion of CPT theorem -	3	
	SU (3) symmetry – meson and baryon octet – Quark Model.	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Analyze the various types of nuclear models	K4
2	Infer the data from nuclear scattering experiments to identify the different properties of nuclear forces.	K3
3	Comprehend the various types of nuclear reactions.	K4
4	Analyze the fission reactions and its applications in nuclear reactors.	K3
5	Examine the properties of elementary particles and infer their interactions.	K2
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	2	2
CLO-2	3	3	3	2	2
CLO-3	3	3	3	2	2
CLO-4	3	3	3	2	2
CLO-5	3	3	3	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	2	2	1	1
CLO2	3	3	2	2	1	1
CLO3	3	3	2	2	2	1
CLO4	3	3	2	2	1	1
CLO5	3	3	2	2	2	1

Advance application– 3; Intermediate level–2; Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	1	Upto K4	2	K3 & K4	1	K3	2 (K4&K4)	1 (K4)
2	2	Upto K3	2	K2 & K3	1	K1	2 (K2&K2)	1 (K3)
3	3	Upto K4	2	K3 & K4	1	K2	2 (K4&K4)	1 (K4)
4	4	Upto K3	2	K3 & K2	1	K2	2 (K3&K3)	1 (K3)
5	5	Upto K2	2	K1 & K1	1	K1	2 (K1&K1)	1 (K2)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be Answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	SectionB (No Choice)	Section C (Either/ or)	SectionD (Open Choice)	Total Marks	% of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Practical	23P4PCCP4	PRACTICAL IV	4	6	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To understand the theory and working of Microprocessor and its applications.

Course Details
(Minimum of Twelve Experiments from the list) - Determination of Thickness of air film. - Solar spectrum – Hartmann’s formula. Edser and Butler fringes. - Determination of velocity and compressibility of a liquid using Ultrasonics Interferometer - Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser. - Measurement of Magnetic Susceptibility - Guoy’s method - Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser. - Determination of Planck Constant – LED Method - Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type) - Study of Binary to Gray and Gray to Binary code conversion. - Study of Modulus Counter 8-bit addition and subtraction, multiplication and division using microprocessor 8085 - Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending order using microprocessor 8085 - Code conversion (8-bit number): a) Binary to BCD b) BCD to binary using microprocessor 8085 - Addition of multi byte numbers, Factorial using microprocessor 8085 - Shift register - Divide by 16-bit counter - ALU - Microprocessor -1’s complement and 2’s complement - Microprocessor Ascending order and descending order - Microprocessor- Square wave generation - Michelson’s Interferometer. - Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters using microprocessor 8085 - Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter using microprocessor 8085 - Interfacing of seven segment display using microprocessor 8085

- | |
|---|
| <ol style="list-style-type: none">24. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves using microprocessor 808525. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action using microprocessor 808526. Interfacing of Temperature Controller and Measurement using microprocessor 808527. Interfacing of Traffic light controller using microprocessor 8085 |
|---|

Books for study:

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008)
3. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085”, 3rd Edition S.Visvanathan Pvt, Ltd.

Books for References:

1. Advanced Practical Physics, S.P Singh, Pragati Prakasan
2. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd
3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing
4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.
5. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications

Course Designer(s):

1. Mr. T. Vivekanandan
2. Dr. M. Kavitha

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
1	Develop the programming skills of Microprocessor	K4
2	Appreciate the applications of Microprocessor programming	K3
3	Understand the structure and working of 8085 microprocessor and apply it.	K2
4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor.	K3
5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.	K4
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze		

Mapping of CLOs with PSOs**MAPPING WITH PROGRAM OUTCOMES:**

Map course outcomes (**CO**) for each course with program outcomes (**PO**) and program specific outcomes (**PSO**) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	3	2
CO2	2	2	3	3	3	2
CO3	3	3	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	3	3	3	3	3

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	3	3
CO2	2	2	3	3	3
CO3	3	3	3	3	3
CO4	3	2	3	3	3
CO5	3	3	3	3	3

DEPARTMENT OF PHYSICS				CLASS II M.Sc. PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Project	23P4PPROV	Project	8	8	25	75	100

Nature of course								
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented				

Course Objectives:

- To motivate students in research methodology
- To promote the experimental and analytical knowledge
- To enhance the knowledge of preparation of project report.

During the fourth semester, students shall undertake a project work and submit the project report.

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K5
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO 5	PO 6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

Internal& External Valuation for Project

Internal (25marks)	External (75 marks)
Guide Evaluation: 1. 10 Marks for Students ability and interest 2.10 Marks for Regularity and Punctuality 3.5 Marks for Quality of the work and Presentation	Dept Evaluation: 25 marks (Min (No.) 50 % of faculty must be present) 1.15Marks for Presentation using ICT tools 2.10 Marks for Quality and Publications / Presentation in Seminar/ conferences External Evaluation: 50 marks 1.20 Marks for the Report 2.30 Marks for Presentation, Quality of work and Viva voce.

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23P4PECT6	SPECTROSCOPY	3	6	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To comprehend the theory behind different spectroscopic methods
- To know the working principles along with an overview of construction of different types of spectrometers involved
- To explore various applications of these techniques in R &D

Unit	Description	Hours	K-level	CLO
I	Microwave spectroscopy Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules) - rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric and asymmetric top molecules - Instrumentation techniques – block diagram - Information Derived from Rotational Spectra- Problems.	18	K3	1
II	Infra- red spectroscopy Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations - Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H ₂ O and CO ₂ - Introduction to application of vibrational spectra - IR Spectrophotometer Instrumentation (Double Beam Spectrometer)	18	K2	2
III	Raman spectroscopy Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes lines - SR branch - Raman activity of H ₂ O and CO ₂ molecules. Mutual exclusion principle - Instrumentation technique and block diagram - structure determination of planar and non-planar molecules using IR and Raman techniques.	18	K3	3

IV	Electronic spectroscopy Vibrational coarse structure - Franck-Condon principle - dissociation energy and dissociation products - rotational fine structure - the Fortrat diagram-pre dissociation- techniques and instrumentation	18	K4	4
V	Resonance spectroscopy Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Chemical shift and its measurement - NMR of Hydrogen nuclei - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries - MRI Scan Electron Spin Resonance: Basic principle – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals – g-factors – Instrumentation - Medical applications of ESR.	18	K4	5

Books for study:

- 1) Fundamentals of molecular spectroscopy by Banwell and Mc Cash, 5th edition, TMH, New Delhi, 2nd Reprint-2014.
UNIT I: Sections: 2.1-2.4, 2.4.1.2, 4.2, 2.7
UNIT II: Sections: 3.1-3.6, 3.6.1-3.6.3
UNIT III: Sections: 4.1, 4.2, 4.2.1, 4.2.2, 4.3 (Excluding 4.3.3 & 4.3.5), 4.5
UNIT IV: Sections: 6.1, 6.4
UNIT V: Sections: 7.1, 7.1.1-7.1.5, 7.2, 7.2.1, 7.4, 7.4.1, 7.5, 7.5.1, 7.5.3, 7.5.5, 7.5.6
- 2) Molecular structure and spectroscopy by G. Aruldas, 2nd edition, PHI, New Delhi.
UNIT I: Section: 6.14
UNIT II: Section: 7.16
UNIT III: Section: 8.6

Books for References:

1. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.

Web Resources

1. <https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5>
2. <https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee>
3. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
4. <https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu>

Rationale for Nature of the course:

Fundamental knowledge provided in this course is highly essential for students those who pursue research after completing this degree course.

Activities having direct bearing on Skill development / Employability Entrepreneurship:

This course is designed to develop the skills on the various spectroscopic techniques through problem solving related to estimation of bond length, bond angle, determination of molecular structure and molecular mass etc.

Pedagogy

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Problem solving.

Course Designer(s):

Mr. T. Vivekanandan

Lecture Schedule

Unit	Topics	Hrs	Mode
I	Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)- rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines	8	Chalk and talk, PPT, Quiz, Seminar and test
	Polyatomic molecules – linear – symmetric and asymmetric top molecules - Instrumentation techniques – block diagram - Information Derived from Rotational Spectra- Problems.	7	
II	Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch	8	Chalk and talk, PPT, Quiz, Seminar and test
	Fundamental modes of vibration of H ₂ O and CO ₂ -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer)	7	
III	Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes lines- SR branch	8	Chalk and talk, PPT, Quiz, Seminar and test
	Raman activity of H ₂ O and CO ₂ molecules .Mutual exclusion principle- Instrumentation technique and block diagram -structure determination of planar and non-planar molecules using IR and Raman techniques	7	
IV	Vibrational coarse structure- Franck-Condon principle - dissociation energy and dissociation products	8	Chalk and talk, PPT, Quiz, Seminar and test
	rotational fine structure-the Fortrat diagram – pre-dissociation- techniques and instrumentation	7	

V	Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Chemical shift and its measurement - NMR of Hydrogen nuclei - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan	8	Chalk and talk, PPT, Quiz, Seminar, test and Assignment
	Electron Spin Resonance: Basic principle – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals – g-factors – Instrumentation - Medical applications of ESR	7	

Course Learning Outcomes:

At the end of the course, students will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Estimate rotational constant of molecules	K3
CLO–2	Explain the theories of harmonic and anharmonic oscillators	K2
CLO–3	Apply the knowledge of Raman spectroscopy in the determination of structure of simple molecules	K3
CLO–4	Analyze the variation of intensities of vibrational –electronic spectra based on Franck –Condon principle	K4
CLO–5	Differentiate the principle of NMR from ESR technique	K4

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5
CLO–1	3	2	1	1	1
CLO–2	3	2	1	1	1
CLO–3	3	2	1	1	1
CLO–4	3	2	1	1	1
CLO–5	3	2	1	1	1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	2	1	1	3
CLO2	3	1	2	1	1	3
CLO3	3	1	2	1	1	3
CLO4	3	1	2	1	1	3
CLO5	3	1	2	1	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1 (K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K2	2 (K1 & K1)	1 (K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K4)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1 (K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	--	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	20	40	33.33	33%
K4	-	-	10	20	30	25.00	25%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Elective	23P4PECT6	ANALYSIS OF CRYSTAL STRUCTURES	3	6	25	75	100

Nature of course						
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		

Objectives:

- To teach the concept of crystal structures and symmetry, and diffraction theory
- To provide students with a background to X-ray generation, scattering theory and experimental diffraction from single crystals
- To provide instruction on the methods and basis for determining low-molecular weight crystal structures using X-ray Crystallography
- To give the students a background to the instrumentation used for powder diffraction and structure refinement using Rietveld method
- To teach the different levels of structure exhibited by proteins and nucleic acids and methods used in protein crystallography.

Unit	Description	Hours	K-level	CLO
I	CRYSTAL LATTICE Unit cell and Bravais lattices - crystal planes and directions - basic symmetry elements operations - translational symmetries - point groups - space groups - Bragg's law - reciprocal lattice concept - Laue conditions - Ewald and limiting spheres - Laue groups.	18	K2	1
II	DIFFRACTION X-ray generation, properties - sealed tube, focal spot, power rating, rotating anode, synchrotron radiation – safety precautions - absorption filters and Atomic scattering factor - Fourier transformation and structure factor - anomalous dispersion.	18	K3	2
III	STRUCTURE ANALYSIS Single crystal diffractometers – general features - scan modes - scintillation and area detectors -intensity data collection - data reduction - factors affecting X-ray intensities - temperature factor - electron density - phase problem - Patterson function and heavy atom method - structure refinement - least squares method - Fourier and difference Fourier synthesis - R factor – The scaling of observed data.	18	K4	3

IV	POWDER METHODS Fundamentals of powder diffraction - Debye Scherrer method - diffractometer geometries - use of monochromators and Soller slits - sample preparation and data collection - powder diffraction files (ICDD) - Rietveld refinement fundamentals - profile analysis - peak shapes - structure refinement procedures – indexing patterns of cubic and non cubic crystals – structure determination from powder data - new developments. Energy dispersive X-ray analysis – residual stress analysis - high and low temperature and high pressure crystallography (basics only).	18	K3	4
V	PROTEIN CRYSTALLOGRAPHY Globular and fibrous proteins, nucleic acids – primary, secondary, tertiary and quaternary structures - helical and sheet structures - Ramachandran map and its significance – crystallization methods for proteins - factors affecting protein crystallization - heavy atom derivatives – methods used to solve protein structures - anomalous dispersion methods.	18	K4	5

Books for study:

1. Cullity, B.D. and Stock, S.R. "Elements of X-ray Diffraction", Pearson, 2014.
2. Woolfson, M.M. "An Introduction to X-ray Crystallography" Cambridge University Press, New York, 1997.
3. Albert L. Lehninger, David L. Nelson and Michael M. Cox., "Principles of Biochemistry" Second Edition, CBS Publishers & Distributors, Delhi

Books for References:

1. Glusker, J.P. and Trueblood, K.N. Crystal Structure Analysis: A Primer", Oxford University Press, New York, 1994.
2. Ladd, M.F.C. and Palmer, R.A., "Structure Determination by X-ray Crystallography", Plenum Press, New York, 3rd Edition, 1993.
3. Stout, G.H. and Jensen, L. "X-ray Structure Determination, A Practical Guide", Macmillan, New York, 1989.
4. Sam Zhang, Lin Ki, Ashok Kumar, Materials Characterization Techniques, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009
5. Azaroff, L.V., "Elements of X-Ray Crystallography", Techbooks, New York, 1992.
6. Blundell, T.L. and Johnson, L., "Protein Crystallography", Academic Press, New York, 1986.
7. H.L. Bhat, Introduction to Crystal Growth Principles and Practice CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2015.
8. B.R. Pamplin, Crystal Growth, Pergamon Press, Oxford, 1975.

Web Resources

1. <https://archive.nptel.ac.in/courses/112/106/112106227/>
2. <https://archive.nptel.ac.in/courses/104/108/104108098/>
3. <https://www.digimat.in/nptel/courses/video/102107086/L11.html>
4. https://onlinecourses.nptel.ac.in/noc19_cy35/preview
https://onlinecourses.nptel.ac.in/noc19_cy35/preview
5. <https://nptel.ac.in/courses/104/104/104104011/>

Rationale for Nature of the course

Analysis of crystal structure course is a key analytical technique to serve the growth and development of Science and technology to determine atomic arrangement, identification of fine-grained minerals such as clays and mixed layer clays that are difficult to determine optically and modal amounts of minerals

Activities having direct bearing on Skill development / Employability Entrepreneurship

XRD application to solid state reaction monitoring can also provide information on phase stability and transformation. PXRD is useful in trace analysis. It can be used to contact traces of paint flakes, hair, glass fragments, stains of any description and loose powdered materials. Identification and comparison of trace quantities of material can help in the conviction of a suspect of his involvement in a crime. It includes identification of crystalline particles that creates faults in bulk quantity of glass, measurements of crystalline coatings for texture, crystallite size and crystallinity. Advances in PXRD instrumentation and software have improved the efficiency of pharmaceutical drugs, efficiency of solid state characterization and rapid analysis of composites and materials. Hence a suitable opportunity for employment is obvious.

Pedagogy

Chalk and talk, materials, PPT, Quiz, Assignment, Seminar, Problem solving, Group discussion and interaction.

Course Designer(s):

Dr. M. Revathi

Course Schedule

Unit	Topics	Hrs	Mode
I	Unit cell and Bravais lattices - crystal planes and directions - basic symmetry elements operations.	6	Presentation using digital media, Chalk and talk, Quiz, test and Seminar
	Translational symmetries - point groups - space groups - Bragg's law - reciprocal lattice concept.	6	
	Laue conditions - Ewald and limiting spheres - Laue groups.	6	
II	X-ray generation, properties - sealed tube, focal spot, Power rating.	6	Presentation using digital media, Chalk and talk, test, Seminar, Quiz, test and Group discussion
	Rotating anode, synchrotron radiation – safety precautions - absorption filters.	6	
	Atomic scattering factor - Fourier transformation and structure factor - anomalous dispersion.	6	
III	Single crystal diffractometers – general features - scan modes - scintillation and area detectors	4	Presentation using digital media, Chalk and talk, test, Quiz and Seminar
	Intensity data collection - data reduction - factors affecting X-ray intensities - temperature factor - electron density - phase problem	5	
	Patterson function and heavy atom method - structure refinement - least squares method	5	
	Fourier and difference Fourier synthesis - R factor – The scaling of observed data.	4	
IV	Fundamentals of powder diffraction - Debye Scherrer method.	4	Presentation using digital media, Chalk and talk, test Seminar, Quiz and Group discussion
	Diffractometer geometries - use of monochromators and Soller slits - sample preparation and data collection	4	
	Powder diffraction files (ICDD) - Rietveld refinement fundamentals - profile analysis - peak shapes - structure refinement procedures	4	
	Indexing patterns of cubic and non cubic crystals – structure determination from powder data - new developments.	3	
	Energy dispersive X-ray analysis – residual stress analysis - high and low temperature and high pressure crystallography (basics only).	3	
V	Globular and fibrous proteins, nucleic acids – primary, secondary, tertiary and quaternary structures-	5	Presentation using digital media, Chalk and talk, Quiz, seminar and Assignment
	Helical and sheet structures - Ramachandran map and its significance	4	
	Crystallization methods for proteins - factors affecting protein crystallization	4	
	Heavy atom derivatives – methods used to solve protein structures - anomalous dispersion methods.	5	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand crystal symmetry and reciprocal lattice concept for X-ray diffraction	K2
CLO-2	Gain a working knowledge of X-ray generation, X-ray photography with Laue, oscillation and moving film methods, and space group determination	K3
CLO-3	Get an exposure to crystal structure determination using program packages	K4
CLO-4	Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method	K3
CLO-5	Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	3	3	3	3	3
CLO-2	3	2	3	3	3
CLO-3	3	3	3	3	3
CLO-4	3	3	3	3	3
CLO-5	3	2	3	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	2	3	2
CLO2	3	3	1	2	3	3
CLO3	3	3	2	2	3	3
CLO4	3	3	2	2	3	2
CLO5	3	3	3	2	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Assessment scheme
Distribution of Section-wise Marks with K Levels
Blueprint for Semester Examination

Units	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1&K1	1	K1	2 (K1&K1)	1(K2)
2	CLO 2	Up to K3	2	K2&K2	1	K1	2 (K2&K2)	1(K3)
3	CLO 3	Up to K4	2	K3&K3	1	K2	2 (K4&K4)	1(K4)
4	CLO 4	Up to K3	2	K3&K3	1	K2	2 (K3&K3)	1(K3)
5	CLO 5	Up to K4	2	K4&K4	1	K3	2(K4&K4)	1(K4)
No. of Questions to be asked			10			5	10	5
No. of Questions to be Answered			10			5	5	3
Marks for each question			1			2	5	10
Total Marks for each Section			10			10	25	30

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	%of Marks without choice
K1	2	4	10	-	16	13.33
K2	2	4	10	10	26	21.67
K3	4	2	10	20	36	30.00
K4	2	-	20	20	42	35.00
Total Marks	10	10	50	50	120	100.00

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Professional Competency Skill	23P4PSED2	Aptitude, Reasoning, Comprehension and Numerical Ability	2	4	25	75	100

Nature of course					
Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To prepare students for facing competitive examinations like UPSC / TNPSC
- To help students aspiring for CSIR UGC NET / SET with their preparation for General Aptitude paper.

Unit	Description	Hours	K-level	CLO
I	Mathematical Reasoning and Aptitude Types of reasoning - Number series, Letter series, Codes and relationships - Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.)	12	K4	1
II	Logical Reasoning Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical square of opposition - Evaluating and distinguishing deductive and inductive reasoning – Analogies - Venn diagram: Simple and multiple use for establishing validity of arguments	12	K4	2
III	Data Interpretation Sources, acquisition and classification of data - Quantitative and qualitative data - Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of data - Data Interpretation.- Data and governance.	12	K4	3
IV	Reading Comprehension	12	K3	4

V	Information and Communication Technology (ICT) ICT: General abbreviations and terminology - Basics of Internet, Intranet, E-mail, audio and video conferencing - Digital initiatives in higher education - ICT and Governance	12	K3	5

Books for study:

1. Madaan K V S, NTA UGC NET | SET | JRF 2023 – Teaching and Research Aptitude (Paper – 1), 7th Edition, Pearson Education (2023)

Web Resources

1. <https://byjusexamprep.com/ugc-net/ugc-net-paper-1-preparation-strategy#toc-2>
2. <https://www.udemy.com/course/ugc-net-paper1-course-bundle/>

Rationale for Nature of the course

Reading comprehension, reasoning, numerical aptitude and data interpretation are essential skills for a research / teaching career and also for preparation for competitive examinations.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Students will solve problems and previous years question papers to develop their aptitude and reasoning skills.

Pedagogy

Problem solving

Course Designer(s):

1. Dr.K.Neyvasagam
2. Mr.S.Sivaramakrishnan

Course Schedule

Unit	Topics	Hrs	Mode
I	Types of reasoning - Number series, Letter series, Codes and relationships	6	Problem solving, Quiz, Seminar, and Test
	Mathematical Aptitude (Fraction, Time & Distance, Ratio, Proportion and Percentage, Profit and Loss, Interest and Discounting, Averages etc.)	6	
II	Understanding the structure of arguments: argument forms, structure of categorical propositions, Mood and Figure, Formal and Informal fallacies, Uses of language, Connotations and denotations of terms, Classical square of opposition	6	Problem solving, Quiz, Seminar, and Test
	Evaluating and distinguishing deductive and inductive reasoning – Analogies - Venn diagram: Simple and multiple use for establishing validity of arguments	6	
III	Sources, acquisition and classification of data - Quantitative and qualitative data - Graphical representation (Bar-chart, Histograms, Pie-chart, Table-chart and Line-chart) and mapping of data	6	Problem solving, Quiz, Seminar, and Test
	Data Interpretation. - Data and governance.	6	
IV	Reading comprehension	12	Problem solving, Quiz, Seminar, and Test
V	ICT: General abbreviations and terminology - Basics of Internet, Intranet, E-mail, audio and video conferencing	6	Problem solving, Quiz, Seminar, and Assignment
	Digital initiatives in higher education - ICT and Governance	6	

Course Learning Outcomes:

At the end of the course, the students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
1	Analyze number series and letter series and predict sequences and solve problems demonstrating numerical ability.	K4
2	Demonstrate deductive and inductive reasoning to arguments and identify fallacies in arguments.	K4
3	Interpret and analyze data represented in graphs / charts / tables.	K4
4	Comprehend passages and answer questions linking their existing knowledge with the given reading content.	K3
5	Understand the role of ICT and appreciate ICT initiatives in higher education.	K3

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
CLO-1	1	2	3	2	3
CLO-2	1	3	3	2	2
CLO-3	1	3	3	3	1
CLO-4	1	1	2	3	1
CLO-5	1	1	1	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	2	3	2	3	2
CLO2	2	2	3	3	2	2
CLO3	3	3	3	3	3	3
CLO4	1	1	1	1	1	3
CLO5	1	1	1	1	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B (Open Choice)	Section C (Open Choice)
			MCQs			
			No. of Questions	K-Level		
1	1	K4	6	K4	K2	K2
2	2	K4	6	K4	K2	K3
3	3	K4	6	K4	K3	K3
4	4	K3	6	K3	K3	K2
5	5	K3	6	K3	K1	K2
No. of Questions to be asked			30		5	5
No. of Questions to be answered			30		3	3
Marks for each question			1		5	10
Total marks			30		15	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Open choice)	Section C (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1		1		5	4.7	42.8
K2		2	3	40	38.1	
K3	12	2	2	42	40	40
K4	18			18	17.1	17.1
Total Marks	30	25	50	105		

DEPARTMENT OF PHYSICS				CLASS: II MSc PHYSICS				
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Extension	23P4PEXTN	Extension Activity	1	-	-	-	-

Nature of course								
Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented				

Course Objectives:

- To motivate students to take up community driven activities and projects.
- To develop the societal awareness of students.
- To promote environmental, sustainability and G20 High-Level Principles on Lifestyles for Sustainable Development (LiFE) among students.

During the duration of the programme, students shall undertake extension activities for a minimum duration of 15 hours including preparation and submit a work diary and report of activities along with certificates (if any) from trusts/ NGOs/ public offices / schools.

At the end of the programme, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in extension activities and community projects	K4
CLO 2	Develop into dutiful and morally upright citizens of the country with an understanding of the problems of the society	K5
CLO 3	Suggest and implement out of the box solutions to the problems of the society from their domain knowledge and through their learning.	K4
CLO 4	Survey and understand the problems of the society and humanity as a whole.	K2
CLO 5	Communicate the problems of the society to civil administration/government forums for finding solutions to the problems of the locality.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CLO 1	3	3	3	3	3
CLO 2	3	3	3	3	3
CLO 3	3	3	3	3	3
CLO 4	3	3	3	3	3
CLO 5	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation Schema for Extension Activity

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4



The Madura College (Autonomous), Madurai – 625 011

Department of Physics

PG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course			Scope of Focus			Percentage of Revision/ New
					Empl	Ent	Skill	Local	National	Global	
III	23P3PCCT5	Quantum Mechanics –II	6	5			Y		Y		35
	23P3PCCT6	Condensed Matter Physics	6	5			Y		Y		49.0
	23P3PCCP3	Practical III	6	4			Y		Y		44.4
	23P3PECT5	Electromagnetic theory	5	3			Y		Y		38
	23P3PECT5	Microprocessor 8086 and Microcontroller 8051	5	3			Y	Y			New
	23P3PMDC1	Material science	5	3	Y		Y		Y		20
	23P3PSEN2	Astrophysics	2	2			Y			Y	New
	23P3PINTR	Internship / Industrial activity		2					Y		
Total			30	24							

IV	23P4PCCT7	Nuclear and Particle Physics	6	5			Y		Y		20
	23P4PCCP4	Practical IV	6	4			Y		Y		55.5
	23P4PPROV	Project with Viva-Voce	8	8							
	23P4PECT6	Spectroscopy	6	3			Y		Y		07
	23P4PECT6	Analysis of Crystal structure	6	3	Y		Y		Y		New
	23P4PSED2	NET/SET/TNPSC Coaching	4	2			Y		Y		New
	23P4PEXTN	Extension activity		1				Y			
Total			30	23							

***Empl - Employability; Ent - Entrepreneurship; Skill - Skill Development**



DEPARTMENT OF CHEMISTRY

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION
(TANSCHÉ)
(Choice Based Credit system with Outcome Based Education)**

Academic Year 2024-2025 onwards

**III and IV semesters (B.Sc. Chemistry)
Allied Courses
III and IV semesters (M.Sc. Chemistry)**



THE MADURA COLLEGE (AUTONOMOUS), MADURAI – 625 011.
DEPARTMENT OF CHEMISTRY

Curriculum Structure for the Department of Chemistry III and IV Semester
Semester III

Courses offered to Major students:

S. No.	Course Title	Course Code	Credit	Hours
1	Language-1 (Tamil / Hindi / Sanskrit)		3	6
2	English		3	6
3	Allied (Maths/Zoology)		4	6
4	General Chemistry III	23U3CCCT3	4	4
5	Qualitative Inorganic Analysis	23U3CCCP3	3	3
6	Pesticide Chemistry	23U3CSED4	2	2
7	Entrepreneurial Skills in Chemistry	23U3CSED5	2	2
8	Environmental Science (EVS)	23U3EVST1	-	1
Total			21	30

Courses offered to Allied departments:

S. No.	Course Title	Course Code	Credit	Hours
1	Chemistry for Physical Sciences – I (For II B. Sc. Physics)	23U3CGET1	4	4
2	Chemistry for Biological Sciences – I (For II B. Sc. Botany)	23U3CGET2	4	4
3	Chemistry Practical for Physical and Biological Sciences – I (For II B. Sc. Physics and II B. Sc. Botany)	23U3CGEP1	1	2
4	Bioinstrumentation (For II B. Sc. Microbiology)	23U3CGET1	4	4
5	Chemistry Practical for Microbiology – I (For II B. Sc. Microbiology)	23U3CGEP1	1	2

Value Added Courses:

Add-on Course:

S. No.	Course Title	Course Code	Credit	Hours
1	Cosmetics & Biochemistry	23U3CAO1	2	2

Semester IV

Courses offered to Major students:

S. No.	Course Title	Course Code	Credit	Hours
1	Language-1 (Tamil / Hindi / Sanskrit)		3	6
2	English		3	6
3	Allied (Maths/Zoology)		4	6
4	General Chemistry IV	23U4CCCT4	4	4
5	Physical Chemistry Practical – I (Practicals)	23U4CCCP4	3	3
6	Forensic Science	23U4CSED6	2	2
7	Instrumental Methods of Chemical Analysis	23U4CSED7	2	2
8	Environmental Science (EVS)	23U4EVST2	2	1
Total			23	30

Courses offered to Allied departments:

S. No.	Course Title	Course Code	Credit	Hours
1	Chemistry for Physical Sciences – II (For II B. Sc. Physics)	23U4CGET3	4	4
2	Chemistry for Biological Sciences – I I (For II B. Sc. Botany)	23U4CGET4	4	4
3	Chemistry Practical for Physical and Biological Sciences – II (For II B. Sc. Physics and II B. Sc. Botany)	23U4CGEP2	1	2
4	Food Processing Technology (For II B. Sc. Microbiology)	23U4CGET2	4	4
5	Chemistry Practical for Microbiology – I (For II B. Sc. Microbiology)	23U3CGEP2	1	2

Value Added Courses:

Self-Study course:

S. No.	Course Title	Course Code	Credit	Hours
1	Chemistry and Health	23U4CSS1	2	2

DEPARTMENT OF CHEMISTRY					CLASS: II. B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Major Core	23U3CCCT3	GENERAL CHEMISTRY - III	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Know the physical properties of gases, liquids, solids and X-ray diffraction of solids.
- Learn fundamentals of nuclear chemistry and nuclear waste management.
- Understand the applications of nuclear energy.
- Analyse the chemistry of halo-organic compounds, phenol and other aromatic alcohols.
- Write the preparation and properties of phenols and alcohols.

Unit	Description	Hours	K-level	CLO
I	Gaseous state Kinetic molecular model of a gas: postulates and derivation from the kinetic gas equation-The Maxwell-Boltzmann distribution of speed of molecules average-root mean square and most probable velocity and average kinetic energy-law of equipartition of energy-degrees of freedom and molecular basis of heat capacities. Collision frequency-collision diameter-mean free path. Real gases: Deviations from ideal gas behavior-compressibility factor Z, and its variation with pressure for different gases-equations of states for real gases-van der Waal's equation-Virial equation-Boyle temperature- Numerical problems based on equations of states for real gases-isotherms of real gases.	12	Up to K3	1
II	Liquid and Solid State Properties of Liquids- Surface tension, viscosity and their applications. Crystalline and amorphous – differences - geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism Crystals –size and shape; laws of crystallography; symmetry elements – plane, centre and axis-Miller indices, unit cells and space lattices-classification of crystal systems-Bravais lattices-X – ray diffraction – Bragg's equation Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing-structural features of NaCl, CsCl, ZnS, TiO ₂ .	12	Up to K2	2

III	Nuclear Chemistry Nuclear stability – neutron proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and $t_{1/2}$ and radioactive series(uranium and neptunium series). Natural radioactivity – α, β and γ rays; half-life period; Fajan–Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones, mirror nuclei, isodiaphers; nuclear isomerism; radioactive decay series; magic numbers; units – Curie, Rutherford, Roentgen; Isotopes – uses – determination of age of rocks by radiocarbon dating. (Problems to be worked out)-Nuclear energy; nuclear fission and fusion-disposal of radioactive waste and safety measures	12	Up to K3	3
IV	Halogen derivatives Aliphatic halogen derivatives Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent. Synthesis and uses of DDT and BHC Aromatic halogen compounds Nomenclature, preparation, properties and uses-Mechanism of nucleophilic aromatic substitution – benzyne intermediate. Aryl alkyl halides Nomenclature, benzyl chloride – preparation – properties and uses	12	Up to K3	4
V	Alcohol and its derivatives Alcohols: Nomenclature, classification, General method of preparation, properties and uses. Test for hydroxyl groups. Phenol: Preparation from diazonium salts, cumene, Dow's process, Raching process; properties – acidic character and effect of substitution on acidity. Reactions – Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer - Teimen, Kolbe, Schmidt, Gattermann synthesis, Libermann nitroso reaction. Benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, chemical properties– reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide, oxidation – substitution on the benzene nucleus-uses.	12	Up to K4	5

Books for study:

1. Puri, B. R., Sharma, L.R., Pathania, M. S. Principles of Physical Chemistry, 46th edition, Vishal Publishing, 2020.
2. Puri, B.R., Sharma, L.R., Kalia, K.C. Principles of Inorganic Chemistry, Milestone Publishers and Distributors, New Delhi, 13th edition, 2009.
3. Soni, P.L., Chawla, H.M. Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, 29th edition, 2007.

Books for References:

1. Soni, P.L. Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2. Peter Atkins and Julio de Paula, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.
3. Finar, I. L. Organic Chemistry, Wesley Longman Ltd, England, 6th edition, 1996.

Web Resources:

1. <https://www.embibe.com/exams/gaseous-state/>
2. <https://byjus.com/jee/solid-state/>
3. <https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/>

Rationale for Nature of the course

This course will enable the students to enrich the understanding capacity in gaseous state. Understand the concept of Properties of Liquids and Packing in atomic solids. Understand the concept of nuclear reactions and their sequence. Understand the nuclear solid waste disposal and applications of nuclear isotopes used in medicine, agriculture and industry. Understand the reactions and mechanism.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The general chemistry course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on physical properties of gases, liquids and solids ii) group discussion on fundamentals of nuclear chemistry and nuclear waste management iii) Assignment on halogen derivatives and alcohol derivatives. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. P. Prasanna

Course Schedule

Unit	Topics	Hrs	Mode
I	Gaseous state		
	Kinetic molecular model of a gas: postulates and derivation from the kinetic gas equation;	2	Chalk and talk/PPT/ Animated Videos/quiz/seminar and Test
	The Maxwell –Boltzmann distribution of speed of molecules average, root mean square and most probable velocity and average kinetic energy, law of equipartition of energy	3	
	degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path.	2	
	Real gases: Deviations from ideal gas behavior, compressibility factor, Z, and its variation with pressure for different gases	2	
	equations of states for real gases-van der Waal's equation; Virial equation; Boyle temperature;	1	
	Numerical problems based on equations of states for real gases, isotherms of real gases.	2	
II	Liquid and Solid State		
	Properties of Liquids- Surface tension, viscosity and their applications. Crystalline and amorphous – differences	2	Chalk and talk/PPT/quiz/seminar and Test
	geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism.	2	
	Crystals –size and shape; laws of crystallography; symmetry elements – plane, centre and axis; Miller indices	2	
	unit cells and space lattices; classification of crystal systems; Bravais lattices; X – ray diffraction – Bragg's equation	2	
	Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing;	2	
	Structural features of NaCl, CsCl, ZnS, TiO ₂ .	2	
III	Nuclear Chemistry		
	nuclear stability – neutron proton ratio; binding energy;	2	Chalk and talk/Assignment
	packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and $t_{1/2}$ and radioactive series.	2	
	Geiger–Nattal rule; isotopes, isobars, isotones, mirror nuclei, isodiaphers; nuclear isomerism; radioactive decay series(uranium and neptunium series)	2	
	magic numbers; units – Curie, Rutherford, Roentgen; Natural radioactivity – α , β and γ rays; half-life period; Fajan–Soddy group displacement law	2	

	Isotopes – uses – determination of age of rocks by radiocarbon dating. (Problems to be worked out)	2	
	Nuclear energy; nuclear fission and fusion-disposal of radioactive waste and safety measures.	2	
IV	Halogen derivatives		
	Aliphatic halogen derivatives Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions.	2	Chalk and talk/ Animated Videos/ seminar/quiz and Test
	Nucleophilic substitution reactions – S _N 1, S _N 2 and S _N i mechanisms with stereochemical aspects and effect of solvent.	2	
	Synthesis and uses of DDT and BHC.	2	
	Aromatic halogen compounds Nomenclature, preparation, properties and uses	2	
	Mechanism of nucleophilic aromatic substitution – benzyne intermediate.	2	
	Aryl alkyl halides Nomenclature, benzyl chloride – preparation – properties and uses	2	
V	Alcohol and its derivatives		
	Alcohols: Nomenclature, classification, General method of preparation, properties and uses. Test for hydroxyl groups.	2	Chalk and talk/PPT/ Animated Videos/ seminar/quiz and Test
	Phenol: Preparation from diazonium salts, cumene, Dow's process, Raching process; properties	2	
	acidic character and effect of substitution on acidity. Reactions – Fries, claisen rearrangement, Electrophilic substitution reactions,	2	
	Reimer - Teimen, Kolbe, Schmidt, Gattermann synthesis, Libermann nitroso reaction. benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde	2	
	Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride,	2	
	thionyl chloride, acetic anhydride, hydrogen iodide, oxidation – substitution on the benzene nucleus-uses.	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	Course Learning Outcomes	K-level
CLO1	Organize the kinetic properties of gases by using mathematical concepts	Up to K3
CLO2	Explain the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations.	Up to K2
CLO3	Build knowledge about the radioactivity, nuclear energy and its production, also the nuclear waste management.	Up to K3
CLO4	Develop the nomenclature, physical & chemical properties and basic mechanisms of halo organic compounds and alcohols.	Up to K3
CLO5	Illustrate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol including thiol.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY				CLASS: II. B.Sc. Chemistry				
SEM	Course type	Course code	Course Title	Credits	Contact Hours/ week	CIA	Ext	Total
III	Major core practical	23U3CCCP3	Qualitative Inorganic Analysis	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Demonstrate the laboratory techniques of qualitative analysis at semi-micro level
- Understand the basic laboratory concepts required to do systematic analysis of simple inorganic salts
- Develop the skill on systematic analysis of mixture of inorganic salts
- Encourage more hands-on training to undergraduate students by adding more individualized practical exercises
- Develop the intellectual and psychomotor skills of the students by imparting knowledge in qualitative analysis of inorganic compounds

Semi - Micro Qualitative Analysis

1. Analysis of simple acid radicals: carbonate, sulphate, chloride, nitrate
2. Analysis of interfering acid radicals: fluoride, oxalate, borate, phosphate.
3. Elimination of interfering acid radicals and identifying the group of basic radicals
4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, zinc, manganese, nickel, cobalt, calcium, strontium, barium, ammonium
5. Analysis of a mixture - containing two cations and two anions (of which one is interfering type)

Books for study:

1. Venkateswaran V., Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.
2. Pandey O. P., Bajpai D. N., Giri S., Practical Chemistry, ISBN: 9788121908122, Revised edition, S Chand & Co Ltd.

Books for reference:

1. Vogel, Text Book of Qualitative Chemical Analysis, 5th edn., ELBS/ Longman England, 1989.
2. Ramanujam V.V., Inorganic Semimicro qualitative analysis, National Publishing Company, Madras, 1974.

Web Resources

1. https://www.academia.edu/10186454/SEMI_MICRO_QUALITATIVE_ANALYSIS_OF_SIMPLE_I_NORGANIC_SALT
2. <https://www.thoughtco.com/qualitative-analysis-in-chemistry-608171>
3. <https://www.vlab.co.in/broad-area-chemical-sciences>

Rationale for Nature of the course

Semi-micro qualitative analysis is used for qualitative analysis of cations and anions present in the given inorganic salts (both simple & mixture).

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Students will develop skill to analyse the unknown simple and mixture of inorganic salts even in semi-micro level.

Pedagogy: Demonstration and practical session.

Course outcomes: After the end of the course, the student will be able to

CLOs	CLO statement	Knowledge level
CLO 1	Demonstrate mastery of basic Inorganic chemistry laboratory analysis.	Up to K2
CLO 2	Organize the basic laboratory techniques of qualitative analysis of Inorganic salts containing two cations and two anions	Up to K3
CLO 3	Identify the interfering acid radicals, eliminate interfering anion and to perform a systematic analysis and identify the cations	Up to K3
CLO 4	Infer analytical results	Up to K4
CLO 5	Make scientific claims that are supported by their results and other observations.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO1	3	2	2	2	2	2
CLO2	3	2	2	2	2	2
CLO3	3	2	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	2
CLO2	3	3	2	2	2	2
CLO3	3	3	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Evaluation:

Continuous Internal Assessment	:	25 Marks
External Assessment	:	75 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total Marks	25

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO 1	Demonstrate mastery of basic Inorganic chemistry laboratory analysis.	Up to K2	10
CLO 2	Organize the basic laboratory techniques of qualitative analysis of Inorganic salts containing two cations and two anions	Up to K3	20
CLO 3	Identify the interfering acid radicals, eliminate interfering anion and to perform a systematic analysis and identify the cations	Up to K3	20
CLO 4	Infer analytical results	Up to K4	15
CLO 5	Make scientific claims that are supported by their results and other observations.	Up to K4	10
Total Marks			75

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Name of the Course Designer

Dr. M. Hasmath Farzana

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	SEC-IV	23U3CSED4	PESTICIDE CHEMISTRY	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Gain knowledge about the various types of pesticides and their toxicity
- Understand the properties and toxicity of insecticide
- Learn various effect of pesticide residues on environment
- Understand effects of pesticides residue on human life, birds and animals
- Gain knowledge on choice of alternate and eco-friendly pesticides

Unit	Description	Hours	K-level	CLO
I	Introduction and Toxicity of pesticides History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides (Chemical class, targets), structures, chemical names, physical and chemical properties. Toxicity of pesticides: Acute and chronic toxicity in mammals, birds, aquatic species etc. Methods of analysis of pesticides.	6	Up to K2	CLO1
II	Insecticides Classification and study of following insecticides with respect to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, Mode of action, their uses, and toxicity. Organophosphates and Phosphothionates: Acephate, Chlorpyrifos, Monocrotophos, and parathion-methyl. Organochlorine: Endosulfan, heptachlor; Carbamate: Cartap hydrochloride, Methomyl, Propoxur.	6	Up to K3	CLO2
III	Pesticide residues Introduction- application of agrochemicals, dissemination pathways of pesticides, causes of pesticide residues, remedies. Pesticide residues in atmosphere- entry into atmosphere, action of pesticides, effects on environments. Pesticides residues in water - entry into water systems, action and effect in aquatic environment. Pesticides residues in soil. Entry into soil, absorption, retention and transport in soil, effects on microorganism, soil condition and fertility, decomposition and degradation by climatic factors and microorganism.	6	Up to K3	CLO3

IV	Pesticide Residues effect and analysis Effects of pesticide residue on human life, birds and animals- routes for exposure to pesticides, action of pesticides on living system. Analysis of pesticides residues- sample preparation, extraction of pesticides residues (soil, water and vegetables/fruits) simple methods and schemes of analysis, multi-residue analysis.	6	Up to K3	CLO4
V	Biopesticides Pheromones, attractants, repellents – Introduction, types and applications - Trimedlure, Cue-lure, methyl eugenol, N,N-diethyl-m-toluamide, Dimethyl phthalate, Icaridin). Baits- Metaldehyde, Iron (II) phosphate, Indoxacarb, Zinc Phosphide	6	Up to K4	CLO5

Books for study:

1. Handa S. K. Principles of pesticide chemistry. Agrobios (India); 2012.
2. Matolcsy G, Nádas M, Andriská V. Pesticide chemistry. Elsevier; 1989.
3. Miyamoto J. and Kearney P. C., Pesticide Chemistry Human Welfare and the Environment vol. IV, Pergamon press, 1985.

Books for References:

1. Roy N. K., Chemistry of Pesticides. CBS Publisher & Distributors P Ltd; 1st Ed. (2010).
2. Nollet L.M., Rathore H.S., Handbook of pesticides: methods of pesticide residues analysis. CRC press; 2016.
3. Ellerbrock R.H., Pesticide Residues: Significance, Management and Analysis, 2005

Web Resources

1. <https://byjus.com/chemistry/pesticides/>
2. <https://byjus.com/chemistry/insecticides/>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8230470/#:~:text=Biopesticides%20are%20naturally%20occurring%20compounds,control%20agricultural%20pests%20and%20pathogens.>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on history of pesticide, insecticide and their toxicity. Pesticide residual analysis and their effect on environment and thus it bring Skill Enhancement.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The coordination chemistry course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like (i) pesticide, (ii) insecticide (iii) toxicity. (iv) Pesticide residual analysis and (v) their effect on environment. Hence students will have chance to develop business plans for entrepreneurial ventures in the field of pesticide chemistry

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. M. Boominathan

Course Schedule

Unit	Topics	Hrs	Mode
I	Introduction and Toxicity of pesticides History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides (Chemical class, targets),	1	PPT, Chalk and talk, Group discussion, test, and Quiz/ seminar
	Structures, chemical names, physical and chemical properties.	1	
	Toxicity of pesticides: Acute and chronic toxicity in mammals, birds, aquatic species etc.	2	
	Methods of analysis of pesticides.	2	
II	Insecticides Classification and study of following insecticides with respect to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, Mode of action, uses, toxicity.	2	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	Organophosphates and Phosphothionates: Acephate, Chlorpyrifos, Monocrotophos, and parathion-methyl.	2	
	Organochlorine – Endosulfan, heptachlor;	1	
	Carbamate: Cartap hydrochloride, Methomyl, Propoxur	1	
III	Introduction- application of agrochemicals, dissemination pathways of pesticides, causes of pesticide residues, remedies.	1	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	Pesticides residues in atmosphere- entry into atmosphere, action of pesticides, effects on environments.	1	
	Pesticides residues in water - entry into water systems, action and effect in aquatic environment.	2	
	Pesticides residues in soil. Entry into soil, absorption, retention and transport in soil, effects on microorganism, soil condition and fertility, decomposition and degradation by climatic factors and microorganism.	2	

IV	Pesticide Residues effect and analysis Effects of pesticides residue on human life, birds and animals-	2	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	Routes for exposure to pesticides, action of pesticides on living system.	1	
	Analysis of pesticides residues- sample preparation, extraction of pesticides residues (soil, water and vegetables/fruits)	2	
	simple methods and schemes of analysis, multi-residue analysis	1	
V	Biopesticides Pheromones, attractants, repellents –	1	PPT, Chalk and talk, Group discussion assignment and Quiz/ seminar
	Introduction, types and application	1	
	Trimedlure, Cue-lure, methyl eugenol, N,N- Diethyl-m-toluamide, Dimethyl phthalate, Icaridin)..	2	
	Baits- Metaldehyde, Iron (II) phosphate, Indoxacarb, Zinc Phosphide	2	

Course Learning Outcomes: At the end of the course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO–1	Gain knowledge about the various types of pesticides and their toxicity	Up to K2
CLO–2	Understand the properties and toxicity of insecticide	Up to K3
CLO–3	Learn various effect of pesticide residues on environment	Up to K3
CLO–4	Understand Effects of pesticides residue on human life, birds and animals	Up to K3
CLO–5	Analyse the choice of alternate and eco-friendly pesticides	Up to K4

Mapping of CLOs with PSOs

_#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5	PSO–6
CLO–1	3	3	3	3	3	3
CLO–2	3	3	3	3	3	3
CLO–3	3	3	3	3	3	3
CLO–4	3	3	3	3	3	3
CLO–5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K1	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	SEC-V	23U3CED5	ENTREPRENEURIAL SKILLS IN CHEMISTRY	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Express the knowledge about the lubricants.
- Understand the principle and fabrics some dyes.
- Construct the extraction, testing and preparation of paint, oil.
- Examine the resins and rubber.
- Develop knowledge about the preparation of some products.

Unit	Description	Hours	K-level	CLO
I	Lubricants Friction and wear-Function of lubricants-mechanism-classification-(Oil, greases and solid)- properties lubricating oils- Determination of viscosity by Redwood viscometer, Flash and fire points,	6	Up to K2	CLO1
II	Dyes Definition –requirements of good dyes- Classification – Natural dyes (Heena, turmeric, saffron, indigo), synthetic dyes and their characteristics – basic methods and operation - principles of dyeing on cotton fabrics with natural and synthetic dyes,	6	Up to K3	CLO2
III	Oil, paint and printing 1) Extraction of oils from spices and flowers. 2) Testing of water samples using testing kit. 3) preparation of paint ,pigments and thinners 4) Printing - Tie and Dye, Batik	6	Up to K3	CLO3
IV	Resins and rubber 1)Plastic basic properties and Uses- preparation and properties, uses of Polyethylene, PVC, PVA, Teflon, Bakelite and naphthalene resins , 2) Rubber-Natural rubber and its type -Vulcanization-Advantages and its applications.	6	Up to K4	CLO4

V	Small scale products Preparation of products like candles, soap, detergents, cleaning powder, shampoos, pain balm, tooth paste/powder and disinfectants in small scale Preparation of Jam, squash and Jelly, Gulkand, cottage cheese.	6	Up to K3	CLO5

Books for study:

1. George, S. Muralidharan, V. Fibre to Finished Fabric: A Simple Approach, Chennai Publication Division, 2007.
2. Appaswamy G P, A Handbook on Printing and Dyeing of Textiles .2008.
3. Jain, Jain Engineering chemistry, Dhanpat Rai Publishing Company, 2009.

Books for References:

1. Garcia-Martinez, J. Chemistry Entrepreneurship, Wiley-VCH, 1st edition, 2021.
2. Sharma, B. K. Industrial Chemistry Part 1 and 2, Goel Publishing House, 2019.
3. Foulds, J. Dyeing and Printing: A handbook (Small-scale textiles), Practical Action Publishing, 1990.

Web Resources

1. <https://www.vlab.co.in/broad-area-chemical-sciences>
2. <https://www.routledge.com/Oil-Extraction-and-Analysis-Critical-Issues-and-Competitive-Studies/Luthria/p/book/9781893997783>
3. <https://www.accessengineeringlibrary.com/content/book/9780071410373/chapter/chapter5>

Rationale for Nature of the course

This course will enable the students to enrich their ideas on various fields in chemistry and to provide an experience to prepare and develop products and its bringing to Entrepreneurial skills.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

This course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are the list of activities :
 i) conduct quiz competition on Lubricants and Dyes ii) group discussion on general characteristics oil paint and printing iii) resins and rubber iv) small scale products. .

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. S. SELVAKUMAR

Course Schedule

Unit	Topics	Hrs	Mode
I	Lubricants Friction and wear-Function of lubricants.	1	PPT, Chalk and talk, Quiz / Seminar and Test
	mechanism-classification-(Oil, greases and solid) lubricating oils-	2	
	Determination of viscosity by Redwood viscometer, Flash and fire points, Quize/ Seminar	3	
II	Dyes Definition –requirements of good dyes- Classification —	1	PPT, Chalk and talk, Quiz / Seminar and Test
	Natural dyes (Heena, turmeric, saffron, indigo), synthetic dyes and their characteristics	2	
	basic methods and operation -principles of dyeing on cotton fabrics with natural and synthetic dyes,	3	
III	Oil , paint and printing 1) Extraction of oils from spices and flowers.	1	PPT, Chalk and talk, Quiz / Seminar and Test
	2) Testing of water samples using testing kit.	2	
	,3) preparation of paint ,pigments and thinners 4) Printing- Tie and Dye, Batik Assignment	3	
IV	Resins and rubber 1)Plastic basic properties and Uses- preparation and properties	2	PPT, Chalk and talk, Quiz / Seminar and Test
	uses of Polyethylene, PVC, PVA, Teflon	1	
	Bakelite and naphthalene resins ,	2	
	2) Rubber-Natural rubber and its type -Vulcanization-Advantages and its applications. Test	1	
V	Small scale products- introduction	1	PPT, Chalk and talk, Group discussion & Assignment
	Preparation of products like candles, soap, detergents, cleaning powder	3	
	shampoos, pain balm, tooth paste/powder rand disinfectants in small scale Test	2	

Course Learning Outcomes: At the end of the course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Elaborate the knowledge about the lubricants.	Up to K2
CLO2	Collect the principle and fabrics some dyes.	Up to K3
CLO3	Make use of extraction, testing and preparation of paint, oil.	Up to K3
CLO4	Inspect the resins and rubber.	Up to K4
CLO5	Organise the knowledge about the preparation of some products.	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	3	3	3	2	3
CLO2	1	2	3	3	2	2
CLO3	3	3	1	3	3	3
CLO4	3	2	3	1	3	3
CLO5	3	3	2	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	2	2	2	1
CLO2	3	3	2	3	3	3
CLO3	1	1	3	2	1	2
CLO4	1	1	1	2	2	3
CLO5	3	1	1	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total marks	10	10	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II.B.Sc Physics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Generic Elective	23U3CGET1	CHEMISTRY FOR PHYSICAL SCIENCES - I	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Know the chemical bonding and nuclear chemistry
- Learn the fundamentals of fuel cells and its applications
- Understand the fundamentals of organic chemistry
- Analyse the principles of thermodynamics and their types
- Discuss the principles of volumetric analysis and chromatographic techniques

Unit	Description	Hours	K-level	CLO
I	Chemical Bonding and Nuclear Chemistry Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect . Nuclear fission and nuclear fusion - differences – Applications of radioisotopes - carbon dating and medicinal applications.	12	Up to K3	1
II	Industrial Chemistry Fuels: Fuels: Fuel gases: Natural gas, water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate	12	Up to K2	2
III	Fundamental Concepts in Organic Chemistry Hybridization: Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Polar effects: Inductive effect and consequences on K _a and K _b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples and explanation. Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine	12	Up to K3	3

IV	Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system.	12	Up to K3	4
V	Analytical Chemistry Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Chromatography: principle and application of column, paper and thin layer chromatography.	12	Up to K4	5

Books for study:

1. Soni, P.L. Chawla, H.M. Text Book of Inorganic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
2. Veeraiyan, V. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.
3. Arun Bahl, B.S. Bahl, Advanced Organic Chemistry; Chand. S and Company, New Delhi, twenty third edition, 2012.

Books for References:

1. Gosh, J. Fundamental Concepts of Applied Chemistry; Sultan & Chand, Edition 2006.
2. Soni, P.L. Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
3. Sharma, B.K, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
4. Vaithyanathan, S. Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.

Web Resources:

- 1) <https://byjus.com/tn-board/class-11-chemistry-text-book/>
- 2) <https://ncert.nic.in/ncerts/l/kech205.pdf>
- 3) <https://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on history of Chemical bonding, nuclear chemistry, Industrial chemistry fuels, organic chemistry, Thermodynamics and analytical chemistry and thus it bring Skill Enhancement.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The chemistry of physical science course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like the basic study of chemical bonding helps the students to understand the concept of nuclear chemistry. Understand the concepts of fuel cells and organic chemistry. Understand the basic concept of thermodynamics and understand the fundamentals concept of analytical chemistry.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer

Dr. R. Ramachandran

Course Schedule

Unit	Topics	Hrs	Mode
I	Chemical Bonding and Nuclear Chemistry		
	Chemical Bonding: Molecular Orbital Theory-bonding, Molecular orbital diagrams for Hydrogen, Helium, Nitrogen;	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz
	Discussion of bond order and magnetic properties. Anti-bonding and non-bonding orbitals.	3	
	Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions -	2	
	Group displacement law. Nuclear binding energy - mass defect.	2	
	Nuclear fission and nuclear fusion - differences – Applications of radioisotopes -	1	
	Carbon dating and medicinal applications.	2	
II	Industrial Chemistry Fuels		
	Fuels: Fuel gases: Natural gas, and oil gas (manufacturing details not required). ammonium sulphate,	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz
	Discuss water gas, producer gas, CNG, LPG	2	
	Silicones: Synthesis, properties and uses of silicones.	2	
	Fertilizers: Urea,	2	
	NPK fertilizer,	2	
	potassium nitrate superphosphate, triple superphosphate	2	
III	Fundamentals concepts of organic chemistry		
	Hybridization: Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Heterocyclic compounds:	2	Chalk and talk/seminar/quiz
	Mesomeric, hyper conjugation and steric-examples and explanation	2	
	Polar effects: Inductive effect and consequences on K _a and K _b of organic acids and bases, electromeric,	2	
	Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution;	2	

	Nitration, halogenation, Friedel-Craft's alkylation and acylation.	2	
	Preparation, properties of pyrrole and pyridine	2	
IV	Thermodynamics and phase equilibria		
	Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Phase	2	Chalk and talk/Animated Videos/seminar/quiz
	Statements of first law and second law of thermodynamics.	2	
	Carnot's cycle and efficiency of heat engine.	2	
	Entropy and its significance.	2	
	Free energy change and its importance (no derivation).	2	
	Phase rule - definition of terms in it. Applications of phase rule to water system.	2	
V	Analytical chemistry		
	Introduction qualitative analysis	2	Chalk and talk/Assignment
	Principles of quantitative analysis.	2	
	Principles of volumetric analysis.	2	
	Chromatography: principle	2	
	Application of column, paper	2	
	thin layer chromatography.	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	Course Learning Outcomes	K-level
CLO1	Develop the molecular orbital diagram, different theories to explain the anti-bonding and non-bonding in chemical bondings	Up to K3
CLO2	Explain the fuel cells of natural gases, Discuss water produces gases and LPG	Up to K2
CLO3	Build the Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Heterocyclic compounds	Up to K3
CLO4	Identify the reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes.	Up to K3
CLO5	Illustrate the Principles of quantitative analysis.	Up to K4

Mapping of CLOs with PSOs (Department of Physics)

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	1	2	1	1	1
CLO2	1	2	1	1	1
CLO3	2	2	2	2	3
CLO4	2	2	2	1	2
CLO5	1	2	1	1	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II.B.Sc. Botany			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Generic elective	23U3CGET2	CHEMISTRY FOR BIOLOGICAL SCIENCES - I	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Know the chemical bonding and nuclear chemistry
- Learn the fundamentals of fuel cells and its applications
- Understand the fundamentals of organic chemistry
- Write the definition, structure and uses of drugs
- Discuss the principles of volumetric analysis and chromatographic techniques

Unit	Description	Hours	K-level	CLO
I	Chemical Bonding and Nuclear Chemistry Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect . Nuclear fission and nuclear fusion - differences – Applications of radioisotopes - carbon dating and medicinal applications.	12	Up to K3	1
II	Industrial Chemistry Fuels: Fuels: Fuel gases: Natural gas, water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate	12	Up to K2	2
III	Fundamental Concepts in Organic Chemistry Hybridization: Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Polar effects: Inductive effect and consequences on K _a and K _b of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric-examples and explanation	12	Up to K3	3

	Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine			
IV	Drugs and Speciality Chemicals Definition, structure and uses: Antibiotics viz., Penicillin and Chloramphenicol. Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial Sweeteners viz., saccharin and Aspartame	12	Up to K3	4
V	Analytical Chemistry Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Chromatography: principle and application of column, paper and thin layer chromatography.	12	Up to K4	5

Books for study:

1. Soni, P.L. Chawla, H.M. Text Book of Inorganic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
2. Vaithyanathan, . S. Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Arun Bahl, Bahl, B.S Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012.

Books for References:

1. Gosh, J. Fundamental Concepts of Applied Chemistry; Sultan & Chand, Edition 2006.
2. Soni, P.L. Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
3. Sharma, B.K, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
4. Veeraiyan, V. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition, 2009.

Web Resources:

- 1) <https://byjus.com/tn-board/class-11-chemistry-text-book/>
- 2) <https://ncert.nic.in/ncerts/l/kech205.pdf>
- 3) <https://www.sfu.ca/~mbahrami/ENSC%20388/Notes/Intro%20and%20Basic%20Concepts.pdf>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on history of Chemical bonding, nuclear chemistry, Industrial chemistry fuels, organic chemistry, drugs and analytical chemistry and thus it bring Skill Enhancement.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The chemistry of physical science course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students.

Here are some activities that can have a direct bearing on these aspects like the basic study of chemical bonding helps the students to understand the concept of nuclear chemistry. Understand the concepts of fuel cells and organic chemistry. Understand the basic concept of thermodynamics and understand the fundamentals concept of analytical chemistry.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer

Dr. R. Ramachandran

Course Schedule

Unit	Topics	Hrs	Mode
I	Chemical Bonding and Nuclear Chemistry		
	Chemical Bonding: Molecular Orbital Theory-bonding, Molecular orbital diagrams for Hydrogen, Helium, Nitrogen;	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz
	Discussion of bond order and magnetic properties. Anti-bonding and non-bonding orbitals.	3	
	Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions -	2	
	Group displacement law. Nuclear binding energy - mass defect.	2	
	Nuclear fission and nuclear fusion - differences – Applications of radioisotopes -	1	
	Carbon dating and medicinal applications.	2	
II	Industrial Chemistry Fuels		
	Fuels: Fuel gases: Natural gas, and oil gas (manufacturing details not required). ammonium sulphate	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz
	Discuss water gas, producer gas, CNG, LPG	2	
	Silicones: Synthesis, properties and uses of silicones.	2	
	Fertilizers: Urea,	2	
	NPK fertilizer,	2	
	potassium nitrate superphosphate, triple superphosphate	2	

III	Fundamentals concepts of organic chemistry		
	Hybridization: Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Heterocyclic compounds:	2	Chalk and talk/seminar/quiz
	Mesomeric, hyper conjugation and steric-examples and explanation	2	
	Polar effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric,	2	
	Reaction mechanisms: Types of reactions- aromaticity-aromatic electrophilic substitution;	2	
	Nitration, halogenation, Friedel-Craft's alkylation and acylation.	2	
	Preparation, properties of pyrrole and pyridine	2	
IV	Drugs and specialist chemicals		
	Definition, structure and uses of drugs; Artificial Sweeteners viz.,	2	Chalk and talk/Animated Videos/seminar/quiz
	Penicillin and Chloramphenicol.	2	
	Antibiotics viz. and Anaesthetics viz.,	2	
	Chloroform and ether; Antipyretics viz.,	2	
	aspirin, paracetamol and ibuprofen	2	
	Saccharin and Aspartame.	2	
V	Analytical chemistry		
	Introduction qualitative analysis	2	Chalk and talk/Assignment
	Principles of quantitative analysis.	2	
	Principles of volumetric analysis.	2	
	Chromatography: principle	2	
	Application of column, paper	2	
	thin layer chromatography.	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	Course Learning Outcomes	K-level
CLO1	Develop the molecular orbital diagram, different theories to explain the anti-bonding and non-bonding in chemical bondings	Up to K3
CLO2	Explain the fuel cells of natural gases, discuss water produces gases and LPG	Up to K2
CLO3	Build the Orbital overlap hybridization and geometry of CH ₄ , C ₂ H ₄ and C ₂ H ₂ . Heterocyclic compounds	Up to K3
CLO4	Identify the structure and uses of drugs	Up to K3
CLO5	Illustrate the Principles of quantitative analysis.	Up to K4

Mapping of CLOs with PSOs (Department of Botany)

#	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	1	2	1	1	1
CLO2	1	2	1	1	1
CLO3	2	2	2	2	3
CLO4	2	2	2	1	2
CLO5	1	2	1	1	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc. Botany& II B.Sc. Physics			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Ancillary Practical	23U3CGEP1	CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES - I	1	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to:

- Gain an understanding of the use of standard flask and volumetric pipettes, burette.
- Design, carry out, record and interpret the results of volumetric titration
- Apply their skill in the analysis of water/hardness
- Analyses the normality of solutions
- Gain the analytical knowledge

Experiments
VOLUMETRIC ANALYSIS 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of hydrochloric acid using standard oxalic acid. 3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate. 5. Estimation of potassium permanganate using standard NaOH. 6. Estimation of magnesium using EDTA. 7. Estimation of ferrous ion using biphenyl amine as indicator.

Books for References:

1. Venkateswaran , V, Veeraswamy, R., Kulandaivelu, A. R. Basic Principles of Practical Chemistry, S. Chand & Co., New Delhi, 1997.
2. Pandey, O. P., Bajpai, N. Giri, S. “Practical Chemistry” S. Chand and Co Ltd., 2010.
3. Schimpf, H. W. “A text book of volumetric analysis”, Biolife Publishers, 2009.
4. Pherson, P. M. “Practical volumetric analysis” RSC publications, 2014.

Web Resources

1. <https://byjus.com/chemistry/volumetric-analysis/>
2. <https://collegedunia.com/exams/volumetric-analysis-chemistry-articleid-746>
3. <https://www.vedantu.com/chemistry/volumetric-analysis>
4. <https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cy02/>

Rationale for Nature of the course

This course will enable to the students to enrich basic ideas on volumetrically and to develop titration process and it's bringing to analytical chemistry in laboratory.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Practical chemistry course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Following activities are planned:

- i) Preparation of solutions of various normality.
- ii) Titration techniques.
- iii) Usage of analytical tools.

Pedagogy

- Demonstration
- Hands on training

COURSE OUTCOMES:

At the end of the course, the student will be able to:

	CO Statement	K-Level
CO1	Associate the use of standard flask and volumetric pipettes, burette.	K2
CO2	Conclude the work design, carry out, record and interpret the results of volumetric titration.	K4
CO3	Find their skill in the analysis of water/hardness.	K3
CO4	Prepare the different normality of solutions	K3
CO5	Utilize the analytical knowledge	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	2	2	3	1
CLO2	2	1	2	3	2	1
CLO3	1	3	2	2	1	3
CLO4	2	2	1	2	2	1
CLO5	3	1	1	2	1	3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	1	2	1	2	3
CLO2	1	2	2	2	2	2
CLO3	2	3	1	2	3	2
CLO4	1	3	1	1	1	3
CLO5	2	1	3	1	2	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Assessment Schema

Continuous Internal Assessment	: 25 Marks
External Assessment	: 75 Marks
Total	: 100 Marks

Blueprint for Test component of CIA

Component	Weight / Mark
Internal test	15
Observation /Record	5
Continuous class assessment	5
Total	25

Blueprint for Semester Examination

	CO Statement	K-Level	Marks
CLO1	Gain an understanding of the use of standard flask and volumetric pipettes, burette.	K2	10
CLO2	Design, carry out, record and interpret the results of volumetric titration.	K4	20
CLO3	Apply their skill in the analysis of solution.	K3	20
CLO4	Analyze and report	K3	20
CLO5	Gain the analytical knowledge	K3	5
Total			75

Name of the course Designer

Dr. S.SELVAKUMAR

DEPARTMENT OF CHEMISTRY					CLASS: II.B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Major Core	23U4CCCT4	GENERAL CHEMISTRY -IV	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Learn thermodynamic concepts on chemical processes and applied aspects.
- Calculate thermo chemical calculations
- Study transition elements with reference to periodic properties and group study of transition metals.
- Know the chemistry of ethers, aldehydes and ketones
- Study the chemistry of carboxylic acids

Unit	Description	Hours	K-level	CLO
I	Thermodynamics I Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (U), enthalpy (H)-calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv)-Joule Thomson effect- inversion temperature. Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications-effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions-Hess's law and its applications; Measurement of heat of reaction - Zeroth law of thermodynamics-Absolute Temperature scale.	12	Up to K2	CLO1
II	Thermodynamics II Second Law of thermodynamics - Limitations of first law, spontaneity and randomness-Carnot's cycle-statement of second law of thermodynamics-Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a real gas with changes in temperature, volume and pressure-physical significance of entropy.	12	Up to K3	CLO2

	Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature and pressure-criteria for spontaneity-Gibbs-Helmholtz equation-derivations and applications-Maxwell relationships. Statement of Third law of thermodynamics - Nernst heat theorem.			
III	General Characteristics of d-block elements Transition Elements- Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non-transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Manganese and Zinc groups.	12	Up to K3	CLO3
IV	Ethers, Thio ethers and Epoxides Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages, alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group. Reactions of epoxides with alcohols, ammonia derivatives and LiAlH_4. Thioethers - nomenclature, structure, preparation and uses. Aldehydes and Ketones Nomenclature, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Ponnordorf Verley reduction, reduction with LiAlH_4 and NaBH_4.	12	Up to K3	CLO4
V	Carboxylic Acids: Nomenclature, structure, preparation of aliphatic(from esters and nitriles) and aromatic monocarboxylic acid. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdiecker reaction. Carboxylic acid Derivatives: Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl	12	Up to K4	CLO5

	halide, anhydride, ester, amide. Schottan- Baumann reaction. Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement (mechanism not necessary). Active methylene compounds: Keto – enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.			

Books for study:

1. Puri, B.R. and Sharma, L.R. Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 33rd edition, 1992.
2. Meissler, G. L., Tarr, D. A. Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008.
3. Soni, P.L., Chawla, H.M. Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, 29th edition, 2007.

Books for References:

1. Maron, S. H. and Prutton, C. P. Principles of Physical Chemistry, 4th edition, The Macmillan Company: Newyork, 1972.
2. Lee, J. D. Concise Inorganic Chemistry, 4th edition, ELBS William Heinemann: London, 1991.
3. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.

Web Resources:

1. <https://byjus.com/physics/thermodynamics/>
2. <https://www.geeksforgeeks.org/second-law-of-thermodynamics/>
3. <https://www.toppr.com/guides/chemistry/the-d-and-f-block-elements/general-properties-transition-elements-d-block/>

Rationale for Nature of the course

This course will enable the students to enrich the understanding capacity in law of thermodynamics. Understand the general characteristics of d-block elements. Understand the reactions and mechanism.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The General chemistry course can incorporate various activities that directly contribute to skill development and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on law of thermodynamics ii) group discussion on general characteristics of d-block elements iii) Assignment on aldehydes and carboxylic acids. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion and Seminar
- Quiz through ICT- Mode

Course Designer:
Dr. P. Prasanna

Course Schedule

Unit	Descriptions	Hours	Mode
I	Thermodynamics I		
	Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes;	2	Chalk and talk/PPT/ Animated and Test
	First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (U), enthalpy (H); calculations of q, w, E and H for reversible,	3	
	irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (C_p & C_v); Joule Thomson effect- inversion temperature.	2	
	Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications;	2	
	effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions;	1	
	Hess's law and its applications; Measurement of heat of reaction - Zeroth law of thermodynamics-Absolute Temperature scale.	2	
II	Thermodynamics II		
	Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle	2	Chalk and talk/PPT/ Animated and Test
	Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing	2	
	calculation of entropy changes of an ideal gas and a real gas with changes in temperature, volume and pressure-physical significance of entropy.	2	
	Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy	2	
	their variation with temperature and pressure-criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships.	2	
	Statement of Third law of thermodynamics - Nernst heat theorem.	2	
III	General Characteristics of d-block elements- Transition Elements		
	Electronic configuration - General periodic trend variable valency,	2	Chalk and talk/Assignment
	oxidation states, stability of oxidation states, colour, magnetic properties	2	
	catalytic properties and tendency to form complexes	2	
	Comparative study of transition elements and non-transition elements	2	
	comparison of II and III transition series with I transition series	2	
	Group study of Titanium, Manganese and Zinc groups	2	

IV	Ethers, Thio ethers and Epoxides		
	Aldehydes and Ketones		
	Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages,	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz and Test
	alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group.	2	
	Reactions of epoxides with alcohols, ammonia derivatives and LiAlH ₄ . Thioethers - nomenclature, structure, preparation and uses.	2	
	Nomenclature, structure and reactivity of aliphatic and aromatic aldehydes and ketones; general methods of preparation and physical properties.	2	
	Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes.	2	
Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Ponnendorf Verley reduction, reduction with LiAlH ₄ and NaBH ₄ .	2		
V	Carboxylic Acids: Carboxylic acid Derivatives: Active methylene compounds: Hydroxy acids		
	Nomenclature, structure, preparation of aliphatic and aromatic monocarboxylic acids(from esters and nitrile). Physical properties, acidic nature,	2	Chalk and talk/PPT/seminar/quiz and Test
	effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdiecker reaction.	2	
	Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride, ester	2	
	amide. Schotten- Baumann reaction. Claisen condensation,	2	
	Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement.	2	
	Keto – enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	K-level
CLO1	Explain the kinetic properties of gases by using mathematical concepts	Up to K2
CLO2	Organize the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations.	Up to K3
CLO3	Build knowledge about the radioactivity, nuclear energy and it's production, also the nuclear waste management.	Up to K3
CLO4	Develop the nomenclature, physical & chemical properties and basic mechanisms of halo organic compounds and alcohols.	Up to K3
CLO5	Illustrate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol including thiol.	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Core Practical	23U4CCCP4	PHYSICAL CHEMISTRY PRACTICAL – I	3	3	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: Objective of this course is to make the students to

- Have hands on experience in carrying out the experiments
- Determine eutectic temperature and transition temperature
- Study of phenol –water critical solution temperature
- Determine distribution co-efficient and equilibrium constant using distribution law
- Find out the strength of the solution using conductometric and potentiometric titration

List of Experiments
1. Simple eutectic system - determination of eutectic temperature and composition - naphthalene-diphenyl system 2. Determination of transition temperature of a salt hydrate. 3. Determination of upper critical solution temperature of phenol – water system 4. Determination of concentration of sodium chloride using phenol - sodium chloride system 5. Determination of the distribution coefficient of iodine between carbon tetrachloride and water. 6. Conductometric titration of hydrochloric acid against sodium hydroxide 7. Potentiometric titration of ferrous ion against potassium permanganate.

Books for study:

1. Sindhu, P.S. Practicals in Physical Chemistry, Macmillan India : New Delhi, 2005.
2. Khosla, B. D. Garg, V. C.; Gulati, A. Senior Practical Physical Chemistry, R. Chand : New Delhi, 2011.
3. Gupta, Renu, Practical Physical Chemistry, 1st Ed.; New Age International : New Delhi, 2017.

Books for References:

1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand & Sons: New Delhi, 1997
2. Nad, A. K.; Mahapatra, B.; Ghoshal, A.; An advanced course in Practical Chemistry, 3rd ed.; New Central Book Agency: Kolkata, 2007.
3. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education Ltd: New Delhi, 2000.

Web Resources:

1. <https://pdfcoffee.com/experiment-4-distribution-pdf-free.html>
2. <https://carnotcycle.wordpress.com/tag/phenol-water-system/>
3. <https://egyankosh.ac.in/bitstream/123456789/15870/1/Unit-12.pdf>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on phase rule and develops the students approach towards accurate measurement of molecular mass using simple eutectic method. Involves titration based on electrochemical techniques like conductometric and potentiometric titration and they carry out experiments based on distribution law

Activities having direct bearing on Skill development / Employability Entrepreneurship

Hands on training on electrochemical techniques and phase diagram studied will give students to get opportunities in various chemical industries.

Pedagogy

- Demonstration
- Hands on training

Course Designer:

Dr. R. Ramachandran

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Examine principles associated with various physical chemistry experiments	K2
CLO-2	Explain the procedure, data and methodology for the practical work	K4
CLO-3	Apply the principles of phase rule and electrochemistry for carrying out the practical work	K3
CLO-4	Apply the principles of distribution law for carrying out the practical work	K3
CLO-5	Demonstrate laboratory skills for safe handling of the equipment and chemicals	K4

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	1	1	1	2	2
CLO2	1	2	3	1	1
CLO3	1	1	1	2	2
CLO4	1	1	1	1	2
CLO5	2	2	2	2	2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	2	2	2	3	3	2
CLO-2	3	2	2	2	3	3	2
CLO-3	3	2	2	2	3	3	2
CLO-4	3	2	2	2	3	3	2
CLO-5	2	2	2	2	2	2	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Components for	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total	25

Summative Assessment:

CLO	CLO Statement	K level	Marks
CLO1	To apply the principles associated with various physical chemistry experiments.	K2	15
CLO2	To scientifically plan and perform all the experiments.	K4	20
CLO3	To observe and record systematically the readings in all the experiments.	K3	15
CLO4	To calculate and process the experimentally measured values and compare with graphical data.	K3	20
CLO5	To interpret the experimental data scientifically to improve students' efficiency for societal developments.	K4	5
Total marks			75

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	SEC VI	23U4CSED6	FORENSIC SCIENCE	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The students are enable to

- Understand of types of Poisoning and to write post-mortem reports
- Analyse the crime detection through analytical instruments
- Appraise the forgery and its detection
- Comprehend the traces of crime detection
- Assess the medical aspects involved by forensic methodology

Unit	Description	Hours	K-level	CLO
I	Poisons Poisons - types and classification - diagnosis of poisons in the living and the dead-. Heavy metal contamination (Hg, Pb, Cd) of seafoods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning – use of antidotes for common poisons.	6	Up To K2	1
II	Crime Detection Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) -composition of bullets and detecting powder burns.	6	Up To K3	2
III	Forgery and counterfeiting Documents - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery methods - writing deliberately modified- uses of ultraviolet rays – checking silver line water mark in currency notes – alloy analysis using AAS to detect counterfeit coins .	6	Up To K3	3
IV	Tracks and Traces Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints -residue prints, walking pattern or tyre marks - detecting steroid consumption in athletes	6	Up To K4	4
V	Medical Aspects Aids - causes and prevention - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography-Arson -natural fires and arson - burning characteristics and chemistry of combustible materials -nature of . Ballistics - classification - internal and terminal ballistics	6	Up To K3	5

Books for study:

1. Sharma B.R., "Scientific Criminal Investigation", Universal Law Publishing Co. Pvt. Ltd, New Delhi. 2006.
2. Kelly M. Elkins., "Introduction to Forensic Chemistry", CRC Press, Taylor & Francis Group, 2019.
3. Richard.S, "Criminalistics-An Introduction to Forensic Science", (CollegVersion), 8th edition, Sopsfestein, Printice hall, 2003.

Books for References:

1. Iqbal S.A, "M Liviu., "Textbook of forensic chemistry", Discover publishing house private limited, 2011.
2. Javed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr., "Basic principles of Forensic chemistry, Humana Press, 1st edition", 2012.
3. Bapuly A.K. "Forensic Science- Its application in crime investigation", Paras Medical Publisher, Hyderabad, 2006.

Web Resources

1. <http://www.library.ucsb.edu/ist/03-spring/internet.html>
2. <http://www.wonderhowto.com/topic/forensic-science/>
3. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/3

Rationale for Nature of the course

The Basic knowledge of forensic science for their carrier orientation and are able to comprehend the idea of forensic science in various crime aspects

Activities having diirect bearing on Skill development / Employability Entrepreneurship

A case study can be given to apply the knowledge of forensic science in various types of crimes.

Pedagogy

- Chalk-Talk room ativities
- Group Discussion
- Seminar
- ICT enabled learning process

Course Designer:

Dr. M. Karpagavalli

Course Schedule

Unit	Topics	Hrs	Mode
I	Poisons	6	PPT, Chalk and talk, Test, Quiz/Seminar
	Poisons - types and classification - diagnosis of poisons in the living and the dead	2	
	Heavy metal contamination (Hg, Pb, Cd) of seafoods	2	
	use of neutron activation analysis in detecting arsenic in human hair.	1	
	Treatment in cases of poisoning – use of antidotes for common poisons.	1	
II	Crime Detection	6	PPT, Chalk and talk, Test, Quiz/Seminar
	Accidental explosion during manufacture of matches and fireworks (as in Sivakasi).	2	
	Human bombs - possible explosives (gelatin sticks and RDX)	2	
	composition of bullets and detecting powder burns.	2	
III	Forgery and counterfeiting	6	PPT, Chalk and talk, Test, Quiz/Seminar
	Documents - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery methods.	2	
	writing deliberately modified- uses of ultraviolet rays	2	
	checking silver line water mark in currency notes -alloy analysis using AAS to detect counterfeit coins .	2	
IV	Tracks and Traces	6	PPT, Chalk and talk, Test, Quiz/Seminar
	Tracks and traces - small tracks and police dogs	1	
	foot prints - costing of foot prints -residue prints, walking pattern or tyre marks – miscellaneous traces and tracks	1	
	Analysis of biological substances - blood, saliva, urine and hair	2	
	detecting steroid consumption in athletes	2	
V	Medical Aspects	6	PPT, Chalk and talk, Assignment, Group discussion
	Aids - causes and prevention - burns and their treatment by plastic surgery	2	
	Metabolite analysis using mass spectrum - Gas chromatography	2	
	natural fires and arson - burning characteristics and chemistry of combustible	1	
	nature of . Ballistics - classification - internal and terminal ballistics	1	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Learn about the Poisons - types and classification of poisons in the living and the dead organisms and also get information about Postmortem.	Up to K2
CLO-2	Get awareness on Human bombs, possible explosives (gelatin sticks and RDX) and metal defector devices and other security measures for VVIP - composition of bullets and detecting powder burns	Up to K3
CLO-3	Detect the forgery documents, different types of forged signatures	Up to K3
CLO-4	Have an idea about how to tracks and trace using policedogs, foot prints identification and gain the knowledge in analyzing biological substances - blood, semen, saliva, urine and hair - DNA Finger printing for tissue identification in dismembered bodies	Up to K4
CLO-5	Get the awareness on Aids - causes and prevention and also have an exposure on handling fire explodes.	Up to K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C	Section D (Open Choice)
			MCQs		Short answers		(Either/or Choice)	
			No. of Questions	K- Level	No. of Questions	K- Level	K- Level	
1	CLO 1	Up to K2	2	K1 & K2	1	K1	2 (K1& K1)	1 (K2)
2	CLO 2	Up to K3	2	K1 & K2	1	K2	2 (K2& K2)	1 (K3)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1 (K3)
4	CLO 4	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K3	2	K1 & K2	1	K2	2 (K3& K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	5	4	10	-	19	15.83	42
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42
K4	-	-	10	10	20	16.67	16
Total marks	10	10	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	SEC VII	23U4CSED7	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Understand Stoichiometry and the related concentration terms and types of error
- Learn principle and applications of atomic absorption spectroscopy
- Examine the principle and applications of UV and IR spectroscopy
- Comprehend thermal and electro analytical methods
- Learn purification techniques

Unit	Description	Hours	K-level	CLO
I	Qualitative and Quantitative Aspects of Analysis S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Coefficient of Variation,	6	Up to K3	1
II	Atomic Absorption Spectroscopy: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction. Techniques for the quantitative estimation of trace level of metal ions from water samples.	6	Up to K2	2
III	UV-Visible and IR Spectroscopy Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. Infrared Spectroscopy: Basic principles of instrumentation (choice of 4source, monochromator& detector) for single and double beam instrument; sampling techniques.	6	Up to K3	3

IV	Thermal and Electro-analytical Methods of analysis TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of silver nitrate, calcium oxalate and calcium acetate. Electroanalytical methods: polarography - principle, instrumentation and applications.	6	Up to K3	4
V	Separation and purification techniques Chromatography: Column, TLC and Paper, Principle, Classification, Choice of Adsorbents, Solvents, Preparation of Column, Elution Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms and Rf value.	6	Up to K4	5

Books for study:

1. Chatwal, G. R., Anand, S. K. Instrumental Methods of Chemical Analysis, Himalaya Publishing House, 5th edition, 2023.
2. Gopalan, R. Subramanian, P. S., Rengarajan, K. Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007
3. Skoog, Holler and Crouch, Principles of Instrumental Analysis, Cengage Learning, 6th Indian Reprint (2017).

Books for References:

1. Skoog D.A, West. D. M and. Holler, F. J , Analytical Chemistry: An Introduction, 5th edition., Saunders college publishing, Philadelphia, 1998.
2. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th edition., The English Language Book Society of Longman. 2017
3. Dash U N, Analytical Chemistry; Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011.
4. Christian, Gary D; Analytical Chemistry, 6th Ed., John Wiley & Sons, New York, 2004.

Web Resources

1. <http://www.epa.gov/rpdweb00/docs/marlap/402-b-04-001b-14 final.pdf>
2. <http://eric.ed.gov/?id=EJ386287>
3. <http://www.sjsu.edu/faculty/watkins/diamag.htm>

Rationale for Nature of the course

The course will enable the students to learn and understand various instrumentation techniques like UV, IR and thermal methods. Students will get direct exposure to industrial oriented instrumental techniques

Activities having direct bearing on Skill development / Employability Entrepreneurship

Learning of instrumental techniques , students will understand various instrumentation details. They will exposure to prepare stoichiometric solution and find out the sources error. Basic

understanding of instrumentation procedure will give them direct employability in various industries.

Pedagogy

- Chalk-Talk room activities
- Group Discussion and Seminar
- ICT enabled learning process

Course Designer:

Dr. P. Gajendran

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Qualitative and Quantitative Aspects of Analysis S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb.	3	PPT, Chalk and talk, Quiz, Seminar & Test
	Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation, Coefficient of Variation,	3	
Unit II	Atomic Absorption Spectroscopy: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs.	3	PPT, Chalk and talk, Quiz, Seminar & Test
	Techniques of atomization and sample introduction. Techniques for the quantitative estimation of trace level of metal ions from water samples.	3	
Unit III	UV-Visible and IR Spectroscopy Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.	3	PPT, Chalk and talk, Quiz, Seminar & Test
	Infrared Spectroscopy: Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques	3	
Unit IV	Thermal and Electro-analytical Methods of analysis TGA and DTA- Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA,	3	PPT, Chalk and talk, Quiz, Seminar & Test
	Thermal analysis of silver nitrate, calcium oxalate and calcium acetate. Electroanalytical methods: polarography - principle, instrumentation and applications.	3	

Unit V	Separation and purification techniques Chromatography: Column, TLC and Paper, Principle, Classification, Choice of Adsorbents, Solvents, Preparation of Column	3	PPT, Chalk and talk, Group discussion and Assignment
	Elution Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms and Rf value.	3	

COURSE LEARNING OUTCOMES:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	preparation of solutions, stoichiometric calculations and apply error analysis in the calibration and use of analytical instruments	Up to K3
CLO-2	Explain theory, instrumentation and application of flame photometry and Atomic Absorption spectrometry	Up to K2
CLO-3	Explain theory, instrumentation and application of UV visible and Infrared spectroscopy.	Up to K3
CLO-4	Able to discuss instrumentation, theory and applications of thermal and electrochemical techniques	Up to K3
CLO-5	Explain the use of chromatographic techniques in the separation and identification of mixtures	Up to K4

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II.B.Sc. Physics			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Generic Elective II	23U4CGET3	CHEMISTRY FOR PHYSICAL SCIENCES II	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Study Co-ordination Chemistry and Water Technology
- Know the chemistry of Carbohydrates and Amino acids
- Understand basics and applications of electrochemistry
- Describe basics and applications of kinetics and catalysis
- Analyse various photochemical phenomenon

Unit	Description	Hours	K-level	CLO
I	Co-ordination Chemistry and Water Technology Definition of terms-IUPAC Nomenclature -Werner's theory - EAN rule - Pauling's theory – Postulates -Applications to $[\text{Ni}(\text{CO})_4]$, $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Co}(\text{CN})_6]^{3-}$ -Chelation- Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method--Purification techniques-Biological oxygen demand.	12	Up to K3	1
II	Carbohydrates and Amino acids Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose-fructose interconversion. Properties of starch and cellulose. Amino acids: Classification - preparation and properties of alanine, RNA and DNA (elementary idea only).	12	Up to K2	2
III	Electrochemistry Galvanic cells - Standard hydrogen electrode - calomel electrode -standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - buffer solutions and its biological applications.-corrosion and its control by sacrificial anodic protection method.	12	Up to K3	3

IV	Kinetics and Catalysis Order and molecularity. Integrated rate expression for I and II (2A → Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction– Half-life period – Catalysis -homogeneous and heterogeneous, catalyst used in Contact and Haber's processes.	12	Up to K3	4
V	Photochemistry Beer-Lambert's law -Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12	Up to K4	5

Books for study:

1. Veeraiyan, V. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, 1st edition, 2009.
2. Vaithyanathan, S. Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Bahl, A., Bahl, B.S. Advanced Organic Chemistry; S.Chand and Company, New Delhi, 23rd edition, 2012.

Books for References:

1. Soni, P.L. Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, 20th edition, 2007.
2. Puri, R., Sharma, L.R., Pathania, M.S. Text book Physical Chemistry; Vishal Publishing Co., New Delhi, 47th edition, 2018.
3. Sharma, B.K. Industrial Chemistry; GOEL publishing house, Meerut, 16th edition, 2014.

Web Resources:

- 1) <https://byjus.com/jee/coordination-compounds/>
- 2) <https://www.britannica.com/science/carbohydrate>
- 3) [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_\(Analytical_Chemistry\)/Electrochemistry](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry)

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on co-ordination Chemistry, water technology, carbohydrates, amino acids, electrochemistry, kinetics, catalysis and photochemistry

Activities having direct bearing on Skill development / Employability Entrepreneurship

The chemistry for physical sciences course can incorporate various activities that directly contribute to skill development, and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on co-ordination chemistry and water technology ii) group discussion on carbohydrates and amino acids iii) Assignment on electrochemistry and photochemistry. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer

Dr. P. Prasanna

Course Schedule

Unit	Topics	Hrs	Mode
I	Co-ordination Chemistry and Water Technology		
	Definition of terms-IUPAC Nomenclature -Werner's theory - EAN rule	2	Chalk and talk/PPT/ Animated/quiz/ seminar and Test
	Pauling's theory – Postulates -Applications to $[\text{Ni}(\text{CO})_4]$, $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Co}(\text{CN})_6]^{3-}$	3	
	Chelation- Biological role of Haemoglobin and Chlorophyll (elementary idea)	2	
	Applications in qualitative and quantitative analysis.	2	
	Water Technology: Hardness of water	1	
	determination of hardness of water using EDTA method-- Purification techniques-BOD.	2	
II	Carbohydrates and Amino acids		
	Carbohydrates: Classification, preparation of glucose	2	Chalk and talk/PPT/ Animated Videos/seminar /quiz and Test
	preparation and properties of fructose and sucrose	2	
	Discussion of open chain ring structures of glucose and fructose.	2	
	Glucose–fructose interconversion-Preparation of sucrose and starch	2	
	properties of sucrose and starch.	2	
	Amino acids: Classification - preparation and properties of alanine, RNA and DNA (elementary idea only).	2	
III	Electrochemistry		
	Galvanic cells - Standard hydrogen electrode	2	Chalk and talk/seminar/quiz and Test
	calomel electrode -standard electrode potentials	2	
	electrochemical series. Strong and weak electrolytes	2	
	ionic product of water -pH, pKa, pKb	2	
	Conductometric titrations - buffer solutions and its biological applications.	2	
	corrosion and its control by sacrificial anodic protection method.	2	
IV	Kinetics and Catalysis		
	Order and molecularity	2	Chalk and talk/Animated Videos/seminar /quiz and Test
	Integrated rate expression for I and II ($2A \rightarrow \text{Products}$) order reactions	2	
	Pseudo first order reaction, methods of determining order of a reaction	2	

	Half-life period – Catalysis	2	
	homogeneous and heterogeneous catalysis	2	
	catalyst used in Contact and Haber’s processes.	2	
V	Photochemistry		
	Beer-Lambert’s law -Grothus-Draper’s law	2	Chalk and talk/Assignment t
	Stark-Einstein’s law of photochemical equivalence	2	
	Hydrogen-chloride reaction	2	
	Phosphorescence, fluorescence	2	
	chemiluminescence and photosensitization	2	
	photosynthesis	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	Course Learning Outcomes	K-level
CLO1	Develop the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology	Up to K3
CLO2	Explain the preparation and property of carbohydrate, amino acids and nucleic acids.	Up to K2
CLO3	Build the standard hydrogen electrode, electrochemical series, and explain electrochemistry principles in corrosion, electroplating and fuel cells.	Up to K3
CLO4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	Up to K3
CLO5	Illustrate the various type of photochemical process.	Up to K4

Mapping of CLOs with PSOs (Department of Physics)

	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	1	2	1	1	1
CLO2	1	2	1	1	1
CLO3	2	2	2	2	3
CLO4	2	2	2	1	2
CLO5	1	2	1	1	2

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II.B.Sc. Botany			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Generic Elective II	23U4CGET4	CHEMISTRY FOR BIOLOGICAL SCIENCES II	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Co-ordination Chemistry and Water Technology
- Carbohydrates
- Amino acids and Essential elements of biosystem
- Basics and applications of electrochemistry
- Various photochemical phenomenon

Unit	Description	Hours	K-level	CLO
I	Co-ordination Chemistry and Water Technology Definition of terms-IUPAC Nomenclature -Werner's theory - EAN rule - Pauling's theory – Postulates -Applications to $[\text{Ni}(\text{CO})_4]$, $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Co}(\text{CN})_6]^{3-}$ - Chelation- Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method--Purification techniques-Biological oxygen demand.	12	Up to K3	1
II	Carbohydrates Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose–fructose interconversion. Preparation and properties of sucrose and starch.	12	Up to K2	2
III	Amino Acids and Essential elements of biosystem Classification - preparation and properties of alanine– Proteins classification – structure - Colour reactions – Biological functions – nucleosides – nucleotides – RNA and DNA – structure. Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg.	12	Up to K3	3

IV	Electrochemistry Galvanic cells - Standard hydrogen electrode - calomel electrode -standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - buffer solutions and its biological applications.-corrosion and its control by sacrificial anodic protection method.	12	Up to K3	4
V	Photochemistry Beer-Lambert's law -Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence-Beer - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	12	Up to K4	5

Books for study:

1. Veeraiyan, V. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, 2009.
2. Vaithyanathan, S. Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Bahl, A., Bahl, B.S. Advanced Organic Chemistry; S.Chand and Company, New Delhi, 23rd edition, 2012.

Books for References:

1. Peter Atkins and Julio de Paula, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.
2. Soni, P.L., Chawla, H.M. Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, 29th edition, 2007.
3. Soni, P.L., Katyal, M. Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, 20th edition, 2007.

Web Resources:

1. <https://byjus.com/jee/coordination-compounds/>
2. <https://www.britannica.com/science/carbohydrate>
3. <https://www.britannica.com/science/amino-acid/Standard-amino-acids>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on co-ordination Chemistry, water technology, carbohydrates, amino acids, electrochemistry and photochemistry

Activities having direct bearing on Skill development / Employability Entrepreneurship

The chemistry for physical sciences course can incorporate various activities that directly contribute to skill development, and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on co-ordination chemistry and water technology ii) group discussion on carbohydrates and amino acids iii) Assignment on electrochemistry and photochemistry. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer

Dr. P. Prasanna

Course Schedule

Unit	Topics	Hrs	Mode
I	Co-ordination Chemistry and Water Technology		
	Definition of terms-IUPAC Nomenclature -Werner's theory - EAN rule	2	Chalk and talk/PPT/ Animated Videos/seminar/quiz and Test
	Pauling's theory – Postulates -Applications to $[\text{Ni}(\text{CO})_4]$, $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Co}(\text{CN})_6]^{3-}$	3	
	Chelation- Biological role of Haemoglobin and Chlorophyll (elementary idea)	2	
	Applications in qualitative and quantitative analysis.	2	
	Water Technology: Hardness of water	1	
	determination of hardness of water using EDTA method-- Purification techniques-BOD.	2	
II	Carbohydrates		
	Carbohydrates: Classification, preparation of glucose	2	Chalk and talk/PPT/ Animated videos/seminar/quiz and Test
	preparation and properties of fructose and sucrose	2	
	Discussion of open chain ring structures of glucose and fructose.	2	
	Glucose–fructose interconversion.	2	
	Preparation of sucrose and starch.	2	
	properties of sucrose and starch.	2	
III	Amino Acids and Essential elements of biosystem		
	Classification – preparation of alanine	2	Chalk and talk/seminar/ quiz and Test
	properties of alanine	2	
	Proteins classification– structure	2	
	Colour reactions – Biological functions –nucleosides	2	
	nucleotides– RNA and DNA – structure	2	
	Essentials of trace metals in biological system-Na, Cu, K, Zn, Fe, Mg.	2	
IV	Electrochemistry		
	Galvanic cells - Standard hydrogen electrode	2	Chalk and talk/Animated
	calomel electrode -standard electrode potentials	2	
	electrochemical series. Strong and weak electrolytes	2	

	ionic product of water -pH, pKa, pKb	2	Videos/seminar/quiz and Test
	Conductometric titrations - buffer solutions and its biological applications.	2	
	corrosion and its control by sacrificial anodic protection method.	2	
V	Photochemistry		Chalk and talk/Assignment
	Beer-Lambert's law -Grothus-Draper's law	2	
	Stark-Einstein's law of photochemical equivalence	2	
	Hydrogen-chloride reaction	2	
	Phosphorescence, fluorescence	2	
	chemiluminescence and photosensitization	2	
	photosynthesis	2	

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	Course Learning Outcomes	K-level
CLO1	Develop the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology	Up to K3
CLO2	Explain the preparation and property of carbohydrate	Up to K2
CLO3	Plan the preparation and properties of amino acids, nucleic acids and enlighten the biological role of transition metals.	Up to K3
CLO4	Build the standard hydrogen electrode, electrochemical series and apply the electrochemistry principles in corrosion, electroplating and fuel cells.	Up to K3
CLO5	Illustrate the various type of photochemical process.	Up to K4

Mapping of CLOs with PSOs (Department of Botany)

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	3	3	2	2	3	2
CLO2	3	3	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	2	2	3	2
CLO5	3	3	3	3	3	2

Mapping of CLOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application – 3;

Intermediate level – 2;

Basic level - 1

Blueprint for Summative Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either / or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY					CLASS: II B.Sc. Botany II B.Sc. Physics			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Ancillary (P2)	23U4CGEP 2	CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES - II	1	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives:

- Basics of organic qualitative analysis
- Determination of elements in organic compounds
- Identification of organic functional groups
- Differentiate the aromatic and aliphatic compounds
- Different types of organic compounds with respect to their properties

Experiments
SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS The analysis must be carried out as follows: (a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose]. (b) Detection of elements (N, S, Halogens). (c) Distinguish between aliphatic and aromatic compounds. (d) Distinguish – Saturated and unsaturated compounds.

Books for study:

1. Gnanapragasam. N.S. and Ramamurthy.G, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
2. Gurtu. J. N and Kapoor. R, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.
3. John Leonard, Students hand book practical organic chemistry, 1989.

Books for References:

1. Venkateswaran.V, Veerasamy.R, Kulandaivelu. A.R, Practical book, 1987.
2. Basic Principles of organic Practical Chemistry, Gnanaprakasam, Second edition, 1997.
3. Vogel's, practical organic chemistry, 5th edition 1986.

Web Resources

1. <https://cd1.edb.hkedcity.net/cd/science/chemistry/TAS/ref-bks.pdf>
2. <https://cd1.edb.hkedcity.net/cd/science/chemistry/TAS/ref-bks.pdf>
3. <https://Textbook-Practical-Organic-Chemistry-Arthur/dp/0582442508>

Rationale for Nature of the course

This course enhances the better understanding of basic of organic chemistry.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

Practical chemistry course can incorporate various activities that directly contribute to skill development, enhance employability among the students. Here are some activities in organic compound analysis saturation and aromaticity. Hence students will have enhanced the better understanding of basic of fundamental acquired organic practical knowledge in chemistry.

Pedagogy

- Demonstration
- Hands-on-training

COURSE LEARNING OUTCOMES: At the end of the course, the student will be able to:

	CLO Statement	K-Level
CLO1	Gain an understanding of the use of organic compounds.	K2
CLO2	Design, carry out, record and interpret the results of organic analysis.	K4
CLO3	Apply their skill in the analysis of S and N elements.	K3
CLO4	Analyze the kinds of functional groups	K3
CLO5	Identify the saturated and unsaturated group of compounds	K3

Mapping of CLOs with PSOs

#	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CLO1	2	3	2	1	2	3
CLO2	1	2	2	2	2	2
CLO3	2	3	1	3	3	2
CLO4	1	3	3	1	3	3
CLO5	3	1	3	1	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	2	3	2	3	1
CLO2	3	1	2	3	2	3
CLO3	1	3	2	2	1	3
CLO4	2	3	1	2	2	3
CLO5	3	1	1	2	1	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Assessment Schema

Continuous Internal Assessment	: 25Marks
External Assessment	: 75 marks
Total	: 100 Marks

Blueprint for Test component of CIA

Component	Weight / Mark
Internal test	10
Observation /Record	5
Continuous class assessment	5
Short Procedure	5
Total	25

Blueprint for Semester Examination

Component	Weight / Mark
Experiment 1. Aromatic/Aliphatic (10Marks) 2. Saturated/ Unsaturated (10 Marks) 3. Elements (10 Marks) 4. Functional group (20 Marks)	50
Observation /Record	10
Procedure	15
Total	75

Name of the course Designer

Dr. S. Selvakumar

FOR ADD ON COURSES:**Evaluation:**

Continuous Internal Assessment	:	50 Marks
External Assessment	:	50 Marks
Total	:	100 Marks

- ✓ Evaluation by internal examiner

CIA Components

Component	Evaluation type	Marks
I	Periodic assignment (3)	20
II	Paper presentation/Group discussion	15
III	Quiz/viva-voce	15

For Final Semester Examinations:

- ✓ Total end semester examination marks : 50
- ✓ Duration : 2 hours
- ✓ Exam pattern:

Part	Type	No. of questions	Marks per question	No. of questions to be answered	Total Marks
A	Objective	10	1	10	10
B	Descriptive	7	10	4	40
Total Marks					50

- ✓ Minimum pass marks : 40 (Both CIA & end semester exams put together)
- ✓ There is no pass minimum separately for internal and external components.

DEPARTMENT OF CHEMISTRY				CLASS: II. B. Sc. Chemistry				
SEM	Course type	Course code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Add on course	23U3CAO1	Cosmetics and Biochemistry	2	2	50	50	100

UNIT I - Chemistry of cosmetics and perfumes

(6 hours)

A General study including preparation and uses of the following:

Hair dye, hair spray, shampoo, Suntan lotions, Face Powder, Lipsticks, Talcum Powder, Nail enamel, Creams (Cold, Vanishing and Shaving Creams), Antiperspirants and artificial flavours. Essential oils and their importance in Cosmetic industries with reference to Eugenol, Geraniol, Sandalwood oil, jasmone, 2-phenylethyl alcohol, Eucalyptus, Civetone, Muscone.

UNIT II - Pesticide Chemistry

(6 hours)

General Introduction to pesticides (Natural and Synthetic), benefits and advance effects, Changing Concept of pesticides, Structural activity relationship, Synthesis and technical manufacture and use of representative pesticides in the following classes: Organo chlorides (DDT, Gammexene); Organo phosphate (Malation, Parathion); Carbamate (Carbofuran and Carbaryl); Quinones (Chloranil), Anilides (alachlor and Butachlor)

UNIT III – Fermentation

(6 hours)

Aerobic and anaerobic fermentation, Production of (i) Ethyl alcohol and Citric acid (ii) Antibiotics Penicillin, Cephalosporin, Chloromycetin and Streptomycin (iii) Lysine, Glutamic acid, Vitamin B₂, Vitamin C. Preparation of Aspirin and Magnesium bisilicate (Antacid)

UNIT IV - Business Skills for chemists

(6 hours)

Key business concepts: Business plans, Market need, Market used, Project management and routes to market. Chemistry in Industry: Current Challenges and Opportunities for the Chemistry & using Industries, Role of Chemistry in India and global economics. Making money: Financial aspects of business with case studies. Intellectual property: Concept of intellectual property, patents.

UNIT V - Biochemistry of disease

(6 hours)

A diagnostic approach by blood/urine analysis.

Blood: Composition and function of blood and preservation of sample, Anaemia, Regulation, estimation and interpretation for blood sugar, urea creatinine, cholesterol and bilirubin.

Urine: Collection and preservation of samples formation of urine. Composition and estimation of constituents of normal and pathological urine.

References:

1. Patrick.G. (2017), Introduction to Medicinal Chemistry, Oxford University Press.
2. Singh.H; Kapoor S.K (1996), Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan.

3. Foye, W.O.; Lemke, T.L.; William, D.A (1995), Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd.
4. Devlin, T.M. (2010), Textbook of Biochemistry with Clinical Correlation, Wiley.
5. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2002), Biochemistry, W.H. Freeman.
6. Pandey, N.; Dhama, K. (2014), Intellectual Property Rights, PHI Learning Pvt.
7. Ganguli, P. (2001), Intellectual Property Rights: Unleashing the knowledge, McGraw Hill.
8. Barel, A.O.; Paye, M.; Maibach, H.I. (2014). Handbook of Cosmetic Science and Technology, CRC Press.
9. Gupta, P.K.; Gupta, S.K. (2011), Pharmaceuticals and Cosmetics, Pragati Prakashan.
10. Kumar, R. (2018). Chemistry of Cosmetics, Prestige Publisher.

Name of the Course Designer

- Dr. M. Karpagavalli

FOR SELF-STUDY COURSES:

- ✓ Duration of the course : 1 year
- ✓ Evaluation by internal examiner
- ✓ Minimum pass marks : 40 (Both CIA & end semester exams put together)
- ✓ There is no pass minimum separately for internal and external components.

Assessment type		Marks
Internal examination	Part – A – Objective type Answer ALL questions - (10 x 1 = 10 Marks)	10
	Part – B – Descriptive type, Open choice Answer ANY THREE questions (3/5 x 5 = 15 Marks)	15
Assignment (2)		25
Project / Case study		25
Seminar/model		25
Total Marks		100

DEPARTMENT OF CHEMISTRY				CLASS: II. B. Sc. Chemistry		
SEM	Course type	Course code	Course Title	Credits	Contact Hours/week	Total
III & IV	Self-Study	23U4CSS1	Chemistry and Health	2	2	100

Course Objectives

This is a self-study course on understanding chemistry in health. This is an attempt to make the students aware of fundamental chemistry of health maintenance with food and medicines, deviation from healthy living, correcting such deviation with medicinal practices and products.

UNIT –I: Food and Health

(6 hrs)

Food materials: sources, types – calorific value-Macro and micronutrients – non- dietary foods - balanced diet-imbalance and its consequences.

UNIT-II: Health and Chemicals

(6 hrs)

Food and allergy -natural and manmade food materials - food pollution – food contamination-organic food materials- Effect of food materials on body ailments.

UNIT-III: Health and Biomolecules

(6 hrs)

Health maintenance - Height weight-body mass index-obesity – Role of enzymes , hormones in health - Nutritional additives-vitamins-micro nutrients - various disorders associated with deficiencies of metal and non metal elements. Sources for various nutrients - fibre content - vitamins etc.

UNIT- IV: Diagnostic tools

(6 hrs)

Traditional methods of diagnosis – Pulse – blood – Microscopy, Endoscopy, Auto-analyser, Differential cell counter, X-ray, ECG, EEG, scanning : ultrasound, echo, CT, MRI,

UNIT –V: Drug Chemistry

(6 hrs)

Requirements of an ideal drug - Need for conversion of drug into medicine – Additives and their role – Various forms of administration of drugs: solid, liquid, semisolid, aerosols, powders, tablet, capsules, injectables, syrups, suspensions, ointments, creams.

References:

- David Krupadanam.G. L. , Vijayaprasad. D, VaraprasadRao. K, Reddy. K. L. N, Sudhakar. C,
Drugs University press (India) Ltd., Orient Longman, First edn.2001.
- Ramnaiksood, Medical laboratory technology-Methods and interpretation, 3rdedn, Jaypee Brothers medical publishers, 1995.
- JayashreeGhosh, Applied Chemistry, 1stEdn, S. Chand & company pvt. Ltd, 2016.

Name of the Course designers

- Dr. M. Malarvizhi
- Dr. J. Shanmugapriya

DEPARTMENT OF CHEMISTRY (S.F)					CLASS: II.B.Sc Micro biology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
III	Generic Elective I	23U3CGET1	BIOINSTRUMENTATION	4	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- To Understand the analytical instruments and study the basic principles in the field of sciences
- To gain knowledge about principles of spectroscopy
- To Understand the analytical techniques of Chromatography and electrophoresis
- To understand the principle of different types of scans used in medical diagnosis
- To gain information about the principles of radioactivity and its measurements

Unit	Description	Hours	K-level	CLO
I	Basic instruments: pH meter, Buffer of biological importance, Centrifuge-Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator. Biochemical calculations-preparations of Molar solutions - Buffers-Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation	12	Up to K3	CLO1
II	Spectroscopic Techniques: Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra-red and Mass Spectroscopy.	12	Up to K2	CLO2
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC. Electrophoresis Techniques: Starch Gel, AGE, PAGE	12	Up to K3	CLO3
IV	Imaging techniques: Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.	12	Up to K3	CLO4
V	Fluorescence and radiation based techniques: Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography	12	Up to K4	CLO5

Books for study:

1. Jayaraman J .Laboratory Manual in Biochemistry, .Wiley Eastern Ltd., New Delhi. Second edition, 2011
2. Ponmurugan .P and Gangathara P. B Biotechniques MJP publishers first edition 2012
3. Veerakumari, L Bioinstrumentation MJP publishers. Fifth edition 2009

Books for References:

1. Webster, J. G..Bioinstrumentation John Wiley & Sons (Asia)Pvt. Ltd,Singapore. Fourth edition 2004
2. Wilson.K , Walker. J, .Principles and techniques of Biochemistry and Molecular Biology Cambridge University Press seventh edition 2010.
3. Nelson L.D, Michael M Cox.Lehninger Principles of Biochemistry”, W.H.Freeman,Newyork fifth edition .2008
4. Khandpur R S, Handbook of Biomedical Instrumentation, , McGraw Hill Education (India) third edition, 2014
5. Sharma B K. Instrumental Methods of Chemical Analysis, GOEL Publishing House. twenty fourth edition 2005

Web Resources

1. <http://www.biologydiscussion.com/biochemistry/centrifugation/centrifugeintroduction-types-uses-and-other-details-with-diagram/12489>.
2. <https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html>.
3. <http://www.rsc.org/learnchemistry/collections/spectroscopy/introduction>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on co Basic instruments, Spectroscopic Techniques, Chromatographic and Electrophoresis Techniques, Imaging techniques, Fluorescence and radiation based techniques.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The chemistry for physical sciences course can incorporate various activities that directly contribute to skill development, and enhance employability among students. Here are some activities that can have a direct bearing on these aspects like i) conduct quiz competition on Basic instruments and spectroscopic techniques ii) group discussion on Chromatographic and Electrophoresis Techniques iii) Assignment on Imaging techniques, Fluorescence and radiation based techniques. Hence the students will have chance to get skill oriented jobs in various industries.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer(s):

1. Dr. R. Sakthivadivel
2. Dr. R. Sathya
3. Dr. S. Sujarani

Course Schedule

Unit	Topics	Hrs	Mode
I	pH meter, Buffer of biological importance, Centrifuge	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.	4	
	Biochemical calculations-preparations of Molar solutions - Buffers- Phosphate, Acetate, TE, TAE- calculation of Normality ,PPM- Ammonium sulphate precipitation	4	
II	Spectroscopic Techniques: Colorimeter	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Ultraviolet and visible	4	
	Infra-red and Mass Spectroscopy.	4	
III	Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC.	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Electrophoresis Techniques: Starch Gel, AGE, PAGE	4	
	Instrumentation and application of ECG,	4	
IV	EMG, MRI, CT	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	PET scan radioisotopes	4	
V	Spectrofluorimeter, Flame photometer	4	Chalk and talk/Assignment
	Scintillation counter, Geiger Muller counter,	4	
	Autoradiography	4	

Course Learning Outcomes: At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Develop the experiment and apply the basic instruments in the laboratory.	K3
CLO-2	Explain the functionality of Beer – Lambert’s law in identifying and quantifying a biomolecule.	K2
CLO-3	Compare the separation techniques for separating bio molecules based on chromatography and electrophoresis techniques.	K3
CLO-4	Build the clinical important of isotopes and their detection of isotopes.	K3
CLO-5	Illustrate the separation techniques for separating biomolecules by centrifugation	K4

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5	PSO–6
CLO–1	3	3	2	2	3	2
CLO–2	3	3	2	2	3	2
CLO–3	3	3	3	3	3	2
CLO–4	3	3	2	2	3	2
CLO–5	3	3	3	3	3	2

3-Strong correlation;

2-Medium correlation;

1-Weak Correlation

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY (S.F)				CLASS: II. B.Sc. Microbiology				
SEM	Course type	Course code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
III	Allied practical-I	23U3CGEP1	Chemistry Practical for Microbiology - I	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Objectives: This course aims at providing knowledge on the

- Basics of organic qualitative analysis
- Determination of elements in organic compounds
- Identification of organic functional groups
- Differentiate the aromatic and aliphatic compounds
- Different types of organic compounds with respect to their properties.

SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

The analysis must be carried out as follows:

1. Functional group tests [Carboxylic acids (Benzoic acid, phthalic acid), phenol, urea, Aniline.
2. Detection of elements (N, Halogens).
3. To distinguish between aliphatic and aromatic compounds
4. To distinguish – Saturated and unsaturated compounds.
5. Preparation of buffer (Phosphate Buffer)
Determination of pH of biological samples using pH meter.
6. Fractionation of biological material into its various components by centrifuge

Books for study:

1. Gnanapragasam N.S and Ramamurthy G., Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
2. Gurtu J.N. and Kapoor R., Advanced Experimental Chemistry(Organic), S. Chand and Co., 1987.

Books for reference:

1. Venkateswaran.V Veerasamy.R, .Kulandaivelu.A.R, Practical book , Basic Principles of Practical Chemistry; Sultan Chand & sons, Second edition, 1997.

Web Resources

1. <https://www.vlab.co.in/broad-area-chemical-sciences>

Rationale for Nature of the course

Knowledge, Analytical ability, organic compounds

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

This course enhances the better understanding of basic of organic chemistry.

Pedagogy: Demonstration and practical session.

Course outcomes: After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	Gain an understanding of the use of organic compounds	K2
CLO2	Design, carry out, record and interpret the results of organic analysis.	K4
CLO3	Apply their skill in the analysis of S and N elements.	K3
CLO4	Analyze the kinds of functional groups	K3
CLO5	Illustrate the saturated and unsaturated group of compounds	K4

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	2
CLO2	3	3	2	2	2	2
CLO3	3	3	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5	PSO–6
CLO1	3	2	2	2	2	2
CLO2	3	2	2	2	2	2
CLO3	3	2	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Evaluation:

Continuous Internal Assessment	:	25 Marks
External Assessment	:	75 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total Marks	25

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO1	To demonstrate mastery of basic organic chemistry laboratory analysis.	K2	10
CLO2	To demonstrate the basic laboratory techniques of qualitative analysis of organic salts	K4	20
CLO3	To identify the nitrogen element, aromatic, aliphatic, saturated unsaturated and to perform a systematic analysis and identify the functional group	K3	20
CLO4	To infer analytical results	K3	15
CLO5	To make scientific claims that is supported by their results and other observations.	K4	10
Total Marks			75

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Name of the Course Designer

- 1. Dr. S. Sujarani**
- 2. Dr. R. Sakthivadivel**
- 3. Dr. R. Sathya**

DEPARTMENT OF CHEMISTRY (S.F)					CLASS: II.B.Sc Microbiology			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Generic Elective II	23U4CGET2	FOOD PROCESSING TECHNOLOGY	3	4	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Provide knowledge on objectives of food preservation.
- Explain the freshness criteria and quality assessment of meat and fish.
- Outline the methods of milk processing and fermented milk products.
- Explain the importance of fat and oil processing.
- Discuss the methods of microbiological examination of foods.

Unit	Description	Hours	K-level	CLO
I	Introduction to food preservation Objectives and techniques of food preservation. Preservation: principles of high temperature, low temperature, radiation, chemical preservatives and bio preservatives.	12	Up to K3	CLO1
II	Freshness criteria and quality assessment of meat and fish Spoilage and methods of preservation. Production of byproducts after processing waste and their utilization. Role of packaging material, types of packaging material.	12	Up to K2	CLO2
III	Composition and Assessment of milk Thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques). Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk. Hygiene and sanitation requirement in food processing and fermentation industries.	12	Up to K3	CLO3
IV	Importance of fats and oils in Food Extraction of fats and Oils-Rendering, pressing, solvent extraction, pressing of oil- degumming, refining, bleaching, deodorization, fractionation, pyrolysis of fats, toxicity of frying oil.	12	Up to K3	CLO4
V	Methods for the microbiological examination of foods. Food borne illness and diseases. Microbial cultures for food fermentation. Indian Factories Act on safety, HACCP, Safety from adulteration of food.	12	Up to K4	CLO5

Books for study:

1. Sharma .A Text Book of Food Science and Technology, International Book,Distributing Co, Lucknow, UP third edition 2006
2. Sivasankar. Food Processing and Preservation, Prentice hall of India Pvt Ltd,,NewDelhi Third edition 2005
3. Ramaswamy H & Marcotte M. Food Processing: Principles & Applications. Taylor & Francis 2006

Books for References:

1. Fellos PJ Food Processing Technology: Principle &Practice 2ndEdition. CRC second edition 2005
2. Zeuthen.P and Leif Bogh-Sorenson. Food Preservation Techniques, WoodlandPublishing Ltd, Cambridge, England. 2005
3. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano Novel Food Processing Technologies, CRC 2004
4. Suman Bhatti, Uma Varma. Fruit and vegetable processing organizations andinstitutions, 1st Edition., CBS Publishing, New Delhi.first edition 1995
5. MirdulaMirajkar, Sreelatha Menon.. Food Science and Processing Technology Vol-2,Commercial processing and packaging, Kanishka publishers, New Delhi. 2002

Web Resources

1. <https://sites.google.com/a/uasd.in/ecourse/food-processing-technology>.
2. <https://nptel.ac.in/courses/126105015>
3. <https://engineeringinterviewquestions.com/biology-notes-on-food-adulteration/>

Rationale for Nature of the course

Knowledge, Analytical ability, Professional Competency, Professional Communication and Transferable skills.

Activities having direct bearing on Skill development / Employability Entrepreneurship

This course will enable to the students to enrich their knowledge on Plan the food safety and adulteration detection and the ways to assess the fundamental concepts of food preservation and thus it brings employability.

Pedagogy

- Chalk-Talk class room Activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer(s):

1. Dr. R. Sathya
2. Dr. S. Sujarani
3. Dr. R. Sakthivadivel

Course Schedule

Unit	Topics	Hrs	Mode
I	Objectives and techniques of food preservation	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Preservation: principles of high temperature, low temperature, radiation,	4	
	chemical preservatives and bio preservatives.	4	
II	Spoilage and methods of preservation.	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Production of byproducts after processing waste and their utilization	4	
	. Role of packaging material, types of packaging material.	4	
III	Thermal processing of fluid milk-pasteurization (LTH, HTST&UHT techniques).	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	Fermented milk products-cheese, Butter milk, Yogurt, Kumis, Kefir and Acidophilus milk	4	
	Hygiene and sanitation requirement in food processing and fermentation industries.	4	
IV	Extraction of fats and Oils-Rendering, pressing, solvent extraction,	4	Chalk and talk/Animated Videos/seminar/quiz and Test
	pressing of oil- degumming, refining, bleaching, deodorization	4	
	fractionation, pyrolysis of fats, toxicity of frying oil.	4	
V	Food borne illness and diseases	4	Chalk and talk/Assignment
	Microbial cultures for food fermentation.	4	
	Indian Factories Act on safety, HACCP, Safety from adulteration of food.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Develop the knowledge on objectives of food preservation	K3
CLO-2	Explain the freshness criteria and quality assessment of meat and fish.	K2
CLO-3	Develop the methods of milk processing and fermented milk products.	K3
CLO-4	Explain the importance of fat and oil processing..	K3
CLO-5	Illustrate the methods of microbiological examination of foods.	K4

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	3	2
CLO2	3	2	2	2	3	2
CLO3	3	3	3	3	3	2
CLO4	3	2	2	2	3	2
CLO5	3	2	2	2	3	2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	2	2	3	2
CLO-2	3	3	2	2	3	2
CLO-3	3	3	3	3	3	2
CLO-4	3	3	2	2	3	2
CLO-5	3	3	3	3	3	2

3-Strong correlation;

2-Medium correlation;

1-Weak Correlation

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D(Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K3	2	K1 & K2	1	K2	2 (K2 & K2)	1(K3)
2	CLO 2	Up to K2	2	K1 & K2	1	K1	2 (K1 & K1)	1(K2)
3	CLO 3	Up to K3	2	K1 & K2	1	K1	2 (K3 & K3)	1(K3)
4	CLO 4	Up to K3	2	K1 & K2	1	K2	2 (K3 & K3)	1(K3)
5	CLO 5	Up to K4	2	K1 & K2	1	K2	2 (K4 & K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks with choice	Consolidated
K1	5	4	10	-	19	15.83	42%
K2	5	6	10	10	31	25.83	
K3	-	-	20	30	50	41.67	42%
K4	-	-	10	10	20	16.67	16%
Total Marks	10	10	50	50	120	100.00	100%

DEPARTMENT OF CHEMISTRY (S.F)				CLASS: II. B.Sc. Microbiology				
SEM	Course type	Course code	Course Title	Credits	Contact Hours/week	CIA	Ext	Total
IV	Allied practical-II	23U4CGEP2	Chemistry Practical for Microbiology - I	2	2	25	75	100

Nature of course	Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	✓

Objectives: The objective of this course is to make the student to

- Get awareness on Food adulteration
- Know the types of food adulteration
- Gain knowledge on some common adulterants and their health effects
- Understand the need for the detection of food adulteration
- Carry on common food adulteration detection tests

Analysis of adulterants in food

1. Methods for Detection of common adulterants in milk
Food: Milk
 - (i) Adulterant: Starch
 - (ii) Adulterant: Formalin
 - (iii) Adulterant: Detergent
 - (iv) Adulterant: Washing soda
2. Methods for Detection of common adulterants in sweetening agents
Food: Gram powder
 - (i) Adulterant: Metanil yellow
3. Methods for Detection of common adulterants in food grains and their products
Food: Grains and their products
 - (i) Adulterant: Lead chromate
4. Methods for Detection of common adulterants in green vegetables
Food: Green chilli and other green vegetables
 - (i) Adulterant: Malachite green
5. Methods for Detection of common adulterants in miscellaneous products.
Food: Common salt and Iodised salt
 - (i) Adulterant: White powder
 - (ii) Adulterant: Common salt

Books for study:

1. Bimal N. P, Dr. Ranita Nagar Food Security Law Interdisciplinary Perspectives 1st Edition, 2014

Books for reference:

1. Dr.Sitaram dixit food adulteration testing manual 14th Edition, 2019

Web Resources

1. <https://www.vlab.co.in/broad-area-food-sciences>

Rationale for Nature of the course

Knowledge, Analytical ability, food science

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

This course enhances the better understanding of basic of food technology

Pedagogy: Demonstration and practical session.

Course outcomes: After successful completion of this course, the student will be able

CLOs	CLO statement	Knowledge level
CLO1	Gain an understanding of food adulteration	K2
CLO2	Design, types of food adulterants	K4
CLO3	Apply their skill in the common adulterants and their health effects	K3
CLO4	Analyze the kinds of functional groups	K3
CLO5	Illustrate the some common food adulteration detection	K4

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	2
CLO2	3	3	2	2	2	2
CLO3	3	3	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Mapping of CLOs with PSOs

#	PSO–1	PSO–2	PSO–3	PSO–4	PSO–5	PSO–6
CLO1	3	2	2	2	2	2
CLO2	3	2	2	2	2	2
CLO3	3	2	2	2	2	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Evaluation:

Continuous Internal Assessment	:	25 Marks
External Assessment	:	75 Marks
Total	:	100 Marks

Formative Assessment:

CIA Components	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total Marks	25

Summative Assessment:

CLOs	CLO statement	Knowledge level	Marks
CLO1	To demonstrate mastery of food adulteration and its detection laboratory analysis.	K2	10
CLO2	To demonstrate the types of food adulteration	K4	20
CLO3	To identify the some common adulteration and their health effects	K3	20
CLO4	To infer analytical results	K3	15
CLO5	To make scientific claims that is supported by their results and other observations.	K4	10
Total Marks			75

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Name of the Course Designer

- 1. Dr. R. Sakthivadivel**
- 2. Dr. S. Sujarani**
- 3. Dr. R. Sathya**



The Madura College (Autonomous), Madurai – 625 011
Department of Chemistry
UG Programme Structure

Semester	Course Code	Title of the Course	Hrs	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
I	23U1CCCT1	General Chemistry – I	5	5			Yes			Yes	77 %
	23U1CCCP1	Quantitative Inorganic Estimation (Titrimetry) and Inorganic Preparations	3	3			Yes			Yes	77 %
	23U1CGET1	Chemistry for Physical Sciences - I (for I year Mathematics)	4	4	Yes					Yes	New
		Chemistry for biological sciences - I (for I year Zoology)			Yes					Yes	New
		Biological chemistry (for I year Biotechnology)			Yes	Yes	Yes			Yes	New
	23U1CGEP1	Chemistry Practical for Physical and Biological	2	1			Yes			Yes	28 %

		sciences - I (for I year Mathematics / Zoology)									
		Chemistry practical for Biotechnology – Biological Chemistry - I (for I year Biotechnology)					Yes				New
	23U1CFCT1	Foundation Course	2	2			Yes			Yes	New
	23U1CSED1	Food Chemistry	2	2	Yes	Yes	Yes		Yes		New
II	23U2CCCT2	General Chemistry – II	5	5	Yes					Yes	16 %
	23U2CCCP2	Qualitative Organic Analysis And Preparation Of Organic Compounds	3	3	Yes		Yes			Yes	72 %
	23U2CGET2	Chemistry for Physical Sciences - II (for I year Mathematics)	4	4	Yes	Yes	Yes			Yes	New
		Chemistry for biological sciences - II (for I year Zoology)			Yes	Yes	Yes			Yes	New
		Bioinstrumentation (for I year Biotechnology)			Yes	Yes	Yes			Yes	New
	23U2CGEP2	Chemistry Practical for Physical and Biological	2	1			Yes			Yes	New

		sciences - II (for I year Mathematics / Zoology)									
		Chemistry Practical for Biotechnology – Bioinstrumentation – II (for I year Biotechnology)					Yes			Yes	New
	23U2CSED2	Dairy Chemistry	2	2	Yes	Yes	Yes		Yes		New
	23U2CSED3	Cosmetics and Personal Grooming	2	2			Yes		Yes		New
III	23U3CCCT3	General Chemistry III	4	4	Yes		Yes			Yes	28 %
	23U3CCCP3	Qualitative Inorganic Analysis (Practicals)	3	3	Yes		Yes			Yes	0 %
	23U3CSED4	Pesticide Chemistry	2	2	Yes	Yes	Yes		Yes		New
	23U3CSED5	Entrepreneurial Skills in Chemistry	2	2	Yes	Yes	Yes		Yes		New
	23U3CGET1	Chemistry for Physical Sciences – I (For II B. Sc. Physics)	4	4	Yes		Yes			Yes	New
	23U3CGET2	Chemistry for Biological Sciences – I (For II B. Sc. Botany)	4	4	Yes		Yes			Yes	New

	23U3CGEP1	Chemistry Practical for Physical and Biological Sciences – I (For II B. Sc. Physics and II B. Sc. Botany)	2	1	Yes		Yes			Yes	28 %
	23U3CGET1	Bioinstrumentation (For II B. Sc. Microbiology)	4	4	Yes		Yes				New
	23U3CGEP1	Chemistry Practical for Microbiology – I (For II B. Sc. Microbiology)	2	1	Yes		Yes			Yes	New
	23U3EVST1	Environmental Science (EVS)	1	-							
IV	23U4CCCT4	General Chemistry IV	4	4	Yes		Yes			Yes	36 %
	23U4CCCP4	Physical Chemistry Practical – I	3	3	Yes		Yes			Yes	0 %
	23U4CSED6	Forensic Science	2	2	Yes		Yes			Yes	New
	23U4CSED7	Instrumental Methods of Chemical Analysis	2	2	Yes		Yes			Yes	25 %
	23U4CGET3	Chemistry for Physical Sciences – II (For II B. Sc. Physics)	4	4	Yes		Yes			Yes	New
	23U4CGET4	Chemistry for Biological Sciences –II (For II B. Sc. Botany)	4	4	Yes		Yes			Yes	New

	23U4CGEP2	Chemistry Practical for Physical and Biological Sciences – II (For II B. Sc. Physics and II B. Sc. Botany)	2	1	Yes		Yes			Yes	New
	23U4CGEP2	Chemistry Practical for Microbiology – II (For II B. Sc. Microbiology)	2	1	Yes		Yes			Yes	New
	23U4EVST2	Environmental Science (EVS)	1	2							

Emp- Employability; Ent- Entrepreneurship; Skill- Skill Development



THE MADURA COLLEGE (AUTONOMOUS), MADURAI – 625 011.
DEPARTMENT OF CHEMISTRY

Course Title details for PG III and IV Semester – TANSCH

Semester III

S. No.	Course Title	Course Code	Credit	Hours
1.	Organic Synthesis and Photochemistry	23P3CCCT5	5	6
2.	Co-ordination Chemistry – I	23P3CCCT6	5	6
3.	Physical Chemistry Practicals	23P3CCCP3	4	6
4.	Physical Chemistry – II (Or) Polymer Chemistry	23P3CECT5 23P3CECT6	3	5
5.	Fundamental mathematic safety, instrumentation and Biomolecules	23P3CMD1	3	5
6.	NME	23P3CSEN2	2	2
7.	Internship / Industrial Activity	23P3CINTR	2	-
Total			24	30

Semester IV

S. No.	Course Title	Course Code	Credit	Hours
1.	Co-ordination Chemistry – II	23P4CCCT7	5	6
2.	Analytical Instrumentation Techniques	23P4CCCP4	4	6
3.	Project with Viva Voce	23P4CPROV	8	8
4.	Chemistry of Natural Products (Or) Pharmacognosy and Phytochemistry	23P4CECT7 23P4CECT8	3	6
5.	Skill Enhancement Course / Professional Competency Skill	23P4CSED2	2	4
6.	Extension Activity	23P4CEXTN	1	-
Total			23	30

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	CORE	23P3CCCT5	Organic synthesis and photochemistry	5	6	25	75	100

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	

Objectives: Students are able to

- Understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
- Develop various synthetically important reagents for any successful organic synthesis and apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
- Correlate the concepts of pericyclic reaction mechanisms.
- Analyse the knowledge of photochemical organic reactions.
- Examine the synthesis of cyclic ring systems.

Unit	Description	Hours	K-level	CLO
I	Planning an Organic Synthesis and Control elements Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons - umpolung reactions - typical examples. Functional Group Interconversion (FGI), Functional Group Addition (FGA) - monofunctional disconnection: alcohol disconnection - alkene disconnection -ketone disconnection-acid and their derivatives disconnection - alkane disconnection - amine disconnection - bifunctional 1,2-, 1,3-, 1,4-, 1,5-, and 1,6- disconnections. Multistep Synthesis: Illustrative synthesis of Juvabione from 4-methoxyacetophenone and from 4-methoxybenzaldehyde	18	UptoK2	CLO1
II	Organic Synthetic Methodology Chemoselectivity: Chemo-, region-, and stereoselectivity - reactivity of carbonyl groups towards nucleophiles - selectivity of hydrides in reduction - selectivity in oxidations - Protecting groups - hydroxyl, amino, carbonyl and carboxylic acid protecting groups Regioselectivity: Regioselectivity in electrophilic and nucleophilic aromatic substitution, regioselectivity in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack	18	UptoK3	CLO2

	on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.			
III	Pericyclic Reactions Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams. Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4], Cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions. ; Electrocyclization and ring opening reactions of conjugated dienes and trienes. Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements. Group transfer reactions.	18	UptoK4	CLO3
IV	Organic Photochemistry Photochemical excitation: electronic transitions; Jablonskii diagrams; intersystem crossings; energy transfer processes; Reactions of electronically excited ketones; $n \rightarrow \pi^*$ triplets; Norrish type- I and type-II cleavage reactions; photo reductions; Paterno-Buchi reactions; Photochemistry of α,β -unsaturated ketones; cis-trans isomerisation. Photo cycloadditions, Photochemistry of aromatic compounds, photochemical rearrangements; di- π -methane rearrangement; Reaction of conjugated cyclohexadienone to 3,4- diphenyl phenols; Barton's reactions.	18	UptoK4	CLO4
V	Construction of ring systems a. Different approaches toward synthesis of 3,4,5 and 6 membered rings b. Pauson-khand reaction, Bergman cyclization, Nazrov cyclization, carbon-olefin cyclization, radical-olefin cyclization, interconversion of ring systems (contraction and expansion), construction of macro cyclic rings and ring closing metathesis.	18	UptoK4	CLO5

Books for study:

1. Carey F.A and Sundberg, Advanced Organic Chemistry, 5th ed, Tata McGraw-Hill, New York, 2003.
2. March.J and Smith.M, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007.
3. Ireland R.E, Organic synthesis, Prentice Hall India, Goel publishing house, 1990.

Books for References:

1. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
2. Smith M.B, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011
3. Warren.S, Organic synthesis, The disconnection Approach, Second Edition, John wiley& Sons, 2004.

- Jagdamba Singh and Jaya singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.
- DePuy, C.H: Chapman, O.L. Molecular Reactions and Photochemsitry, Prentice-Hall: Englewood Cliffs, NJ, 1972.

Web Resources

- <https://nptel.ac.in/courses/104105087>
- <https://archive.nptel.ac.in/courses/104/106/104106077/>
- <https://rushim.ru/books/praktikum/Monson.pdf>

Rationale for Nature of the course

The skill of planning and designing the synthesis of various types of compounds under different conditions and to enhance the knowledge on synthesis.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Design new methodology for synthesis and optimising the reaction conditions.

Pedagogy

- Chalk-Talk room ativities
- Group Discussion
- Seminar
- ICT enabled learning process

Course Designer

M. Karpagavalli

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Planning an Organic Synthesis and Control elements	18	PPT, Chalk and talk, Group discussion
	Synthons and synthetic equivalents - types of synthons: donor and acceptor synthons - umpolung reactions - typical examples	3	
	Functional Group Interconversion (FGI), Functional Group Addition (FGA)	3	
	monofunctional disconnection: alcohol disconnection - alkene disconnection	2	
	ketone disconnection- acid and their derivatives disconnection - alkane disconnection - amine disconnection	4	
	bifunctional 1,2-, 1,3-, 1,4-, 1,5-, and 1,6- disconnections.	2	
	Multistep Synthesis: Illustrative synthesis of Juvabione from 4-methoxyacetophenone and from 4-methoxybenzaldehyde	4	

Unit II	Organic Synthetic Methodology	18	PPT, Chalk and talk, Group discussion
	Chemoselectivity: Chemo-, region-, and stereoselectivity - reactivity of carbonyl groups towards nucleophiles - selectivity of hydrides in reduction - selectivity in oxidations	5	
	Protecting groups - hydroxyl, amino, carbonyl and carboxylic acid protecting groups	5	
	Regioselectivity: Regioselectivity in electrophilic and nucleophilic aromatic substitution, regioselectivity in elimination reactions, electrophilic attack on alkenes, regioselectivity in radical reactions, nucleophilic attack on allylic compounds, electrophilic attack on conjugated dienes and conjugate addition.	3	
Unit III	Pericyclic Reactions	18	PPT, Chalk and talk, Group discussion
	Woodward Hoffmann rules; The Mobius and Huckel concept, FMO, PMO method and correlation diagrams.	6	
	Cycloaddition and retrocycloaddition reactions; [2+2], [2+4], [4+4, Cationic, anionic, and 1,3-dipolar cycloadditions. Cheletropic reactions.		
	Electrocyclization and ring opening reactions of conjugated dienes and trienes.	6	
	Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-carbon migrations, degenerate rearrangements. Ionic sigmatropic rearrangements, Group transfer reactions.	6	
Unit IV	Organic Photochemistry	18	PPT, Chalk and talk, Group discussion
	Photochemical excitation: electronic transitions; Jablonskii diagrams; intersystem crossings,	2	
	Reactions of electronically excited ketones; $n \rightarrow \pi^*$ triplets; Norrish type- I and type-II cleavage reactions;	4	
	Photoreductions; Paterno-Buchi reactions; Photochemistry of α, β unsaturated ketones; cis-trans isomerisation.	4	
	Photo cycloadditions, Photochemistry of aromatic compounds, photochemical rearrangements; di- π -methane rearrangement;	4	
	Reaction of conjugated cyclohexadienone to 3,4- diphenyl phenols; Barton's reactions.	4	
Unit V	Construction of ring systems	18	PPT, Chalk and talk, Group discussion
	a. Different approaches toward synthesis of 3,4,5 and 6 membered rings	5	
	b. Pauson-khand reaction, Bergman cyclization, Nazrov cyclization, carbon-olefin cyclization, radical-olefin cyclization,	5	
	interconversion of ring systems (contraction and expansion),	5	
	Construction of macro cyclic rings and ring closing metathesis.	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Predict the suitability of reaction conditions in the preparation of tailor-made organic compounds mechanisms.	Up to K2
CLO-2	Design and synthesize novel organic compounds with the methodologies learnt during the course.	Up to K3
CLO-3	Implement the synthetic strategies in the preparation of various organic compounds	Up to K4
CLO-4	Apply the principles of photochemistry and to understand the various reactions of organic compounds with reaction	Up to K4
CLO-5	Analaysie the versatility of various reactions and to correlate their reactivity with various reaction conditions	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	3	3	2
CLO-4	3	3	3	3	3	2
CLO-5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	2
CLO2	3	3	3	3	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	3	3	3	2
CLO5	3	3	3	3	3	2

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.3	35
K2	2	4	10	10	26	21.7	
K3	4	2	10	20	36	30	30
K4	2	-	20	20	42	35	35
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	CORE	23P3CECT6	COORDINATION CHEMISTRY – I	5	6	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To gain insights into the modern theories of bonding in coordination compounds.
- To learn various methods to determine the stability constants of complexes.
- To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
- To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
- To evaluate the reactions of octahedral and square planar complexes

Unit	Description	Hours	K-level	CLO
I	Modern theories of coordination compounds: Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of Δ_0 - factors affecting Δ_0 - spectrochemical series - crystal field stabilisation energy for low spin complexes- evidences for crystal field splitting - site selections in spinels and antispinel - Jahn Teller distortions and its consequences. Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields, Sigma and pi bonding in octahedral, and tetrahedral complexes.	18	UptoK 2	CLO 1
II	Spectral characteristics of complexes: Spectroscopic term symbols for d_n ions derivation of term symbols and ground state termsymbol, Hund's rule, Selection rule breakdown of selection rules, spin orbit coupling, band intensities, weak and strong field limits - characteristics of d-d transitions - Orgel correlation diagrams - Sugano-Tanabe energy level diagrams - nephelauxetic series - Racha parameter and calculation of inter-electronic repulsion parameter ($10Dq$ and β)-Charge transfer spectra: MLCT and LMCT	18	UptoK 3	CLO 2

III	Stability and Magnetic property of the complexes: Stability of complexes: Factors affecting stability of complexes, Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, and Continuous variation method (Job's method) Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.	18	UptoK 4	CLO 3
IV	Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and Labile complexes; Associative, Dissociative and SN_1CB mechanistic pathways for substitution reactions; acid and base hydrolysis of octahedral complexes; Substitution reactions in square planar complexes: Trans effect, theories of trans effect and applications of trans effect in synthesis of square planar compounds; Kurnakov test.	18	UptoK 4	CLO 4
V	Electron transfer and photo chemistry of complexes Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and Marcus-Hush theory; inner sphere electron transfer reactions; nature of the bridging ligand in inner sphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications.	18	UptoK 4	CLO 5

Books for study:

1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006
2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008
3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993.

Books for References:

1. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, Saunders Publications, USA, 1977.
2. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn.

Web Resources

1. <https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/>
2. <https://www.slideshare.net/laxmimangamma/spectral-properties-of-metal-complexes>
3. <https://mgcub.ac.in/pdf/material/2020042600350178a1936480.pdf>

Rationale for Nature of the course

This course will enable the students to enrich their knowledge on concept of Modern theories of coordination compounds, various Spectral characteristics of complexes, Stability and Magnetic property of the complexes, Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes, Electron transfer and photo chemistry of complexes and thus it brings employability.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The coordination chemistry course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like (i) Spectral characteristics of complexes (ii) Stability and Magnetic property of the complexes, (iii) Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes, (iv) Electron transfer and photo chemistry of complexes. Hence students will have chance to develop business plans for entrepreneurial ventures in the field of coordination chemistry

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer :

Dr. M. Boominathan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Modern theories of coordination compounds: Crystal field theory - splitting of d orbitals in octahedral, tetrahedral and square planar symmetries - measurement of Δ_0 - factors affecting Δ_0 -	5	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	spectrochemical series - crystal field stabilisation energy for low spin complexes- evidences for crystal field splitting.	4	
	site selections in spinels and antispinel - Jahn Teller distortions and its consequences. Molecular Orbital Theory and energy level diagrams concept of Weak and strong fields,	5	
	Sigma and pi bonding in octahedral, and tetrahedral complexes	4	
Unit II	Spectral characteristics of complexes: Term states for d ions - characteristics of d-d transitions	4	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	selection rules for electronic spectra - Orgel correlation diagrams	5	
	Sugano-Tanabe energy level diagrams - nephelauxetic series	5	
	Rach parameter and calculation of inter-electronic repulsion parameter (p & c) - charge transfer spectra MLCT & LMCT	4	
Unit III	Stability and Magnetic property of the complexes: Stability of complexes: Factors affecting stability of complexes,	4	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	Thermodynamic aspects of complex formation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes:	5	
	Formation curves and Bjerrum's half method, Potentiometric method, Spectrophotometric method, and Continuous variation method (Job's method)	5	
	Magnetic property of complexes: Spin-orbit coupling, effect of spin-orbit coupling on magnetic moments, quenching of orbital magnetic moments.	4	
Unit IV	Kinetics and mechanisms of substitution reactions of octahedral and square planar complexes: Inert and Labile complexes; Associative, Dissociative and SN_1CB mechanistic pathways for substitution reactions	4	PPT, Chalk and talk, Group discussion test, and Quiz/ seminar
	Acid and base hydrolysis of octahedral complexes; Substitution reactions in square planar complexes:	5	
	Trans effect, theories of trans effect and	5	
	Applications of trans effect in synthesis of square planar compounds; Kurnakov test..	4	

Unit V	Electron transfer and photo chemistry of complexes Electron Transfer reactions in octahedral complexes: Outer sphere electron transfer reactions and	4	PPT, Chalk and talk, Group discussion/Assignment and Quiz/ seminar
	Marcus-Hush theory; inner sphere electron transfer reactions;	5	
	Nature of the bridging ligand in inner sphere electron transfer reactions.	5	
	Photo-redox, photo-substitution and photo-isomerisation reactions in complexes and their applications.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To gain insights into the modern theories of bonding in coordination compounds.	UptoK2
CLO-2	To learn various methods to determine the stability constants of complexes.	UptoK3
CLO-3	To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.	UptoK4
CLO-4	To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.	UptoK4
CLO-5	To evaluate the reactions of octahedral and square planar complexes	UptoK4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	3
CLO-2	3	3	3	3	3	3
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (COs)

S. No.	COs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
3	CO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
4	CO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be Asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Core	23P3CCCP3	Physical Chemistry Practical	4	6	25	75	100
Nature of course		Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented		

Objectives: Objective of this course is to

- Understand the principle of conductivity experiments through conductometric titrations.
- Evaluate the order of the reaction, temperature coefficient, of the reaction by following pseudo first order kinetics.
- Construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
- Determine the kinetics of adsorption of oxalic acid on charcoal.
- Understand the principle of potentiometry experiments through potentiometric titrations.

List of experiments

1. Determination of equivalent conductance of a strong electrolyte & the verification of Debye-Huckel-Onsager equation.
2. Verification of Ostwald's Dilution Law & Determination of pKa of a weak acid.
3. Verification of Kohlrausch Law for weak electrolytes.
4. Determination of solubility of a sparingly soluble salt.
5. Acid-base titration (strong acid and weak acid vs NaOH).
6. Precipitation titrations –(MgSO_4 Vs BaCl_2)
7. Study of the kinetics of acid hydrolysis of an ester; determine the temperature coefficient and also the activation energy of the reaction.
8. Construction of phase diagram for a simple binary system
9. Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich Isotherm only)

Books for study:

1. Viswanathan. B., and Raghavan. P.S., Practical Physical Chemistry, Viva Books, New Delhi, 2009.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), Viswanathan. S. Co. Pvt., 1996.
3. Athawale. V.D and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008.

Books for References:

1. Yadav. J. B, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
2. Garland. G.W. Nibler. J.W, Shoemaker. D.P., Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
3. Gurthu. J. N. and Kapoor. R, Advanced Experimental Chemistry, S. Chand and Co., 1987.

Web Resources

1. https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf.
2. https://uomustansiriyah.edu.iq/media/lectures/6/6_2020_09_26!06_54_18_PM.pdf
3. <https://vlab.amrita.edu/?brch=190&cnt=1&sim=606&sub=2>

Pedagogy

Demonstration, Hands on experience

Course Designer(s):

Dr.M. Malarvizhi

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To recall the principles associated with various physical chemistry experiments.	K3
CLO-2	To scientifically plan and perform all the experiments.	K4
CLO-3	To observe and record systematically the readings in all the experiments.	K3
CLO-4	To calculate and process the experimentally measured values and compare with graphical data.	K4
CLO-5	To interpret the experimental data scientifically to improve students' efficiency for societal developments.	K4

Mapping of CLOs with PSOs

_#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	2	3	2	3
CLO-2	3	3	2	3	3	3
CLO-3	3	3	2	3	3	2
CLO-4	2	2	3	3	3	3
CLO-5	3	3	3	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	2
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application- 3;

Intermediate level-2;

Basic level-1

Components for	Marks
Internal Test	10
Observation/Record	5
Continuous class assessment	10
Total	25

CLO	CLO Statement	K level	Marks
CLO1	To apply the principles associated with various physical chemistry experiments.	K3	15
CLO2	To scientifically plan and perform all the experiments.	K4	20
CLO3	To observe and record systematically the readings in all the experiments.	K3	15
CLO4	To calculate and process the experimentally measured values and compare with graphical data.	K4	20
CLO5	To interpret the experimental data scientifically to improve students' efficiency for societal developments.	K4	5

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	ELECTIVE	23P3CECT5	PHYSICAL CHEMISTRY-II	3	5	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To understand the essential characteristics of wave functions and need for the quantum mechanics
- To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
- To familiarize the structure of the electrical double layer of different models.
- To compare electrodes between current density and over potential.
- To familiarize the symmetry in molecules and predict the point groups
- To predict the vibrational modes, hybridization using the concepts of group theory.

Unit	Description	Hours	K-level	CLO
I	QUANTUM MECHANICS-I: Black body radiation, photoelectric effect, Bohr theory of hydrogen atom and hydrogen spectrum. Need for quantum mechanics Wave particle duality, Uncertainty principle, Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent Quantum models: , free particles Particle in a box-1D, two dimensional and three-dimensional, degeneracy, ring derivation of Rigid Rotor-wave equation and its solution	15	Upto K2	1
II	QUANTUM MECHANICS-II: Derivation of Harmonic Oscillator wave equation and solution,. Approximation methods - Nonlinear variational methods using trial wave function, and its application to particle in 1D box. Linear variational methods using trial wave function. and its application to linear conjugated molecular system Perturbation method - first order application to Helium atom. Hatre fock self-consistent field method, Hohenberg-Kohn theorem and Kohn-Sham equation, Helium atom-electron spin, paulis exclusion principle and Slater determinant.	15	Upto K3	2

III	ELECTRO CHEMISTRY: Debye-Hückel-Bjerrum theory of ion association and triple ion formations- Debye-Hückel limiting law derivation and its applications. - Electrocapillary phenomena - Surfactants - Lipmann's equation, -Structure of electrical double layer – Helmholtz Perrin, Guoy-Chapmann and Stern models. Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities- and symmetry factor – transfer coefficient Electrokinetic phenomena- Zeta potential and its applications coefficient	15	Upto K4	3
IV	GROIUP THEORY: Group theory: Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Dihedral point groups- C_n , C_{nh} , D_n , D_{nh} , D_{nd} , T_d and O_h . Matrix representation and reducible irreducible and direct product representation. The Great orthogonality theorem – irreducible representation and reduction formula, construction of character table for C_{2v} , C_{2h} , C_{3v} and D_{2h} point groups.	15	Upto K4	4
V	PHOTO CHEMISTRY: Jablonski diagram, Primary and Secondary Processes, quantum yield and its determination-chemical actinometer. Excimers and exciplexes-Kinetics of collisional quenching-Stern Volmer equations-Photosensitization, Chemiluminescence-Photosynthesis, solar energy conversions. Semiconductor photo catalysis, lasers. Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water solvated electrons.	15	Upto K4	5

Books for study:

1. Prasad, R.K. Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition
2. Cotton F. A. Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition
3. Vincent A. Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition
4. Samuel Glasstone , An introduction to electrochemistry, , East-West edition New Delhi,1942

Books for study:

1. Prasad, R.K. Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition
2. Cotton F. A. Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition
3. Vincent. A., Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition
4. Samuel Glasstone , An introduction to electrochemistry, , East-West edition New Delhi,1942

Books for References:

1. Levine N., Quantum Chemistry, Allyn & Bacon Inc, 1983, 4th edition
2. Flurry. R.L. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980
3. Turro N. J, Modern molecular photochemistry, Benjamin/Cummings, Menlo Park, California, 1978
4. Paula, Peter Atkins and Julio de, Elements of Physical chemistry, 5th Ed, Oxford U. P, 2012.
5. Rohatgi-Mukherjee.K.K.Fundamentals of Photochemistry NEW AGE INTERNATIONAL (P) LIMITED, publisher. Revised edition 1986.
6. M.S.Gopinathan & V. Ramakrishnan, "Group Theory In Chemistry", Visal Publications (2000).

Rationale for Nature of the course

The course enables the students to comprehend the fundamental knowledge and facts in quantum chemistry electro chemistry, Group theory and Photo chemistry

Activities having direct bearing on Skill development / Employability Entrepreneurship

The students are trained to solve the eigen value problems using the eigen function to obtain the various properties of quantum mechanical system. Also hands on training provided to visualise the various symmetry and symmetry operation using the standard package and enabled them to correlate with corresponding matrix operation and representation. Students are exposed to some chemical reaction involving luminescence (may be due to fluorescence and phosphorescence)

Pedagogy

- Chalk-Talk class room activities
- Seminar
- Assignment and Quiz through ICT, PPT

Course Designer(s):

Mr S.Vidhyasankar

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Black body radiation, photoelectric effect, Bohr theory of hydrogen atom and hydrogen spectrum. Need for quantum mechanics Wave particle duality, Uncertainty principle	4	Chalk & talk/animation portal
	Postulates of Quantum Mechanics, Schrodinger wave equation, Time independent and time dependent	4	
	Quantum models: Free particle in a box-1D, two dimensional and three-dimensional, degeneracy	3	
	Derivation of ring Rigid Rotor-wave equation derivation and its solution	4	

Unit II	Derivation of Harmonic Oscillator wave equation and solution	4	Chalk & talk
	Approximation methods - Non linear variational methods using trial wave function, and its application to particle in 1D box	4	
	Linear variational methods using trial wave function, and its application to linear conjugated molecular system Perturbation method - first order application to Helium atom	3	
	Hartree Fock self-consistent field method, Hohenberg-Kohn theorem and Kohn-Sham equation Helium atom-electron spin, Pauli exclusion principle and Slater determinant.	4	
Unit III	Debye-Hückel-Bjerrum theory of ion association and triple ion formations- Debye-Hückel limiting law derivation and its applications	4	Chalk & talk, Assignment
	Electro capillary phenomena - Surfactants - Lipmann's equation, -Structure of electrical double layer –	4	
	Helmholtz Perrin, Guoy-Chapmann and Stern models Derivation of Butler-Volmer equation for one electron transfer reaction	3	
	equilibrium and exchange current densities- and symmetry factor– transfer coefficient Electro kinetic phenomena- Zeta potential and its applications coefficient	4	
Unit IV	Group theory: Groups, sub groups, symmetry elements, operations, classification-axial and non-axial. Dihedral point groups	3	Chalk & talk, ppt
	C_n , C_{nh} , D_n , D_{nh} , D_{nd} , T_d and O_h Matrix representation Reducible, irreducible and direct product representation	4	
	The Great orthogonality theorem – irreducible representation and reduction formula	4	
	Construction of character table for C_{2v} , C_{2h} , C_{3v} and D_{2h} point groups.	4	
Unit V	Jablonski diagram, Primary and Secondary Processes, quantum yield	3	Chalk & talk, ppt
	Determination of quantum yield -chemical actinometer Excimers and exciplex -Kinetics of collisional quenching Stern Volmer equations	4	
	Photosensitization, Chemiluminescence-Photosynthesis, solar energy conversions. Semiconductor photo catalysis, lasers	4	
	Radiation Chemistry-linear energy transfer, G-value, dosimeters, radiolysis of water solvated electrons.	4	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To Organize basic concepts of quantum mechanics and to apply operators to solve simple Eigen values problems and approximation methods used in solving molecular energy.	UptoK2
CLO-2	To apply the Approximation methods to find out average energy of a system using trial wave function	UptoK3
CLO-3	To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations	UptoK4
CLO-4	To discuss the characteristics of wave functions and symmetry functions	UptoK4
CLO-5	To Illustrate the various aspects of photochemistry, radiation chemistry and its applications	UptoK4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	2	1	1	1	1
CLO-2	2	3	1	1	1	1
CLO-3	1	1	3	2	1	1
CLO-4	1	1	1	1	3	3
CLO-5	1	1	1	1	1	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	2	3	1	3	3
CLO2	1	1	3	1	3	3
CLO3	1	1	3	1	3	3
CLO4	1	1	3	1	3	3
CLO5	1	1	3	1	3	3

Advance level- 3;**Intermediate level-2;****Basic level-1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K2)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.3	35
K2	2	4	10	10	26	21.7	
K3	4	2	10	20	36	30	30
K4	2	-	20	20	42	35	35
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	Elective VI	23P3CECT6	POLYMER CHEMISTRY	3	5	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objective of this course is to:

- To learn the basic concepts and Molecular weight determination of polymers.
- To explain various types of polymerization reactions and kinetics.
- To understand the importance of industrial polymers and their synthetic uses.
- To focus on industrial polymers.
- To examine polymer processing.

Unit	Description	Hours	K-level	CLO
I	Characterization, Molecular weight and its Determination: Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests, thermal methods, Tg, molecular distribution, stability. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers. Molecular weight determination of high polymers by physical methods.	15	UptoK2	CLO1
II	Mechanism and kinetics of Polymerization: Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization. Reaction kinetics. Step growth polymerization, Degree of polymerization.	15	UptoK3	CLO2
III	Techniques of Polymerization and Polymer Degradation: Bulk, Solution, Emulsion, and Suspension, solid, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers, Solid and gas phase polymerization.	15	UptoK4	CLO3
IV	Industrial Polymers: Preparation of fibre forming polymers, elastomeric material. Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde and expoxide resin. Elastomers: Natural rubber and synthetic	15	UptoK4	CLO4

	rubber - Buna - N, Buna-S and neoprene. Conducting Polymers: Elementary ideas; examples: poly sulphur nitriles, polyphenylene, poly pyrrole and poly acetylene. Polymethylmethacrylate, polyimides, polyamides,			
V	Polymer Processing: Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers, fire retardants and colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing. Film casting, Thermofoaming, Foaming. Catalysis and catalysts – Polymerization catalysis, catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium, heterogeneous catalysis and active centres.	15	UptoK4	CLO5

Books for study:

1. Gowariker V.R, *Polymer Science*, Wiley Eastern, 1995.
2. Misra.G.S, *Introductory Polymer Chemistry*, New Age International (Pvt) Limited, 1996.
3. Bhatnagar M.S, *A Text Book of Polymers*, vol-I & II, S.Chand & Company, New Delhi, 2004.

Books for References:

1. Billmeyer. F. N, *Textbook of Polymer Science*, Wiley Interscience, 1971.
2. Kumar. A and. Gupta.S.K, *Fundamentals and Polymer Science and Engineering*, Tata McGraw-Hill, 1978.
3. Robert O.Ehewele, *polymer science and Technology*, 1988.

Web Resources

1. https://books.google.com.bd/books?id=mvCzE_AflUIC&printsec=copyright#v=onepage&q&f=false
2. https://books.google.co.in/books/about/Polymer_Science.html?id=mvCzE_AflUIC&redir_esc=y
3. <https://bookstation.in/products/9789387788640>

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on concept of polymer chemistry and various applications, polymer processing and industrial applications, Mechanism and kinetics of Polymerization and thus it brings employability.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Polymer chemistry course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like (i) Characterization, Molecular weight

and its Determination (ii) Mechanism and kinetics of Polymerization, (iii) Techniques of Polymerization and Polymer Degradation (iv) Industrial Polymers. Hence students will have chance to develop business plans for entrepreneurial ventures in the field of polymer chemistry

Pedagogy

- Chalk-Talk room activities
- Group Discussion
- Seminar
- ICT enabled learning process

Course Designer

Dr. S.SELVAKUMAR

Course Schedule

Unit	Topics	Hrs	Mode
I	Characterization, Molecular weight and its Determination	15	PPT, Chalk and talk, Group discussion, Revision and test
	Primary and secondary bond forces in polymers; cohesive energy, molecular structure, chemical tests	4	
	Thermal methods, Tg, molecular distribution, stability. Determination of Molecular mass of polymers	3	
	Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers	4	
	Molecular weight determination of high polymers by physical methods.	4	
II	Mechanism and kinetics of Polymerization	15	PPT, Chalk and talk, Group discussion, Revision and test
	Introduction and previous discussion	4	
	Chain growth polymerization: Cationic, anionic, free radical polymerization,	6	
	Stereo regular polymers: Ziegler Natta polymerization.	2	
	Reaction kinetics. Step growth polymerization, Degree of polymerization.	3	
III	Techniques of Polymerization and Polymer Degradation: Bulk, Solution- introduction and discussion	15	PPT, Chalk and talk, Group discussion, Revision and test
	Emulsion, and Suspension, solid, interfacial and gas phase polymerization. Types of Polymer	5	
	Degradation, Thermal degradation, mechanical degradation, photodegradation	4	
	, Photo stabilizers, Solid and gas phase polymerization.	6	
IV	Industrial Polymers:	15	PPT, Chalk and talk, Group discussion, Revision and
	Preparation of fibre forming polymers, elastomeric material. Thermoplastics	3	
	Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile,	4	

	Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester		test
	Thermosetting Plastics: Phenol formaldehyde and epoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene.	4	
	Conducting Polymers: Elementary ideas; examples: poly sulphur nitriles, polyphenylene	2	
	Poly pyrrole and poly acetylene. Polymethylmethacrylate, polyimides, polyamides,	2	
V	Polymer Processing: Introduction	15	PPT, Chalk and talk, Group discussion, Seminar/Quiz @Assignment
	Blow moulding and reinforcing. Film casting, Thermo foaming, Foaming. Catalysis and catalysts – Polymerization catalysis	5	
	Compounding: Polymer Additives: Fillers, Plasticizers, antioxidants, thermal stabilizers	4	
	Fire retardants and colourants. Processing Techniques: Calendaring, die casting, compression moulding, injection moulding,	3	
	Catalyst support, clay compounds, basic catalyst, auto-exhaust catalysis, vanadium, heterogeneous catalysis and active centers.	3	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO1	Relate the bonding in polymers.	Up to K2
CLO2	Construct the scientific plan and perform the various polymerization reactions	Up to K3
CLO3	Conclude to observe and record the processing of polymers.	Up to K4
CLO4	Inspect to calculate the molecular weight by physical and chemical methods.	Up to K4
CLO5	Focus to interpret the experimental data scientifically to improve the quality of synthetic polymers.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO1	3	1	1	1	1	3
CLO2	3	3	2	1	3	1
CLO3	3	3	2	1	3	3
CLO4	3	3	2	1	3	3
CLO5	3	3	2	1	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	1	1	1	1
CLO2	3	3	2	3	2	2
CLO3	3	3	2	3	2	2
CLO4	3	3	2	3	2	2
CLO5	3	3	2	3	2	2

Advance application– 3**Intermediate level–2****Basic level–1**

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (COs)

S. No.	COs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
3	CO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
4	CO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analysing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc CHEMISTRY			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	MDC	23P3CMDC1	Fundamental Mathematics, Safety instrumentation and Biomolecules	3	5	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Understand the theory behind correlation and fundamentals of calculus.
- Know basic knowledge in life assisting and therapeutic devices
- Learn the basic concepts and biological importance of biomolecules and natural products.
- Explain several functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
- Elucidate the structure determination of biomolecules and natural products.

Unit	Description	Hours	K-level	CLO
I	Fundamental statistics & calculus Correlation – Types of Correlation- Computation of Coefficient of correlation –Coefficient of correlation in grouped data- coefficient of concurrent deviation –Rank correlation coefficient –Regression – Lines of Regression – – Fundamentals of calculus	15	UptoK2	CLO-1
II	Safety instrumentation Radiation safety instrumentation-effect of radiation Exposure-Radiation Monitoring Instruments-Area monitoring Instruments-Physiological effects due to 50Hz current Passage-Micro shocks- Macro Shock-Electrical accidents in Hospitals, Micro shock and macro shock Hazards.	15	UptoK2	CLO-2
III	Chemistry and metabolism of carbohydrates: Definition, classification and biological role of carbohydrates. monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides: Starch, glycogen	15	UptoK2	CLO-3

	and cellulose – structure and properties, glycolysis of carbohydrates.			
IV	Proteins and nucleic acids: Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of amino acids - transamination, oxidative deamination and decarboxylation. Role of nucleic acids. Amino acid, Structure nucleosides, nucleotide - Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phase synthesis of oligonucleotides. End Group Analysis.	15	UptoK2	CLO-4
V	Fused Ring Heterocyclic Compounds: Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.	15	UptoK2	CLO-5

Books for study:

1. Sancheti, D.C, Kapoor. V.K, Statistics, Seventh Revised Edition, Sultan Chand & Sons Publishers (Chapter 8,9)
2. Arumugam. M, Bio Medical Instrumentation, Anuradha Publishing Co, Kumbakonam, Tamil Nadu (2004). 9.2,9.2.1,9.2.2,9.2.3,9.3,9.4,9.5,9.5.1,9.5.2
3. Lindhorst, T. K, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America, 2007.

Books for References:

1. Finar, I.L., Organic Chemistry Vol-1, 6th edition, Pearson Education Asia, 2004
2. Jain M. K and Sharma. S. C, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.
3. John G. Webster, Medical Instrumentation Application and Design, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
4. Ahluwalia. V. K and Goyal. M, Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000.
5. Agarwal, O. P. “Organic Chemistry Natural Products” Volume I and II, Krishna prakashan media Ltd., 2015.
6. Singh, J. Ali, S. M., Singh, J. “Natural Products Chemistry”, Pragati Prakashan Publisher, 2010.

Web Resources

1. www.technicalsymposium.com
2. https://www.angelo.edu/faculty/kboudrea/index_2353/Chapter_07.pdf
3. <https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/heterocy.htm>
4. <https://biologydictionary.net/proteins-and-nucleic-acids/>

Rationale for Nature of the course

This course will enable the students to enrich the understanding of basic mathematics applied to chemistry, knowledge on the safety instrumentation, understand the importance of biomolecules.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The knowledge in Biomolecules chemistry will help the students to do research in this field and work industries related to this field. The multidisciplinary approach especially basic Mathematics enable the students excel in problem solving and also to do calculations in project work.

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer(s):**Department of Chemistry**

- Dr. J. Shanmuga Priya

Department of Physics

- Dr. J.Sivasubramanian

& Department of Mathematics

- Dr. C. Thangapandian
- Dr. R. Pandiselvi
- Dr. K.M Dharmalingam

Course Schedule

Unit	Topics	Hrs	Mode
I	Correlation – Types of Correlation- Computation of Coefficient of correlation	5	PPT, Chalk and talk, Test
	Coefficient of correlation in grouped data- coefficient of concurrent deviation- Rank correlation coefficient	5	
	Regression – Lines of Regression – – Fundamentals of calculus Fundamentals of calculus	5	
II	Radiation safety instrumentation-effect of radiation Exposure	4	PPT, Chalk and talk Test
	Radiation Monitoring Instruments-Area monitoring Instruments	4	
	Physiological effects due to 50Hz current Passage-Micro shocks	3	
	Macro Shock-Electrical accidents in Hospitals, Micro shock and macro shock Hazards.	4	
III	Definition, classification and biological role of carbohydrates. monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose,fructose and mannose (structure determination not required)	3	PPT, Chalk and talk, Quiz and Seminar
	Physical and chemical properties of glucose and fructose.	3	
	Disaccharides: Ringstructures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose	5	
	Polysaccharides: Starch, glycogen and cellulose – structure and properties, glycolysis ofcarbohydrates.	4	
IV	Separation and purification of proteins – dialysis, gel filtration and electrophoresis.	4	PPT, Chalk and talk, Assignment
	Catabolism of amino acids - transamination, oxidative deamination and decarboxylation	4	
	Role of nucleic acids. Aminoacid, Structure nucleosides, nucleotide - Primary and secondary structure of RNA and DNA, Watson-Crick model	4	
	solid phase synthesis of oligonucleotides. End Group Analysis.	3	
V	Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties	5	PPT, Chalk and talk, Group discussion, Quiz and Seminar
	Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions,	5	
	Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.	5	

Course Learning Outcomes: At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Understand the theory behind correlation and fundamentals of calculus	UptoK2
CLO-2	Understand the fundamental concept of Radiation safety instrumentation techniques and learn the Physiological effects due to current Passage.	UptoK2
CLO-3	Discuss and assess the different methods of preparation of structurally different carbohydrates	UptoK2
CLO-4	Illustrate the applications of and their functions in the metabolism of nucleic acids in living organisms.	UptoK2
CLO-5	Know the structure of biologically important heterocyclic compounds by different methods.	UptoK2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	1	1	1	1	3
CLO-2	3	3	2	1	3	1
CLO-3	3	3	2	1	3	3
CLO-4	3	3	2	1	3	3
CLO-5	3	3	2	1	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	1	1	1	1	1
CLO2	3	3	2	3	2	2
CLO3	3	3	2	3	2	2
CLO4	3	3	2	3	2	2
CLO5	3	3	2	3	2	2

Advance application- 3;

Intermediate level-2;

Basic level-1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

S.No	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short Answers		(Either/or Choice)		
			No of Questions	K - Level	No of Questions	K - Level	
1	CLO1	Up to K2	1	K1	1	K2& K2	1(K2)
2	CLO2	Up to K2	1	K1	1	K2& K2	1(K2)
3	CLO3	Up to K2	1	K1	1	K2& K2	1(K2)
4	CLO4	Up to K2	1	K1	1	K2& K2	1(K2)
5	CLO5	Up to K2	1	K1	1	K2& K2	1(K2)
No. of Questions to be asked			5		10		5
No. of Questions to be answered			5		5		3
Marks for each question			2		7		10
Total Marks for each section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise Marks with K Levels

K Levels	Section A Short Answers	Section B (Either/or Choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	10	-	-	10	7.69	8
K2	-	70	50	120	92.31	92
Total Marks	10	70	50	130	100	100%

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
III	NME	23P3CSEN2	Applied Chemistry	2	2	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Understand food adulteration and get knowledge on food additives
- Get knowledge on the chemistry of milk and milk products
- Study about the soil composition, fertilizers, and their role in plant growth
- Know about the hardness of water and removal of hardness using various methods
- Study about different types of polymers like PVC, polyethylene, and polyester

Unit	Description	Hours	K-level	CLO
I	Food Chemistry: Common adulterants in different foods: Milk and milk products, vegetable oils, cereals, tea, coffee powder, chilly powder. Food Additives - artificial sweeteners - Saccharin - Cyclamate and Aspartate. Food colours - preservatives - Baking powder- tastemakers - MSG - vinegar.	6	UptoK2	CLO1
II	Dairy Chemistry: Composition of milk and milk products - Ice cream - types - Ingredients - manufacture. Analysis of fat content, acidity and total solids in milk. Processing of milk - Pasteurization. Special milk - flavoured milk - vitaminised milk - toned milk - condensed milk (Definition only). Fermentation of milk.	6	UptoK2	CLO2
III	Agricultural Chemistry: Composition of soil - Organic and Inorganic constituents. Fertilizers - Plant nutrients their role in plant growth - classification of fertilizers - Natural and synthetic fertilizers - NPK fertilizers. Pesticides - Classification. Fungicides - Herbicides - Plant growth regulators.	6	UptoK2	CLO3
IV	Water Chemistry: Source of water – characteristics of water - Hardness of water - Types - Temporary hardness - permanent hardness - disadvantages of hard water - Removal of hardness - Reverse osmosis - zeolite process.	6	UptoK2	CLO4

V	Polymer Chemistry: Monomer - polymer - definition - classification - differences between thermoplastics and thermosetting polymers - polymerization - addition and condensation. Preparation and uses of polymers used in day-to-day life (PVC, polyethylene, polyester).	6	UptoK2	CLO5

Books for study:

1. Ghosh J, Fundamental Concepts of Applied Chemistry, 1st ed., S. Chand & Company, 2010.
2. Jain P.C, Jain, M. Engineering Chemistry, 15th edition, 1998, Dhanpat Rai Publishing Company.
3. Buchel K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 19830.

Books for References:

1. Swaminathan M, Food Science and Experimental Foods, Ganesh Publishers, 1979.
2. Bagavathi Sundari K, Applied Chemistry, MJP Publishers, first edition, 2006.
3. Sharma B. K, Industrial chemistry, 11th Edition Goel Publishing House, 1994.

Web Resources:

1. <https://www.vedantu.com/biology/food-adulteration>
2. <https://www.britannica.com/topic/dairy-product/Ripening>
3. <https://www.sciencenewsforstudents.org/article/explainer-what-are-polymers>

Rationale for Nature of the course

This course will enable the students to enrich their knowledge on chemistry behind food adulteration, milk processing and agriculture. It helps to know about the water treatment methods and various types & preparation of some daily use polymers.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

- Hands on training will be given to identify the food adulteration
- Practical class on preparation of milk products
- Field visit to nearby milk industry and water treatment laboratory

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Assignment & Quiz

Course Designer:

Dr. M. Hasmath Farzana

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Food Chemistry: Common adulterants in different foods: Milk and milk products, vegetable oils, cereals, tea, coffee powder, chilly powder.	2	PPT, Chalk and talk, Group discussion, Test & Quiz
	Food Additives - artificial sweeteners - Saccharin - Cyclamate and Aspartate	2	
	Food colours - preservatives - baking powder- tastemakers - MSG - vinegar.	2	
Unit II	Dairy Chemistry: Composition of milk and milk products - Ice cream – types – Ingredients - manufacture.	2	PPT, Chalk and talk, Seminar, Test & Quiz
	Analysis of fat content, acidity, and total solids in milk. Processing of milk - Pasteurization.	2	
	Special milk- flavoured milk - vitaminised milk - toned milk - condensed milk (Definition only). Fermentation of milk.	2	
Unit III	Agricultural Chemistry: Composition of soil - Organic and Inorganic constituents. Fertilizers - Plant nutrients their role in plant growth	2	PPT, Chalk and talk, Group discussion, Assignment & Quiz
	Classification of fertilizers - Natural and synthetic fertilizers - NPK fertilizers.	2	
	Pesticides - Classification. Fungicides – Herbicides - Plant growth regulators.	2	
Unit IV	Water Chemistry: Source of water – characteristics of water – Hardness of water	2	PPT, Chalk and talk, Group discussion, Test & Quiz
	Types – Temporary hardness – permanent hardness – disadvantages of hard water	2	
	Removal of hardness – Reverse osmosis – zeolite process.	2	
Unit V	Polymer Chemistry: Monomer – polymer – definition – classification – differences between thermoplastics and thermosetting polymers -	2	PPT, Chalk and talk, Seminar, Test & Quiz
	Polymerization – addition and condensation.	2	
	Preparation and uses of polymers used in day-to-day life (PVC, polyethylene, polyester).	2	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Identify the type of adulterants present in foods	UptoK2
CLO-2	Understand about general composition of milk products & milk processing	UptoK2
CLO-3	Elaborate the importance of fertilizers and pesticide chemistry	UptoK2
CLO-4	Know about the hardness of water and its types as well as various hardness removal methods	UptoK2
CLO-5	Classify the types of polymers and gain knowledge on preparation of some daily use polymers	UptoK2

Mapping of CLOs with PSOs

_#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	2	3	3	2	3	3
CLO2	2	3	3	2	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination
Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K- Level	Section A		Section B		Section C (Open Choice)
			Short answers		(Either/or Choice)		
			No. of Questions	K- Level	No. of Questions	K- Level	
1	CLO 1	Up to K2	1	K1	1	2 (K2 & K2)	1(K1)
2	CLO 2	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
3	CLO 3	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
4	CLO 4	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
5	CLO 5	Up to K2	1	K1	1	2 (K2 & K2)	1 (K1)
No. of Questions to be Asked			5		5		5
No. of Questions to be Answered			5		5		3
Marks for each question			2		7		10
Total Marks for each Section			10		35		30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

Distribution of Section-wise Marks with K Levels

K Levels	Section A(No Choice)	Section B (Either /or)	Section C(Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	10	-	50	60	46	46
K2	-	70		70	54	54
Total Marks	10	70	50	130	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	core	23P4CCCT7	COORDINATION CHEMISTRY – II	5	6	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

- To recognize the fundamental concepts and structural aspects of organometallic compounds.
- To learn reactions of organometallic compounds and their catalytic behaviour.
- To identify or predict the structure of coordination compounds using spectroscopic tools.
- To understand the structure and bonding in coordination complexes.
- To evaluate the spectral characteristics of selected complexes

Unit	Description	Hours	K-level	CLO
I	Chemistry of organometallic compounds: Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule; Bonding in metal – olefin complexes (example: Ziese's salt), metal-acetylene and Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding – bonding modes, MO approach of M-CO bonding, π -acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters	18	UptoK2	CLO1
II	Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction. Organometallic catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefin (Wacker process), olefin isomerisation, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsanto process	18	UptoK3	CLO2

III	Inorganic spectroscopy -I: IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds. NMR spectroscopy- Introduction, applications of ^1H , ^{19}F , ^{31}P -NMR spectroscopy in structural identification of inorganic complexes, fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy..	18	UptoK4	CLO3
IV	Inorganic spectroscopy-II: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A; Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets; ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylalimine)copper(II) and $[(\text{NH}_3)_5\text{Co}-\text{O}_2-\text{Co}(\text{NH}_3)_5]^{5+}$. Principle and applications of nuclear quadrupole resonance spectroscopy (NQR) – ^{14}N , NH_3 and NH_4^+	18	UptoK4	CLO4
V	Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homonuclear diatomic molecules (N_2 , O_2) and heteronuclear diatomic molecules (CO , HCl) and polyatomic molecules (H_2O , CO_2 , NH_3) – evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations. Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques	18	UptoK4	CLO5

Books for study:

1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006
2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008
3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993.

Books for References:

1. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. 3rd ed. New York, NY: John Wiley, 2000.
2. P Gütllich, E Bill, A X Trautwein, Mossbauer Spectroscopy and Transition Metal Chemistry: Fundamentals and Applications, 1st edition, Springer-Verlag Berlin Heidelberg, 2011.

Douglas, B, McDaniel, D.M, Alexander, J. Concepts and Models of Inorganic Chemistry, , 3rd edn , John Wiley, 1994, 3rd edn.

3. Drago, D.S, Physical Methods in chemistry, W. B. Saunders Company, Philadelphia,. London. 14
4. Ebsworth, E.A.V, Rankin, D.W.H. and Cradock, S. Structural Methods in Inorganic Chemistry –Blackwell Scientific Publication, 1987.

Web Resources

1. <https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/>
2. <https://nou.edu.ng/coursewarecontent/CHM%20306%20-%20Instrumental%20Methods%20of%20Analysis.pdf>
3. https://my.uq.edu.au/programs-courses/course.html?course_code=CHEM6403

Rationale for Nature of the course

This course will enable to the students to enrich their knowledge on concept of organometallic complexes and their catalytic properties on various reactions, various spectral techniques like UV, IR, NMR, ESR, NQR, and photoelectron spectroscopy used for characterization of complexes and thus it brings employability.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The coordination chemistry course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like (i) Bonding and properties of organometallic complexes (ii) Catalytic properties of organometallic complexes (iii) characterization of complexes using various spectral techniques like UV, IR, NMR, ESR and photoelectron spectroscopy . Hence students will have chance to develop business plans for entrepreneurial ventures in the field of coordination chemistry

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer(s):

1. Dr. P. Gajendran

Course Schedule

Unit	Topics	Hrs	Mode
I	Chemistry of organometallic compounds: Classification of organometallic compounds based on M-C bond – 18 and 16 electron rule	5	Test, Quiz, PPT, Chalk and talk, Group discussion
	Bonding in metal – olefin complexes (example: Ziese's salt), metal-acetylene and Metal-cyclopentadienyl complexes –	4	
	– Examples and MO approach to bonding in metallocenes; fluxional isomerism. Metal – carbonyl complexes: MO diagram of CO; Structure and bonding – bonding modes, MO approach of M-CO bonding,	5	
	π -acceptor nature of carbonyl group, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonyl clusters	4	
II	Reactions and catalysis of organometallic compounds: Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and β eliminations), migratory insertion reaction. Organometallic catalysis:	6	Test, Quiz, PPT, Chalk and talk, Group discussion
	Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxo process),	6	
	oxidation of olefin (Wacker process), olefin isomerisation, cyclo-oligomerisation of acetylenes using Reppe's catalysts, Monsanto process.	6	
III	Inorganic spectroscopy -I: IR spectroscopy: Effect of coordination on the stretching frequency-sulphato, carbonato, sulphito, aqua, nitro, thiocyanato, cyano, thiourea, DMSO complexes; IR spectroscopy of carbonyl compounds.,	4	Test, Quiz, PPT, Chalk and talk, Group discussion
	NMR spectroscopy- Introduction, applications of ^1H , ^{19}F , ^{31}P -NMR spectroscopy in structural identification of inorganic complexes	5	
	fluxional molecules, quadrupolar nuclei- effect in NMR spectroscopy.	5	
		4	
IV	Inorganic spectroscopy-II: Introductory terminologies: g and A parameters-definition, explanation and factors affecting g and A;	4	Test, Quiz, PPT, Chalk and talk, Group discussion
	Applications of ESR to coordination compounds with one and more than one unpaired electrons – hyperfine and secondary hyperfine splitting and Kramer's doublets;	5	
	ESR spectra of V(II), Mn(II), Fe(II), Co(II), Ni(II), Cu(II) complexes, bis(salicylaldehyde)copper(II) and $[(\text{NH}_3)_5\text{Co}-\text{O}_2-\text{Co}(\text{NH}_3)_5]^{5+}$.	5	

	Principle and applications of nuclear quadrupole resonance spectroscopy (NQR) – ^{14}N , NH_3 and NH_4^+	4	
V	Photo Electron Spectroscopy: Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions	4	Seminar, PPT, Chalk and talk, Group discussion
	PES of homonuclear diatomic molecules (N_2 , O_2) and heteronuclear diatomic molecules (CO , HCl) and polyatomic molecules (H_2O , CO_2 , NH_3)	4	
	Evaluation of vibrational constants of the above molecules. Koopman's theorem- applications and limitations.	4	
	Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomers in complexes, Assignment of absolute configuration using CD and ORD techniques	6	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Classification and studying of bonding features of organometallic compounds	K2
CLO-2	Analyse various catalytic reactions using organometallic catalyst	K3
CLO-3	Illustrate structural studies of inorganic complexes using IR and NMR spectroscopy	K4
CLO-4	Examine the structural studies of inorganic complexes using ESR spectroscopy	K4
CLO-5	Discussion on basic principle and applications of photoelectron spectroscopy and ORD & C	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	3
CLO-2	3	3	3	3	3	3
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (COs)

S. No.	COs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
3	CO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
4	CO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A & B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours /Week	CIA	Ext	Total
IV	core	23P4CCCP4	ANALYTICAL INSTRUMENTATION TECHNIQUES	4	6	40	60	100

Nature of course		Skill oriented	√	Employability oriented	√	Entrepreneurship Oriented	√

Objectives of the course	To design chromatographic methods for identification of species. To analyze different constituents through instrumental methods of analysis. To evaluate different ions using potentiometric and conductivity measurements. To design experiments for analysis of inorganic and organic materials. To analyze constituents in materials using absorption techniques
Course Outline	<u>LIST OF EXPERIMENTS:</u> <u>PHYSICAL CHEMISTRY</u> 1. Conductometric titration of NH_4Cl Vs NaOH. 2. Conductometric titration of CH_3COONa Vs HCl. 3. Potentiometric titration of a mixture of HCl and CH_3COOH Vs NaOH 4. Potentiometric titration of KI Vs KMnO_4. 5. Potentiometric titration of a mixture of Chloride and Iodide Vs AgNO_3. 6. Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel electrode. <u>INORGANIC CHEMISTRY</u> 1. Determination of the amount (mol/L) of ferricyanide present in the given solution using cyclic voltammetry. 2. Determination of the diffusion coefficient of ferricyanide using cyclic voltammetry. 3. Determination of the standard redox potential of ferri- ferrocyanide redox couple using cyclic voltammetry. 4. Estimation of Fe, Cu and Ni by colorimetric method. 5. Determination of spectrophotometrically the mole ratio of the ferrithiocyanate complex and equilibrium constant for the complex formation. 6. Estimation of the amount of nitrate present in the given solution using spectrophotometric method. 7. Determination of ascorbic acid in real samples using Differential Pulse Voltammetry and comparing with specifications

8. Estimation of Fe(II) by 1,10 phenanthroline using spectrophotometry

ORGANIC CHEMISTRY

1. Separation of mixture of Azo dyes by TLC
2. Separation of mixture of organic compounds by column chromatography.
3. Interpretation and identification of the given spectra of various organic compounds arrived at from the following instruments
 1. UV-Visible
 2. IR
 3. Raman
 4. NMR
 5. ESR
 6. Mass etc.,

Books for study:

1. Vogel's Text book of Practical Organic Chemistry, 5th Ed, ELBS/Longman, England, 2003.
2. Jeffery G. H. Bassett, J. Mendham. J. and Denney R. C., Vogel's Textbook of Quantitative Chemical Analysis; 6th ed., ELBS, 1989.
3. Woollins, J. D Inorganic Experiments; VCH: Weinheim, 1995

Books for References:

1. Gnanapragasam N. S. and Ramamurthy G., Organic Chemistry – Labmanual, S. Viswanathan Co. Pvt. Ltd, 2009.
2. Gurtu J. N. and Kapoor R., Advanced Experimental Chemistry, S. Chand and Co., 2011
3. Yadav J. B., Advanced Practical Physical Chemistry, Goel Publishing House, 2001

Web Resources

1. <https://bit.ly/3QESF7t>
2. <https://bit.ly/3QANOnX>
3. https://www.fpharm.uniba.sk/fileadmin/faf/Pracoviskasubory/KFCHL/zlozka1/pharmaceutical_physics_2/Laboratory_manual_for_Physical_Chemistry.pdf

Activities having direct bearing on Skill development / Employability Entrepreneurship

Knowledge, Analytical ability and Professional Competency,

Pedagogy

Demonstration, Hands on experience

Course Designer(s):

1. Dr. P. S. HARIKRISHNAN
2. Mr S. VIDHYASANKAR

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	To recall the principles associated with various inorganic organic and physical chemistry experiments.	Up to K2
CLO-2	To scientifically plan and perform all the experiments	Up to K3
CLO-3	To observe and record systematically the readings in all the experiments	Up to K4
CLO-4	To calculate and process the experimentally measured values and compare with graphical data.	Up o K4
CLO-5	To interpret the experimental data scientifically to improve students efficiency for societal developments.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6	PSO-7
CLO-1	3	3	2	3	2	3	2
CLO-2	3	3	2	3	3	3	2
CLO-3	3	3	2	3	3	2	3
CLO-4	2	2	3	3	3	3	3
CLO-5	3	3	3	2	2	2	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5
CLO1	3	3	3	3	3
CLO2	3	3	3	3	3
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3

Advance application- 3;

Intermediate level-2;

Basic level-1

	Components for External Examination		
CLO	CLO Statement	K level	Marks
CLO1	To recall the principles associated with various physical chemistry experiments.	Up to K3	10
CLO2	To scientifically plan and perform all the experiments.	Up to K4	10
CLO3	To observe and record systematically the readings in all the experiments.	Up to K3	15
CLO4	To calculate and process the experimentally measured values and compare with graphical data.	Up to K4	20
CLO5	To interpret the experimental data scientifically to improve students' efficiency for societal developments.	Up to K4	5

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

DEPARTMENT OF CHEMISTRY					CLASS: II M. Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	Discipline Elective	23P4CECT7	Chemistry of Natural Products	3	6	25	75	100

Nature of course		Skill oriented	√	Employability oriented		Entrepreneurship Oriented	

Objectives:

The objective of this course is to make the student

- To learn the basic concepts and biological importance of natural products.
- To explain several of functions of alkaloids, steroids and hormones.
- To recognise the methods for the synthesis of given natural product.
- To elucidate the structure determination of natural products.
- To extract and construct the structure of new alkaloids and terpenoids from different methods.

Unit	Description	Hours	K-level	CLO
I	Alkaloids: Introduction, occurrence, classification, isolation, general methods of structural elucidation and functions of alkaloids. Chemical methods of structure determination of Nicotine, Papaverine. Atropine, Quinine, Cocaine, Heptaphylline, Papaverine.	18	Up to K2	CLO-1
II	Terpenoids: Introduction, occurrence, Isoprene rule, classification. General methods of determining structure. Structure determination of Camphor, Abietic acid, Cadinene, Squalene, Zingiberine.	18	Up to K4	CLO-2
III	Anthocyanines and flavones: Anthocyanines: Introduction to anthocyanines. Structure and general methods of synthesis of anthocyanines. Cyanidine chloride: structure and determination. Flavones: Introduction, Synthesis of flavones and isoflavones by various methods. Quercetin: Structure determination and importance.	18	Up to K4	CLO-3
IV	Natural Dyes and Carotenoids: Natural Dyes: Occurrence, classification, isolation, purification, properties, colour and constitution. Structural determination and synthesis of indigoitin and alizarin. Carotenoids: Introduction, geometrical isomerism, Structure, functions and synthesis of β -carotene and vitamin-A.	18	Up to K3	CLO-4

V	Purines and Steroids: Purines: Introduction, occurrence and isolation of purines. Biological importance, Structure and synthesis of Uric acid and Caffeine. Steroids: Introduction, occurrence, nomenclature, configuration of substituents, Diels' hydrocarbon, stereochemistry, classification, biological importance, colour reactions of steroids, Cholesterol: occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.	18	Up to K4	CLO-5

Books for study:

1. Finar, I. L. "Organic Chemistry Volume II: Stereochemistry and Chemistry of Natural Products", 5th edition, Pearson Education India, 2002.
2. Chatwal, G. R. "Organic Chemistry of Natural Products" Volume I and II, 5th edition, Himalaya Publishing house, 2011.
3. Agarwal, O. P. "Organic Chemistry Natural Products" Volume I and II, Krishna prakashan media Ltd., 2015.

Books for References:

1. Bhat, S. V., Nagasampagi, B. A., Sivakumar, M. "Chemistry of Natural Products", Narosa Publishing House, 2006.
2. Kar, A. "Chemistry of Natural Products", Volume I, II and III, CBS Publisher, 2018.
3. Singh, J. Ali, S. M., Singh, J. "Natural Products Chemistry", Pragati Prakashan Publisher, 2010.

Web Resources

1. [Chromeextension://efaidnbmninnibpcajpcglclefindmkaj/https://oms.bdu.ac.in/ec/admin/contents/1_16SCCCH8_2020051904202312.pdf](https://chromeextension://efaidnbmninnibpcajpcglclefindmkaj/https://oms.bdu.ac.in/ec/admin/contents/1_16SCCCH8_2020051904202312.pdf)
2. <https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch105-consumer-chemistry/ch105-chapter-6-hydrocarbons/>
3. <https://www.slideshare.net/AMIRHASSAN27/chemistry-of-natural-products-201279990>

Rationale for Nature of the course

This course will enable the students to know the chemistry of natural products, to improve their knowledge in elucidation of structure of a given natural product.

Activities having direct bearing on Skill development / Employability Entrepreneurship

The basic knowledge gained through this course, students can analyse the ways to elucidate the structure of an unknown natural product or similar compounds, for this molecules which are not present in the curriculum will be given for analysis. They can derivatise various functional groups also and several tasks will be given to achieve this.

Pedagogy

- Chalk-Talk Class room Activities
- Group discussion & Seminar

- Assignment and Quiz through ICT

Course Designer:

Dr. S. V. Karthikeyan

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Alkaloids: Introduction, occurrence, classification, isolation, general methods of structural elucidation and functions of alkaloids.	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Chemical methods of structure determination of Nicotine, Papaverine. Atropine.	6	
	Quinine, Cocaine, Heptaphylline, Papaverine.	8	
Unit II	Terpeoids: Introduction, occurrence, Isoprene rule, classification. General methods of determining structure.	4	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Structure determination of Camphor, Abietic acid.	7	
	Cadinene, Squalene, Zingiberine.	7	
Unit III	Anthocyanines: Introduction to anthocyanines. Structure and general methods of synthesis of anthocyanines.	6	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Cyanidine chloride: structure and determination.	3	
	Flavones: Introduction, Synthesis of flavones and isoflavones by various methods.	7	
	Quercetin: Structure determination and importance.	2	
Unit IV	Natural Dyes: Occurrence, classification, isolation, purification, properties, colour and constitution.	6	PPT, Chalk and talk, Group Discussion, Quiz/Seminar, Test
	Structural determination and synthesis of indigoitin and alizarin.	6	
	Carotenoids: Introduction, geometrical isomerism, Structure, functions and synthesis of β -carotene and vitamin-A.	6	
Unit V	Purines: Introduction, occurrence and isolation of purines.	4	PPT, Chalk and talk, Group Discussion, Assignment
	Biological importance, Structure and synthesis of Uric acid and Caffeine.	4	
	Steroids: Introduction, occurrence, nomenclature, configuration of substituents, Diels' hydrocarbon, stereochemistry, classification, biological importance, colour reactions of steroids,	6	
	Cholesterol: occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.	4	

Course Learning Outcomes: After successful completion of this course, the student will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Illustrate the importance of natural products and describe structural elucidation of an alkaloid.	Up to K2
CLO-2	Apply the knowledge on terpenoids for the elucidation of structure.	Up to K3
CLO-3	Examine the structure of anthocyanins and flavones among the natural products.	Up to K4
CLO-4	Inspect the structure of a natural dye and illustrate the structure of carotenoids.	Up to K4
CLO-5	Discover the features of purines and steroid nucleus.	Up to K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	2
CLO-2	3	3	3	3	3	2
CLO-3	3	3	3	3	3	2
CLO-4	3	3	3	3	3	2
CLO-5	3	3	3	3	3	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	2	2	2	2	2
CLO2	3	3	3	3	3	2
CLO3	3	3	3	3	3	2
CLO4	3	3	3	3	3	2
CLO5	3	3	3	3	3	2

Advance application– 3;

Intermediate level–2;

Basic level–1

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B		Section C (Either or Choice)	Section D (Open Choice)
			MCQs		Short answers			
			No. of Questions	K-Level	No. of Questions	K- Level		
1	CLO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1 (K2)
2	CLO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1 (K3)
3	CLO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1 (K4)
5	CLO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1 (K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total marks for each			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	16	13.3	35
K2	2	4	10	10	26	21.7	
K3	4	2	10	20	36	30	30
K4	2	-	20	20	42	35	35
Total Marks	10	10	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc Chemistry			
Sem	Course type	Course code	Course title	Credits	Contact hours/ Week	CIA	Ext	Total
IV	Elective	23P4CECT8	PHARMOCOGNOSY AND PHYTOCHEMISTRY	3	6	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives: The objective of this course is to make the student to

- Develop the knowledge of natural products, biological functions and pharmacological uses.
- Develop knowledge on primary and secondary metabolites and their sources.
- Understand the concepts of isolation methods and separation of bioactive compounds.
- Provide the knowledge on selected glycosides and marine drugs.
- Familiarize the guidelines of WHO and different sampling techniques

Unit	Description	Hours	K-level	CLO
I	Pharmacognosy and Standardization of Herbal drugs: Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.	18	UptoK2	CLO1
II	Extraction Techniques: General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction. Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.	18	UptoK3	CLO2
III	Drugs containing Terpenoids and volatile oils: Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrynes; taraxasterol: Structure and pharmacological applications.	18	UptoK4	CLO3

IV	Drugs containing alkaloids: Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.	18	UptoK4	CLO4
V	Plant Glycosides and Marine drugs: Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs –Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.	18	UptoK4	CLO5

Books for study:

1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House.
2. Bhat. S.V, Nagasampagi, B.A, M.Sivakumar. M (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers, 2014
3. Kumar G.S., Jayaveera K.N. A Textbook of Pharmacognosy and Phytochemistry S Chand & Company, 2014

Books for References:

1. Jeffrey B. Harborne , Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer.2012.
2. Ashutoshkar, Pharmacognosy and Pharmacobiotechnology, 2nd edition, New age international (P) limited, New Delhi, 2007
3. Biren N. Shah, A.K. Seth, Textbook of Pharmacognosy and Phytochemistry, Elsevier,2010

Web Resources

1. <https://www.research.unipd.it/retrieve/e14fb26c-53bf-3de1-e053>
2. <https://www.pharmacy180.com/article/classification---drugs-containing-alkaloids-120/>
3. <https://www.pharmacy180.com/article/drugs-containing-volatile-oils-212/>

Rationale for Nature of the course

This course should enable the students to comprehend pivotal role in drug discovery, the integration of traditional and modern medicine, the importance of accurate identification and quality control, and its contribution to sustainable and ethical practices in the utilization of natural resources.

Activities having direct bearing on Skill development / Employability / Entrepreneurship

The pharmacognosy course can incorporate various activities that directly contribute to skill development, enhance employability, and foster entrepreneurship among students. Here are some activities that can have a direct bearing on these aspects like (i) Extraction and Isolation Techniques (ii) Analytical Methods (iii) Plant Identification (iv) Collection and Documentation. So Students can have Internships with pharmaceutical companies and Herbal Medicine Industries specializing in natural products for practical experience in drug development. Hence students will have chance to develop business plans for entrepreneurial ventures in the field of herbal products and starting their own herbal medicine businesses

Pedagogy

- Chalk-Talk class room activities
- Group Discussion
- Seminar
- Quiz through ICT- Mode

Course Designer:

Dr. J. Shanmugapriya

Course Schedule

Unit	Topics	Hrs	Mode
I	Pharmacognosy and Standardization of Herbal drugs: Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine and plant tissue cultures	5	PPT, Chalk and talk, Quiz and Seminar Test
	Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway	4	
	Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation.	5	
	Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.	4	
II	Extraction Techniques: General methods of extraction	4	PPT, Chalk and talk, Quiz and Seminar Test
	types – maceration, Decoction, percolation, Immersion and soxhlet extraction	5	
	Advanced techniques- counter current, steam distillation, supercritical gases, sonication	5	
	Micro waves assisted extraction. Factors affecting the choice of extraction process.	4	
III	Drugs containing Terpenoids and volatile oils: Terpenoids: Classification, Isoprene rule, Isolation and separation techniques.	4	PPT, Chalk and talk, Quiz and Seminar Test
	General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations	5	

	Classifications of Volatile oils, Camphor oil, Geranium oil, Citral-Structure uses.	5	
	Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications.	4	
IV	Drugs containing alkaloids: Occurrence, function of alkaloids in plants, pharmaceutical applications.	4	PPT, Chalk and talk, Assignment
	Isolation, Preliminary Qualitative tests and general properties.	5	
	General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses.	5	
		4	
V	Plant Glycosides and Marine drugs: Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis.		PPT, Chalk and talk, Quiz and Seminar Test
	Pharmacological activity of Senna glycosides, Cardiac glycosides Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin.	5	
	Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride.	5	
	Marine drugs –Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.	4	

Course Learning Outcomes:

At the end of the course, the student will be able to:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Recall the sources of natural medicines and standardization of herbal drugs	K2
CLO-2	Understand the methods of extraction of drugs	K3
CLO-3	Identify importance of drugs containing terpenoids and volatile oils	K4
CLO-4	Categorize drugs containing alkaloids	K4
CLO-5	Conclude plant glycosides and marine drugs	K4

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	3	3	3	3	3	3
CLO-2	3	3	3	3	3	3
CLO-3	3	3	3	3	3	3
CLO-4	3	3	3	3	3	3
CLO-5	3	3	3	3	3	3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	3	3	3	3	3	3
CLO2	3	3	3	3	3	3
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	3	3	3	3	3	3

Advance application– 3;

Intermediate level–2;

Basic level–1

Blueprint for Semester Examination

Articulation Mapping-K Levels with Courses Learning Outcomes (COs)

S. No.	COs	K- Level	Section A		Section B		Section C (Either/or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K- Level	No. of Questions	K- Level		
1	CO 1	Up to K2	2	K1 & K1	1	K1	2 (K1 & K1)	1(K2)
2	CO 2	Up to K3	2	K2 & K3	1	K1	2 (K2 & K2)	1(K3)
3	CO 3	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
4	CO 4	Up to K4	2	K3 & K4	1	K2	2 (K4 & K4)	1(K4)
5	CO 5	Up to K4	2	K2 & K3	1	K3	2 (K3 & K3)	1(K3)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each question			1		2		5	10
Total Marks for each section			10		10		25	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented- Solving Problems

K4- Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A& B (No Choice)	Section C (Either /or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1	6	10	-	16	13.3	35
K2	6	10	10	26	21.7	
K3	6	10	20	36	30	30
K4	2	20	20	42	35	35
Total marks	20	50	50	120	100	100

DEPARTMENT OF CHEMISTRY					CLASS: II M.Sc. Chemistry			
Sem.	Course type	Course code	Course title	Credits	Contact hours/Week	CIA	Ext	Total
IV	SE	23P4CSED2	Professional Competency Skill	2	4	25	75	100

Nature of course		Skill oriented	✓	Employability oriented		Entrepreneurship Oriented	

Objectives:

Objective of this course is to make the student to

- Utilize the principle of quantum mechanics to simple systems in order to gain knowledge on the applications of quantum mechanics and to infer knowledge on the treatment of multielectron atoms.
- Explore the knowledge of electrochemistry and its applications
- Study and analyse the applications of group theory to simple linear and non-linear molecules.
- Explore the knowledge on structure and bonding, reactivity of complexes and biomolecules.
- Solve the problems using UV-Vis, NMR, IR and Mass spectroscopy

Unit	Description	Hours	K-level	CLO
I	Application of Quantum chemistry Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions-Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment, Energy level diagram, Hydrogen molecule ion; Use of linear variation function and LCAO methods. Electronic conjugated system: Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene	12	Upto K4	CLO 1
II	Group theory Applications of group theory- Determination of representations of vibrational modes in non- linear molecules such as water, ammonia, BF ₃ , CH ₄ and XeF ₄ .Determination of Hybrid orbitals in non-linear molecules Examples: NH ₃ , BF ₃ , and CH ₄ . SALC procedure-evaluation of energies and molecular orbitals for systems like ethylene and butadiene.-Selection rules for spectral transitions. Electronic spectra of formaldehyde and ethylene.	12	Upto K4	CLO 2
III	Electrochemistry: Ionic equilibria; electrolytic conductance; electrochemical cells; Nernst equation; redox systems; Debye-Huckel theory; Kohlrausch's law and its applications and conductometric and potentiometric titrations-Specific conductance; Ionic mobility;	12	Upto K4	CLO 3

	Hittorf's theoretical device; Transport number; Determination of transport number; Hittorf's method; Moving boundary method, Activity coefficient of electrolytes; Ionic strength; Ostwald's dilution law;			
IV	Nuclear Magnetic Resonance And their Applications: Basic Principle-chemical shift-factors affecting chemical shift-importance of TMS-shielding and deshielding. Spin-spin coupling-splitting origin.coupling constant- Double irradiation/Spin decoupling, Nuclear Overhauser Effect (NOE). Basic aspects of 2-D NMR techniques: Correlation spectroscopy (COSY). Homo Cosy-Hetero Cosy-Hmbc-& Distortionless Enhancement by Polarization Transfer (DEPT)spectrum, (DEPT-45, DEPT-90 and DEPT-135). UV And IR Spectra of Organic Compounds Electronic absorption: Beer-Lamberts law, Types of electronic excitation. Woodward-Fisher rule. Infrared Spectra: Basic principle-Finger print region. Inter and Intramolecular hydrogen bonding. Various factors affecting IR stretching frequencies. Mass Spectrometry Basic- Molecular ions, Meta stable ions. Base peaks and Isotope peaks. Nitrogen rule.	12	Upto K3	CLO 4
V	Structure, Bonding and reactivity of complexes a. Structure and bonding in homo and hetero nuclear molecules, including shapes of Molecules (VSEPR Theory). b. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms. c. Organometallic compounds: synthesis, bonding and structure, and reactivity, Organometallics in homogeneous catalysis. d. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.	12	Upto K2	CLO 5

Books for study:

1. Puri, B.R., Sharma, L.R. and Pathania, M.S., 2004 (41stEdn.), Principles of Physical Chemistry, S.N. Chand and Co., New Delhi.
2. Ramakrishnan, V and Gopinathan, M. S, Group theory in Chemistry, Vishal Publications, 1988
3. Madan R. D., Modern Inorganic Chemistry, 3rd edn, S. Chand & Company Ltd., Reprint, 2014.
4. Huheey J. E., Keiter E. A and Keiter R. L., Inorganic chemistry-Principles on structure and reactivity, 4th Ed, Pearson- education, 2002.

Books for References:

1. Cotton, F.A, Chemical Application of Group Theory, John Wiley and Sons Inc. New York,
2. Soni P.L., Text book of Inorganic Chemistry, 20th edn, Sultan Chand & Sons, 2000.
3. Puri B. R. Sharma L.R., Kalia K.K, Principles of Inorganic chemistry.35th edition, New edition: Shoban Lal Nagin Chand and co. 2013
4. Frost R. G. and Pearson, Kinetics and Mechanism, Wiley New York, 1961

Web Resources

1. <https://www.ntnu.edu/studies/mschem/organicchemistryhttps://resources.saylor.org/wwwresources/archived/site/wpcontent/uploads/2011/06/VSEPRTheory>.
2. http://www.idconline.com/technical_references/pdfs/chemical_engineering/Valence_bond_theory.pdf ,https://chemistry.tcd.ie/assets/pdf/sf-chemistry/Molecular_Orbital_Theory.pdf
3. <https://byjus.com/jee/electrochemistry/>
4. <https://unacademy.com/course/group-theory-previous-year-questions-csir-ugc-net/QX60NHXX>

Rationale for Nature of the course

The course will enable the students to comprehend the fundamental knowledge and facts in all branches of chemistry like Organic, Inorganic, Physical and Analytical Chemistry.

Activities having direct bearing on Skill development / Employability Entrepreneurship

Activities having direct bearing on Skill development/ Employability/Entrepreneurship The students can understand the theory, bonding nature and structural information of inorganic complexes. Students can understand the analytical techniques used for separation, purification and structural elucidation of compounds using spectral interpretation. The students can grasp and apply set of mathematical principles that attempt to explain the behavior and nature of atomic particles. They can also differentiate, analyze classical and quantum mechanics. Students can comprehend the thermodynamic and kinetics aspects as a function of temperature, time and concentration. Students are able to grasp the principle of stereochemistry for the arrangement of atoms in molecules. They can understand the synthesis and characterization of heterocyclic compounds. Students can comprehend the nature of reaction mechanism in rearrangements and naming reactions

Pedagogy

Chalk and talk, group discussion, power point, assignment

Course Designer(s):

1. Dr. M. Malarvizhi

Course Schedule

Unit	Topics	Hrs	Mode
Unit I	Application of Quantum chemistry Hamiltonian-wave equation and solutions, radial and angular functions, representation of radial distribution functions- Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment.	6	Chalk& talk, ppt Problem Solving, Quiz
	Energy level diagram, Hydrogen molecule ion; Use of linear variation function and LCAO methods. Electronic conjugated system: Huckel method to Ethylene butadiene, cyclopropenyl, cyclo butadiene and Benzene	6	
Unit II	Group theory Applications of group theory- Determination of representations of vibrational modes in non- linear molecules such as water, ammonia, BF ₃ , CH ₄ and XeF ₄ .	6	Chalk & talk. Ppt, problem solving, and assignment
	Determination of Hybrid orbitals in non-linear molecules Examples: NH ₃ , BF ₃ , and CH ₄ . SALC procedure-evaluation of energies and molecular orbitals for systems like ethylene and butadiene.-Selection rules for spectral transitions. Electronic spectra of formaldehyde and ethylene.	6	
Unit III	Electrochemistry: Ionic equilibria; electrolytic conductance; electrochemical cells; Nernst equation; redox systems; Debye-Huckel theory; Kohlrausch's law and its applications and potentiometric titrations.	6	Chalk & talk. Ppt, and problem solving ,Quiz
	Specific conductance; conductometric -Ionic mobility; Hittorf's theoretical device; Transport number; Determination of transport number; Hittorf's method; Moving boundary method, Activity coefficient of electrolytes; Ionic strength; Ostwald's dilution law	6	
Unit IV	Nuclear Magnetic Resonance And Their Applications: Basic Principle-chemical shift-factors affecting chemical shift-importance of TMS-shielding and deshielding. Spin-spin coupling-splitting origin.coupling constant- Double irradiation/Spin decoupling, Nuclear Overhauser Effect (NOE). Basic aspects of 2-D NMR techniques: Correlation spectroscopy (COSY). HOMO COSY-HETERO COSY-HMBC-& Distortionless Enhancement by Polarization Transfer (DEPT)spectrum, (DEPT-45, DEPT-90 and DEPT-135).	6	Chalk & talk. Ppt, ,Quiz and problem solving
	UV And IR Spectra of Organic Compounds Electronic absorption: Beer-Lamberts law, Types of electronic excitation. Woodward-Fieser rule. INFRARED SPECTRA: Basic principle-	6	

	Finger print region. Inter and Intramolecular hydrogen bonding. Various factors affecting IR stretching frequencies. Mass Spectrometry Basic- Molecular ions, Meta stable ions. Base peaks and Isotope peaks. Nitrogen rule.		
Unit V	a. Structure and bonding in homo and hetero nuclear molecules, including shapes of Molecules (VSEPR Theory).b. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.	6	Chalk,& talk. Ppt, Problem Solving and ,Quiz
	c.Organometallic compounds: synthesis, bonding and structure, and reactivity, Organometallics in homogeneous catalysis.d. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.	6	

Course Learning Outcomes:

CLOs	Course Learning Outcomes	Knowledge Level
CLO-1	Connect various theories behind quantum mechanics to illustrate multi-electron system and to calculate the energy of simple multi-electron atoms;	Upto K4
CLO-2	Interpret and analyze the symmetries of molecules and solving problems based on the application of group theory.	Upto K4
CLO-3	Analyse the concepts of ionic interactions, theory of electrolytes, Debye-Huckel limiting law;	Upto K4
CLO-4	Identify the structure of organic compounds; Inspect the characterisation of organic compounds by various spectroscopic techniques like IR, NMR, Mössbauer, UV-Vis etc	Upto K3
CLO-5	Know the structure and types of bonding in inorganic molecules using VB and MO theories	Upto K2

Mapping of CLOs with PSOs

#	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5	PSO-6
CLO-1	1	2	2	1	3	3
CLO-2	3	2	2	1	2	2
CLO-3	3	1	2	3	3	3
CLO-4	3	3	2	2	2	2
CLO-5	3	1	1	2	2	2

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO1	1	2	3	2	3	2
CLO2	2	2	3	3	2	2
CLO3	3	3	3	3	3	3
CLO4	3	3	3	3	3	3
CLO5	2	2	2	2	2	3

Advance application– 3;**Intermediate level–2;****Basic level–1**

Summative - Blue – Print – Model
(Mapping with Course Learning Outcomes (CLOs))

Units	CLOs	K-Level	Section A		Section B (Open Choice)	Section C (Open Choice)
			MCQs			
			No. of Questions	K-Level		
1	CLO 1	K4	6	K4	K2	K2
2	CLO 2	K4	6	K4	K2	K3
3	CLO 3	K4	6	K4	K3	K3
4	CLO 4	K3	6	K3	K3	K2
5	CLO 5	K2	6	K2	K1	K2
No. of Questions to be asked			30		5	5
No. of Questions to be answered			30		3	3
Marks for each question			1		5	10
Total marks			30		15	30

K1- Remembering and recalling facts with specific answers

K2- Basic understanding of facts and stating main ideas with general answers

K3- Application oriented –Solving Problems

K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Open choice)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated %
K1		5		5	4.7	48.5
K2	6	10	30	46	43.8	
K3	6	10	20	36	34.28	34.3
K4	18	-	-	18	17.1	17.2
Total Marks	30	25	50	105		100

DEPARTMENT OF CHEMISTRY				CLASS: II M.Sc. Chemistry				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Project	23P4CPROV	Project & Viva-voce	8	8	25	75	100

Nature of the course	Knowledge and skill		Skill oriented	√	Employability	√	Entrepreneurship	

Course Objectives:

- To motivate students to take up research projects in their field of interest.
- To promote scientific temper and systematic approach to problem solving and research methodology.
- To promote research writing aptitude among students.
- During the fourth semester, students shall undertake a project work and submit the project report.

CLOs	Course Learning Outcomes	K level
CLO 1	Survey scientific literature available and identify gaps in existing studies	K4
CLO 2	Design a scientific study taking practical constraints into account	K5
CLO 3	Perform the scientific study taking practical constraints into account.	K3
CLO 4	Analyze the results.	K4
CLO 5	Communicate the findings based on ethical standards of reporting.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2, Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Internal& External Valuation for Project

Internal	External
25 marks	75 Mark
Guide Evaluation: • 10 Marks for Students ability and interest • 10 Marks for Regularity and Punctuality • 5 Marks for Quality of the work and Presentation	Dept Evaluation: 25 (Min (No.) 50 % of faculty must be present) • 15 Marks for Presentation using ICT tools. • 10 Marks for Quality and Publications / Presentation in Seminar/ conferences External Evaluation: 50 • 20 Marks for the Report • 30 Marks for Presentation, Quality of work and Viva voce.

DEPARTMENT OF CHEMISTRY				CLASS: II M.Sc. Chemistry				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
III	Internship	23P3CINTR	Internship	2	-	-	-	-

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

- To motivate students to takeup internship in research institutions / industry.
- To develop the employability of students.
- To promote entrepreneurial tendencies among students.

During the second semester vacation, students shall undertake internship for a minimum period of two weeks and submit a report and certificate from the company / industry / institution offering internship.

At the end of the internship, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in mission critical projects in real-time	K4
CLO 2	Develop into a critical thinker and solve every day problems in the industry.	K5
CLO 3	Learn and analyze problems faced by the industry and workforce at large.	K4
CLO 4	Survey the job market / understand entrepreneurial opportunities / research opportunities available to them.	K2
CLO 5	Communicate precisely and accurately with team members and supervisors.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation schema for Internship

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4

DEPARTMENT OF CHEMISTRY				CLASS: II M.Sc. Chemistry				
Sem.	Course type	Course code	Course title	Credits	Contact hours/ week	CIA	Ext.	Total
IV	Extension	23P4CEXTN	Extension Activity	1	-	-	-	-

Nature of course	Skill oriented	✓	Employability oriented	✓	Entrepreneurship Oriented	✓

Course Objectives:

- To motivate students to take up community driven activities and projects.
- To develop the societal awareness of students.
- To promote environmental, sustainability and G20 High-Level Principles on Lifestyles for Sustainable Development (LiFE) among students.

During the duration of the programme, students shall undertake extension activities for a minimum duration of 15 hours including preparation and submit a work diary and report of activities along with certificates (if any) from trusts/ NGOs/ public offices / schools.

At the end of the programme, the students will be able to

CLOs	Course Learning Outcomes	K level
CLO 1	Work independently and as a team in extension activities and community projects	K4
CLO 2	Develop into dutiful and morally upright citizens of the country with an understanding of the problems of the society	K5
CLO 3	Suggest and implement out of the box solutions to the problems of the society from their domain knowledge and through their learning.	K4
CLO 4	Survey and understand the problems of the society and humanity as a whole.	K2
CLO 5	Communicate the problems of the society to civil administration/government forums for finding solutions to the problems of the locality.	K3

Mapping of CLOs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Mapping of CLOs with PSOs

#	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CLO 1	3	3	3	3	3	3
CLO 2	3	3	3	3	3	3
CLO 3	3	3	3	3	3	3
CLO 4	3	3	3	3	3	3
CLO 5	3	3	3	3	3	3

Advance application –3, Intermediate level –2 , Basic level–1

Valuation Schema for Extension Activity

The student will be graded on a seven point scale with corresponding GPAs as mentioned below.

Grade	GPA
Outstanding	10
Excellent	9
Very Good	8
Good	7
Average	6
Below average	5
Reappearance	1-4



The Madura College (Autonomous), Madurai – 625 011

Department of Chemistry

PG Programme Structure

Semester	Course Code	Title of the Course	Hours	Credits	Nature of Course(Employability/ Entrepreneurship/ Skill Development)			Scope of Focus (Local / National / Global developmental needs)			Percentage of Syllabus Revision/New
					Empl	Ent	Skill	Local	National	Global	
I	23P1CCCT1	Organic reaction mechanism-I	6	5	Yes	Yes	Yes			Yes	20 %
	23P1CCCT2	Structure and bonding in inorganic compounds	6	5	Yes		Yes			Yes	10 %
	23P1CCCP1	Organic practicals	6	4	Yes	Yes	Yes			Yes	15 %
	23P1CECT1	Nanomaterials and nanotechnology	5	3	Yes	Yes	Yes			Yes	New
	23P1CECT1	Pharmaceutical chemistry	5	3	Yes	Yes	Yes			Yes	New
	23P1CECT2	Molecular spectroscopy	5	3			Yes			Yes	10 %
	23P1CECT2	Electrochemistry	5	3	Yes	Yes	Yes			Yes	30 %
	23P1CSED1	Preparation of consumer products	2	2			Yes			Yes	New

II	23P2CCCT3	Organic reaction mechanism II	6	5	Yes	Yes	Yes			Yes	68 %
	23P2CCCT4	Physical chemistry I	6	5	Yes		Yes			Yes	7 %
	23P2CCCP2	Inorganic practicals	6	4	Yes	Yes	Yes			Yes	New
	23P2CECT3	Green chemistry	5	3	Yes	Yes	Yes			Yes	New
	23P2CECT3	Medicinal chemistry	5	3	Yes					Yes	40 %
	23P2CECT4	Bioinorganic chemistry	5	3	Yes	Yes	Yes			Yes	20 %
	23P2CECT4	Materials science	5	3	Yes	Yes	Yes			Yes	65 %
	23P2CSEN1	Environmental chemistry	2	2	Yes	Yes	Yes			Yes	45 %
III	23P3CCCT5	Organic Synthesis and Photochemistry	6	5	YES		YES			YES	70 %
	23P3CCCT6	Co-ordination Chemistry – I	6	5	YES		YES			YES	14%
	23P3CCCP3	Physical Chemistry Practicals	6	4							
	23P3CECT5 23P3CECT6	Physical Chemistry – II Polymer Chemistry	5	3	YES		YES			YES	8 %
	23P3CMDC1	Fundamental mathematic safety instrumentation and Biomolecules`	5	3			YES			YES	New

	23P3CSEN2	NME - Applied Chemistry	2	2						Yes	
	23P3CINTR	Internship / Industrial Activity	-	2						Yes	
IV	23P4CCCT7	Co-ordination Chemistry – II	6	5						Yes	
	23P4CCCP4	Analytical Instrumentation Techniques	6	4	YES		YES			YES	76.7 %
	23P4CPROV	Project with Viva Voce	8	8						Yes	
	23P4CECT7	Chemistry of Natural Products	6	3			YES			Yes	New
	23P4CECT8	Pharmacognosy and Phytochemistry									
	23P4CSED2	Skill Enhancement Course / Professional Competency Skill	4	2						Yes	20 %
	23P4CEXTN	Extension Activity	-	1						Yes	
Total											

Emp- Employability; ESnt- Entrepreneurship; Skill- Skill Development