



The Madura College (Autonomous)

(Affiliated to Madurai Kamaraj University)

Re-Accredited (3rd cycle) With 'A' grade by NAAC)

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UG Biotechnology Syllabi 2017 Batch



UG Biotechnology – Complete Syllabi 2017 Batch

| Year | Sem | Paper | Course Code | Title | H | C | |
|-----------|------------|-------------|-------------|---|--|-----------|-----------|
| I | I | Major | 17U1LMC1 | Cell Biology and Genetics | 5 | 5 | |
| | | SBE | 17U1SM1 | Bioinstrumentation | 2 | 2 | |
| | | EVS | 17U1LES1 | Environmental studies | 2 | 2 | |
| | | Ancillary-I | 17U1ZAC1 | Funda. of Invertebrates and Chordates | 4 | 2 | |
| | | Language-I | | Tamil/Sanskrit | 6 | 3 | |
| | | Language-II | | English | 6 | 3 | |
| | | Major Lab | | Cell Biol. Genetics & Biochemistry Lab | 3 | * | |
| | | Anc.Lab | | Anc. Zoo Lab | 2 | * | |
| | | | | | 30 | 17 | |
| | II | II | Major | 17U2LMC2 | Biochemistry and Biophysics | 5 | 5 |
| | | | SBE | 17U2LSM2 | Concepts of Biotechnology | 2 | 2 |
| | | | VE | 17U2LVE1 | Value Education | 2 | 2 |
| | | | Ancillary-I | 17U2ZAC2 | Economic Zoology | 4 | 2 |
| | | | Language-I | | Tamil/Sanskrit | 6 | 3 |
| | | | Language-II | | English | 6 | 3 |
| | | | Major Lab | 17U2LMP1 | Cell Biol. Genetics & Biochemistry Lab | 3 | 6 |
| | | | Anc.Lab | 17U2ZAP1 | Anc. Zoo Lab | 2 | 1 |
| | | | | | | 30 | 24 |
| II | III | Major | 17U3LMC3 | Molecular Biology | 4 | 4 | |
| | | NME | | | 2 | 2 | |
| | | Ancillary-I | 17U3ZAC3 | Essentials of Physiology & Microbiology | 2 | 2 | |
| | | SBE (Anc-I) | 17U3ZSA1 | Fishery Science | 2 | 2 | |

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|--|-----------|--------------|----------|--------------------------------|-----------|-----------|
| | | Ancillary-II | 17U3RAC1 | Environmental Microbiology | 2 | 2 |
| | | Language-I | | Tamil/Sanskrit | 6 | 3 |
| | | Language-II | | English | 6 | 3 |
| | | Major Lab | | Mole. Biol. & Bioinfo Lab | 2 | * |
| | | Anc-I Lab | | Anc. Zoo Lab | 2 | * |
| | | Anc-II Lab | | Anc. Microbiology Lab | 2 | * |
| | | | | | 30 | 18 |
| | IV | Major | 17U4LMC4 | Animal Biotechnology | 2 | 2 |
| | | SBE | 17U4LSM3 | Bioinformatics | 2 | 2 |
| | | NME | | | 2 | 2 |
| | | Ancillary-I | 17U4ZAC4 | Molecular Biology & Immunology | 2 | 2 |
| | | Ancillary-II | 17U4RAC2 | Basic Microbiology | 4 | 2 |
| | | Language-I | | Tamil/Sanskrit | 6 | 3 |
| | | Language-II | | English | 6 | 3 |
| | | Major Lab | 17U4LMP2 | Mole. Biol. & Bioinfo Lab | 2 | 4 |
| | | Anc-I Lab | 17U4ZAP2 | Anc. Zoo Lab | 2 | 1 |
| | | Anc-II Lab | 17U4RAP1 | Anc. Microbiology Lab | 2 | 1 |
| | | | | | 28 | 20 |

| Year | Sem | Paper | Course Code | Title | H | C |
|------------|-----------|--------------|-------------|-----------------------------|-----------|---|
| III | V | Major | 17U5LMC5 | Immunology | 5 | 5 |
| | | Major | 17U5LMC6 | Industrial Biotechnology | 5 | 5 |
| | | Major | 17U5LMC7 | Plant Biotechnology | 3 | 3 |
| | | Major-Ele | 17U5LME1 | Biostatistics | 5 | 6 |
| | | Ancillary-II | 17U5RAC3 | Applied Microbiology | 2 | 2 |
| | | SBE (Anc-I) | 17U5RSA1 | Mushroom Cultivation | 2 | 2 |
| | | Major Lab | | Major Lab-I | 3 | * |
| | | Major Lab | | Major Lab-II | 3 | * |
| | | Anc-II Lab | | Anc. Microbiology Lab | 2 | * |
| | | | | 30 | 23 | |
| | VI | Major | 17U6LMC8 | Genetic Engineering | 4 | 4 |
| | | Major | 17U6LME2 | Environmental Biotechnology | 6 | 7 |
| | | Major-Ele | 17U6LME3 | Medical Biotechnology | 6 | 7 |
| | | SBE | 17U6LSM4 | Fisheries Technology | 2 | 2 |
| | | Ancillary-II | 17U6RAC4 | Medical Microbiology | 4 | 2 |
| | | Major Lab | 17U6LMP3 | Major Lab-I | 3 | 6 |
| | | Major Lab | 17U6LMP4 | Major Lab-II | 3 | 6 |
| | | Anc-II Lab | 17U6RAP2 | Anc. Microbiology Lab | 2 | 1 |
| | | | 30 | 35 | | |

Ancillary paper offered for UG Microbiology

| Year | Sem | Paper | Course Code | Title | H | C |
|-----------|------------|---------------|-------------|---|---|---|
| II | III | Ancillary -I | 17U3ZAC1 | Essentials of Invertebrates and Chordates | 1 | 2 |
| | IV | Ancillary -II | 17U4ZAC2 | Applied Zoology | 2 | 4 |

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|------------|-----------|----------------|----------|---|---|---|
| | | Anc-I Lab | 17U4ZAP1 | Anc. Zoo. Practical I | 2 | 2 |
| III | V | SBE | 17U5ZSA2 | Sericulture & Moriculture (SBE) | 2 | 2 |
| | | Ancillary -III | 17U5ZAC3 | Fundamentals of Physiology & Microbiology | 1 | 2 |
| | VI | Ancillary -IV | 17U6ZAC4 | Molecular Biology, Immunology & Biotechnology | 2 | 4 |
| | | Anc-II Lab | 17U6ZAP2 | Anc. Zoo. Practical II | 2 | 2 |

SEMESTER – I

| Course Code | Course Title | C | H | I | E | T |
|--------------------|-------------------------|----------|----------|----------|----------|----------|
| 17U1LMC1 | CELL BIOLOGY & GENETICS | | 5 | 25 | 75 | 100 |

Unit 1: The Cell

Cell theory, Protoplasm theory, Organismal theory. Modern concept of cell. Structure of prokaryotic and eukaryotic cell. Chemical organization of the cell –protoplasm.

Unit 2: Organization of the cell

Cell membrane- plant cell wall, extracellular matrix, plasma membrane, theories, chemical composition. Cytoskeleton- microtubules and microfilaments. Mitochondria- chemical composition and its functions. Golgi complex- morphology, chemical composition functions. Endoplasmic reticulum – types, chemical composition and functions.

Unit 3: Cell organelles and cell cycle

Ribosomes and lysosomes- size and shape, structure, subunits, chemical nature and its functions. Centrosomes, plastids, cilia, flagella and basal bodies. Nucleus and chromosomes structure and its functions. Cell divisions– mitosis and meiosis.

Unit 4: Mendelism and genetic interaction

Introduction to genetics (Vapour, Fluid, preformation, epigenesis, particulate, pangenetic and germplasm theory), mendelism, multiple alleles, multiple gene inheritance, linkage and crossing over, chromosomal map.

Unit 5: Sex linked inheritance

Sex determination in animals, sex linked inheritance, non-disjunction, Cytoplasmic inheritance, twins, inborn errors of metabolism, syndromes, pedigree analysis, Eugenics and eugenics, inbreeding and outbreeding, population, human and microbial genetics.

Text Books

1. Powar.C.B, Cell Biology- 1983,Himalaya publishing house, New Delhi.
2. Singh & Tomar, Cell biology, 10th revised edition, 2012, Rastogi publication, Meerut.

Reference Books

1. E.J.Gardener, M.J.Simmons and D.P.Snustad,Principles of Genetics – John Wiley & Sons
2. DeRobertis, Cell Biology - Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
3. Strickberger M.W., Genetics – Printice hall 4th edition, 1997.

| Course Code | Course Title | C | H | I | E | T |
|-------------|--------------------|---|---|----|----|-----|
| 17U1LSM1 | BIOINSTRUMENTATION | 2 | 2 | 25 | 75 | 100 |

Unit I: Microscopy

Microscopy: Introduction and types; bright field, dark field, Phase contrast, Fluorescence, Polarising microscopy; Electron microscopy: SEM and TEM.

Unit II: pH meter and Centrifuge

pH meter: Principle and working mechanism. Centrifuge: Basic principles of Sedimentation- types of centrifuges and types of rotors. Mechanism of diffusion and sedimentation.

Unit III: Colorimetry and Spectroscopy

Colorimetry: Beer –Lambert’s Law; Spectrophotometry: UV, Visible, Fluorescence, Raman spectroscopy and Infrared spectroscopy –principle, instrumentation and applications.

Unit IV: Chromatography

Chromatography: Paper Chromatography; Thin layer Chromatography; Gas chromatography, ion exchange Chromatography- principle, instrumentation and applications.

Unit V: Electrophoresis

Electrophoresis: Types-moving boundary and zone electrophoresis. Techniques and applications of Agarose gel electrophoresis, native PAGE, SDS-PAGE- principle, instrumentation and applications.

Text Books

1. Veerakumari L., Bioinstrumentation, 3rd edition, 2009, MJP publishers
2. Plummer, D, An Introduction to Practical Biochemistry, 1987, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
3. Jeyaraman, J., Laboratory Manual in Biochemistry, 1985, Wiley Eastern Limited, New Delhi.

Reference Books

1. Boyer, R.F., Modern Experimental Biochemistry, 1993,The Benjamin / Cummings Publishing Company, Inc., New York.
2. Williams B.L., and Wilson,K. A Biologist’s Guide to Principles and Techniques of Practical Biochemistry, 1983, Edward Arnold Publishers Ltd., London.
3. Wilson, K and Walker,J, Principles and Techniques of Practical Biochemistry, 1995, Cambridge University Press, New York.

| Course Code | Course Title | C | H | I | E | T |
|--------------------|-----------------------|----------|----------|----------|----------|----------|
| 17U1LES1 | ENVIRONMENTAL STUDIES | 2 | 2 | 25 | 75 | 100 |

Unit-I Earth and its environment

The earth-formation and evolution of earth over the periods – structure of earth and its components – Atmosphere – lithosphere, hydrosphere and biosphere. Resources – renewable and non-renewable resources.

Unit-II Ecology and Ecosystem concepts

Ecology – definition-ecosystem – definition-structure and functions, energy flow, food chain and food web, any one example in an ecosystem

Biogeochemical cycle – Nitrogen, carbon, phosphorus and water cycle

Unit-III Biodiversity and India

Introduction-definition-values of biodiversity-threats of biodiversity – conservation of biodiversity

Biodiversity of india- mega diversity nation, Biogeo graphical distribution – hotspot of biodiversity, national biodiversity, authority and its functions

Unit-IV Pollution and Global issues

Definition – cause, effects and control measures of air, water, soil, marine, noise, thermal and nuclear pollution

Global issues – global warming and ozone layer depletion

Unit V Development and disaster management

Sustainable development – sustainable agriculture-organic farming and irrigation of water, rain water harvesting and e-waste recycling –cyber waste and management

Disaster management – flood and drought, earth quake and Tsunami, landslides and avalanches, cyclones and hurricane – precautions, warning and rescue

| Course Code | Course Title | C | H | I | E | T |
|-------------|---|---|---|----|----|-----|
| 17U1ZAC1 | FUNDAMENTALS OF INVERTEBRATES AND CHORDATES | 2 | 4 | 25 | 75 | 100 |

Unit- 1

12 Hrs

General characters and outline classification of invertebrates up to phylum. Life cycle of Plasmodium - Canal system in sponges - Corals and coral reefs.

Unit- 2

12 Hrs

Parasitic adaptation in helminthic worms – metamerism - mouth parts and metamorphosis in insects.

Unit- 3

12 Hrs

Torsion in mollusc – economic importance of mollusc – Water vascular system in star fish – General characters and outline classification of vertebrates up to phylum.

Unit- 4

12 Hrs

General characters of Hemichordates, Eurochordates and Cephalochordates with examples – Parental care in fishes– migration of fishes.

Unit- 5

12 Hrs

Neoteny in Amphibians – poisonous snakes of south India (Cobra and krait) - identification of poisonous and non poisonous snakes – flight adaptations in birds – Egg laying and pouched mammals – Adaptive radiation in mammals.

Text book

1. Thangamani, A., Prasanakumar, S., Narayanan, L. M. and Arumugam, N. 2005. A text book of Chordates. Saras publication, Nagercoil.

Reference Books

1. Kotpal, R.L. Modern Text Book of Zoology Invertebrates, Rastogi Publication, Meerut.
2. Parker & Hashwell, Textbook of Zoology Vol. I (Invertebrates) A.Z.T.B.S. Publishers & Distributors. New Delhi.
3. E.L. JORDEN & P.S. VERMA, Invertebrate Zoology, S. Chand & Co. Ltd. New Delhi.
4. Hickman C. P. Jr., Hickman & L.S. Roberts. Integrated principles of zoology, Mosby college publication. St. Louis.
5. Iyer, E.K., And T.N. Ananthkrishnan, Manual of zoology Vol. I, Invertebrata, Part I and II S.Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.
6. A Text Book of Zoology, Vertebrates, Vol-II, Jeffery Parker and W.A. Haswel, Edited by Marshall and Williams, CBS Publication, New Dehli.
7. Chordate Zoology, 1982, P.S Dhami and J.K.Dhami, R.Chand and Co., New Dehli.
8. A Text Book of Zoology, 1984, R.D. Vidyarthi, R. Chand and Co., Dehli.
9. Modern Text Book of Zoology, Vertebrates. R. L. Kotpal, 3rd edn. Rastogi Publications, Meerut.

10. Chordate Zoology, E.L. Jordon. S. Chand & Co., New Dehli.

SEMESTER – II

| Course Code | Course Title | C | H | I | E | T |
|-------------|-----------------------------|---|---|----|----|-----|
| 17U2LMC2 | BIOCHEMISTRY AND BIOPHYSICS | | 5 | 25 | 75 | 100 |

Unit 1: Fundamentals of Biochemistry

Fundamentals of biochemistry: Elements of life; Atoms, Molecules, atomic number, Chemical bonds: Covalent, Ionic and Hydrogen, co-ordinate and Vander-Waals bond, electrolytes; pH: hydrogen ion concentration, Henderson and Hasselbach equation, buffers and osmosis.

Unit 2: Carbohydrates and its metabolism

Carbohydrates: Definition, classification, stereochemistry, cyclic structures and anomeric forms, Haworth projections. Monosaccharide, Disaccharides, Polysaccharides. Homopolysaccharides - starch, glycogen, cellulose. Heteropolysaccharides-hyaluronic acid, chondroitin sulphate and heparin. Metabolism: Glycolysis and TCA cycle.

Unit 3: Proteins and enzyme kinetics

Amino acids and peptides: Definition, amino acids as ampholytes. Structure and classification of amino acids based on chemical nature, Essential amino acids, Peptides; Structure and properties. Metabolism: Deamination, Decarboxylation, Transmethylation and Transamination. Enzymes: classification, kinetics, MM equation, co-enzymes and co-factors.

Unit 4: Lipids and Vitamins

Lipids; Definition, classification of lipids- simple, compound and derived. Compound lipids-Structure and function of phospholipids, glycolipids and lipoproteins. Derived lipids-Fatty acids-saturated and unsaturated. Essential fatty acids. Metabolism of fatty acids- β oxidation. Vitamins: Definition, classification, sources of Fat and water soluble vitamins.

Unit 5: Basics of Biophysics

Biophysics: Introduction. The free energy of a system. Chemical potential - oxidation & reduction potential. Thermodynamics: Entropy, Enthalpy. Diffusion - Fick's laws, constant laws, osmotic coefficient, Active transport Laws of thermodynamics.

Text Book(s):

1. Ambika Shanmugam, Fundamentals of Biochemistry for Medical students, 8th edition, 1998, Published by the Author, Madras.
2. Palanichamy, S. and Shanmugavelu, M. Principles of Biophysics, 2nd Edition, 2011. Palani Paramount Publications, Palani.

Reference Book(s):

1. Satyanarayana, U. and Chakrapani, U. Biochemistry, 2009. Books and Allied Pvt. Ltd., Kolkata.
2. Stryer, L., Biochemistry, Fourth edition, 2000. W.H. Freeman and Company, New York.
3. Voet, D., and J.G.Voet, Biochemistry, second edition. 1995, John Wiley & Sons Inc, New York.

| Course Code | Course Title | C | H | I | E | T |
|-------------|---------------------------|---|---|----|----|-----|
| 17U2LSM2 | CONCEPTS OF BIOTECHNOLOGY | 2 | 2 | 25 | 75 | 100 |

UNIT-I : Biotechnology: Scope and Importance

Biotechnology: History of Biotechnology, Traditional and Modern Biotechnology, Potential of Modern Biotechnology, Biotechnology as an interdisciplinary area-Biotechnology Tree. Achievements of Biotechnology.

UNIT-II : Gene concept and Tools

Gene concept: Definition; Size of a gene, Cistron, Muton and Recon; Gene expression and functions of gene. Tools in Biotechnology: Restriction enzymes: types, naming, target sites, nature of cut ends, host controlled restriction and modification and isoschizomers.

UNIT-III: Biotechnology and environment

Environmental pollution: Bioremediation – Insitu and Exsitu Bioremediation, Xenobiotics. Biodegradation, Biosorption, Bioaugmentation, Mechanism of Biofiltration, Bioleaching.

UNIT-IV: Bioethics and Biosafety

Benefits of Biotechnology, ELSI Biotechnology, Risks and ethics of Biotechnology, Release of Genetically engineered Organisms, Biological warfare. Biosafety guidelines and regulations.

UNIT-V: Rules and Regulations in Biotechnology

Intellectual Property Rights, Intellectual Property Protection, Forms of protection. Patents, Copyrights, WIPO, TRIPS, GATT. Patenting of Biological materials and its significance.

Text Books

1. V. Kumaresan, A text of biotechnology, Saras publication
2. R.C. Dubey, A text book of Biotechnology, 1st revised edition, 2010, S.Chand Publication.

Reference Books

1. U.Sathyanarayana, Biotechnology, 2016, Books and allied (P)Ltd
2. S.C.Rastogi, Biotechnology principles and Applications 2016, Narosa publication
3. S.S. Purohit, Biotechnology fundamentals and Applications 2010, Fourth edition
4. H.K.Das., Text book of Biotechnology. Willey India publication fourth edition
5. Old & Primrose, Principles of Gene Manipulation, 3rd edition 1989.

| Course Code | Course Title | C | H | I | E | T |
|-------------|------------------|---|---|----|----|-----|
| 17U2ZAC2 | ECONOMIC ZOOLOGY | 2 | 4 | 25 | 75 | 100 |

Unit – 1

12 Hrs

Apiculture - Types of honey bees - Bee colony - Newton bee hives - Management of an apiary- Uses of honey - Bee wax and Bee venom. Lac culture - Life history and rearing of lac insects - uses of lac.

Unit – 2

12 Hrs

Sericulture - Types of silk worm - Lfe history of silk worm - Rearing of silk worm - Silk glands - Diseases of silk worm (Pebrine, muscardine and flacherie) - Role of Central Silk Board in Sericulture.

Unit – 3

12 Hrs

Poultry - Breeds of poultry - Housing and management – Nutrition - Diseases and control - Dairy farming – Principles of economically important cattle.

Unit – 4

12 Hrs

Pisciculture - Types of culturable fishes (fin fishes and shell fishes) - polyculture of carps - economic importance of fishes.

Vermiculture – Species – method – vermiwash - uses of vermi compost.

Unit – 5

12 Hrs

Pests of paddy (*Tryporyza incertulas*, *Baliothrips biformis*), sugarcane (*Chilo infescatellus*, *Holotrichia consanguinea*) and cotton (*Pempherus offinis*, *Oxycarenus laetus*) - Cultural, chemical and biological methods of pest control – Integrated pest management.

Text book(s):

1. Tomer, B.S. 2011. Economic Zoology. Emkay publications, Delhi.
2. Arumugam, N., S. Murugan, J. Johnson Rajeshwar, and R. Ramprabhu, 2005. Applied Zoology. Saras publication, Nagercoil.

Reference Books

1. Arumugam, N. 2008. Aqua culture. Saras publication, Nagercoil.
2. Ravindranathan, K.R. 2005. A text book of economic zoology. Dominant publishers and distributors, New Delhi.
3. Vasantharaj David, B. and Kumaraswamy, T. 1996. Elements of Economic Entomology. Popular book depot, Chennai.

| Course Code | Course Title | C | H | I | E | T |
|-------------|-----------------|---|----|----|----|-----|
| 17U2XVE1 | VALUE EDUCATION | 2 | 30 | 25 | 75 | 100 |

Unit I

Value Education: Definition. Need. Values and Individuals; Self discipline. Areas that contribute for values: Arts, Science, Philosophy and Mythology. Classification of Values: Morals, Social, Spiritual, Cultural and Natural (Diversity).

Unit II

Character building: Contribution from Family, society and Educational Institutions. Social Evils: Alcoholism, Smoking, Drug Abuse.

Unit III

Values and Religions: Faith and Believes. Hinduism- Purusharthas-Dharma, Artha, Kama, Moksha. Islam- Brotherhood, Christianity- Love and Justice. Sikhism- Courage. Buddhism- Four Noble Truths. Jainism- Tri Ratna.

Unit IV

Values and Society. Socialization. Traditions and Changes; Culture & Civilization in value building; Conflicts; destructions; Extinctions. Acceptance and Adaptability; Mutual recognition and respect. Role of Mass media in value formation.

Unit V

Impact of exploitation of men, material and money on values. Desertion of villages- Urbanization- Globalization: Concepts, Causes, impacts on Values and Remedial Measures.

| Course Code | Course Title | C | H | I | E | T |
|--------------------|-------------------------------|----------|----------|----------|----------|----------|
| 17U2LMP1 | Major Lab for I & II Semester | 3 | 3 | 50 | 50 | 100 |

1. Micrometry
2. Mitotic studies in onion root tip
3. Meiotic studies in grasshopper testes
4. Mounting of polytene chromosomes
5. Study the cell morphology and motility using hanging drop method
6. Blood smear differential staining
7. Simple Mendelian traits in man
8. Qualitative analysis of carbohydrate
9. Estimation of carbohydrate by Anthrone method
10. Qualitative analysis of protein
11. Estimation of protein by Biuret method
12. Qualitative analysis of Lipids
13. Estimation of DNA by DPA method
14. Verification of Beer-Lambert's law
15. Thin layer chromatography
16. Measurement of pH
17. Preparation of Buffer
18. Separation of amino acids by paper chromatography
19. Agarose gel electrophoresis
20. SDS - PAGE

| Course Code | Course Title | C | H | I | E | T |
|-------------|---|---|---|----|----|-----|
| 17UZZAP1 | Anc. Zoo Practicals for I & II Semester | 2 | 2 | 50 | 50 | 100 |

Earthworm body setae

Mouth parts of Cockroach, Honeybee and housefly

Cockroach salivary glands

Frog- brain, Fifth cranial nerve, urinogential system and Osteology

Trypanosoma, *Obelia*, Ephyra larva, *Taenia*, *Ascaris Lumbricoides*, *Dracunculus medinersis*, Hirudo,

Appendages of Prawn, Asterias, Trochophore larva, Nauplius, Bipinaria, Amphioxus, Placoid scales,

feather of birds, Axolotle larva, Poisonous snakes of South India, Glachodium

SEMESTER – III

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-------------------|---|---|----|----|-----|
| 17U3LMC3 | Molecular Biology | 4 | 4 | 25 | 75 | 100 |

UNIT I Genome Organization

History and scope of molecular biology, DNA structure – B DNA, Z DNA, super coiled DNA, Watson and Crick model, RNA structure– rRNA, tRNA and mRNA, experimental evidence of DNA and RNA as genetic material - transformation experiment, functions of DNA and RNA, genomic organization of prokaryotes

and eukaryotes, chromosomal proteins - histone and non-histone proteins, central dogma of molecular biology.

UNIT II Replication

Prokaryotic and eukaryotic DNA replication - mechanism of DNA replication – initiation, replication fork, chromatin assembly, enzymes and accessory proteins, types of DNA replication- semi conservative, conservative, dispersive, rolling circle and bidirectional replication, inhibitors of DNA synthesis.

UNIT III Transcription

Prokaryotic and eukaryotic transcription - RNA polymerases, general and specific factors, regulatory elements and mechanism, transcriptional and post transcriptional modification in RNA - gene silencing, 5'cap formation, 3' end processing, polyadenylation, editing, splicing, nuclear export of mRNA and mRNA stability.

UNIT IV Translation

Genetic code - characteristics of genetic code, Wobble hypothesis. Prokaryotic and eukaryotic translation - structure and chemical composition of ribosomes, mechanism - initiation, elongation and termination, post translational modification of proteins, inhibitors and modifiers of protein synthesis.

UNIT V DNA damage and repair

Mutation – spontaneous and induced, mutagens- physical, chemical and biological, molecular mechanisms of mutagenesis – transition, transversion, frameshift, mis-sense and non-sense mutation, DNA repair mechanism - photo reactivation, excision, recombination and SOS.

TEXT BOOKS

1. David Freifelder, 2015. Molecular Biology, 4th Edition. Narosa Publishing house New Delhi.
2. Verma and Agarwal, 2016. Cell and Molecular Biology. S.Chand publications, New Delhi.

REFERENCE BOOKS

1. Ramawat and Shaily Goyal, 2010. Molecular Biology and Biotechnology. S.Chand
2. Benjamin Lewin, 2008. Gene VII, 7th Edition. Oxford university press, Nelson cox.
3. Burton E.Tropp, 2012. Molecular Biology Genes to proteins. Jones and Bartlett learning, LLC.
4. S.Wolf, 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California. USA.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|---|----------|----------|----------|----------|----------|
| 17U3ZAC3 | Essentials of Physiology and Microbiology | 1 | 2 | 25 | 75 | 100 |

UNIT-I

Digestive system – Structure of Alimentary canal, Digestive glands - salivary glands, liver, pancreas (Secretions and functions).

UNIT-II

Excretory system of Man – Structure of Kidney, nephrons, Formation of urine, urinary infections (Glomerulo nephritis, renal stones).

UNIT –III

Reproductive system – Reproductive system - Hormones, menstrual cycle, Oestrogen, Androgen, Prolactin, Relaxin, birth control methods & test-tube baby.

UNIT-IV

Introduction to microbiology: Sterilization - Autoclave – structure and functions. Culture medium (Solid, Liquid and its composition, types of culture medium, bacterial growth, growth rate, growth curve, preservation-pasteurization of milk.

UNIT-V

Microbial Diseases: Cholera, Tuberculosis, Rabies and AIDS – causative organism, pathogenecity, mode of transmission, symptoms and their preventive measures.

TEXT BOOKS

1. Rastogi, S.C. 2007. Essentials of Animal Physiology, New Age International Publishers
2. Baveja, C.P. 2017. Textbook of Microbiology, Arya Publications

REFERENCE BOOKS

1. Richard.W Hill, Gordon A. Wyse & Margaret Anderson. 2012. Animal Physiology
2. Surinder Kumar, 2012, Textbook of Microbiology. Jaypee Brothers Medical Publishers P (Ltd), New Delhi.
3. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
4. Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-----------------|---|---|----|----|-----|
| 17U3ZSA1 | Fishery Science | 2 | 2 | 25 | 75 | 100 |

UNIT-I

Fisheries- Definition, scope of fisheries, scenario of Indian fisheries, economic importance of fishes, types of fisheries- inland, brackish water and coastal.

UNIT-II

Cultivable organisms- qualities, types- fin and shell fishes. Culture practices- extensive, semi-intensive, intensive, monoculture, monosex culture, poly culture, cage culture, pen culture, race way culture.

UNIT –III

Integrated fish farming types - paddy cum fish culture-, fish cum poultry culture. Fish feed- live feed, artificial feed- simple and compound, composition of ideal fish feed, qualities of good artificial feed

UNIT-IV

Feeding- feeding rates, feeding schedule, FCR. Fish spoilage- preservation of fishes- drying and canning

UNIT-V

Fish Diseases- protozoan (white spot) bacterial (Erythroderma), viral (Epizootic ulcerative syndrome) & fungal (gill rot)

Text Books

1. Arumugam, N. 2010. Aquaculture. Saras Publications, Nagercoil.

Reference Books

1. Shukla, J.P. and Pandey 2012. Fish and Fisheries. Rastogi Publications. New Delhi.
2. Rath, R.K. 1993. Freshwater Aquaculture, Scientific Publishers, Jodhpur.
3. Zade, S.B., Khune, C.J., Sitre, S.R and Tijare, R.V. Himalaya Publishing House, New Delhi.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------------|---|---|----|----|-----|
| 17U3RAC1 | Environmental Microbiology | 2 | 2 | 25 | 75 | 100 |

Unit I

6 Hrs

Microbiology of soil – Rhizosphere, soil microflora, significance of soil microbes. Role of microbes in Biogeochemical cycle- Carbon , Nitrogen and Phosphorus.

Unit II

6 Hrs

Microbiology of air – Enumeration of bacteria from air – Air sampling devices – Air sanitation- Air borne diseases –Tuberculosis , Influenza.

Unit III

6 Hrs

Microbiology of water – Potability of water quality -MPN test – Indicator organisms -IMVIC test – water purification – waterborne diseases and their control measures – Amoebic dysentery, Cholera & Typhoid.

Unit IV

6 Hrs

Microbiology of sewage – chemical and biochemical characteristics of sewage – Sewage treatment – Physical, chemical and biological methods -trickling filter, activated sludge, Lagoon and sewage farming.

Unit V

6 Hrs

Role of microbes in biodegradation – Xenobiotics –Biomining eg. (copper). Biodegradation of paper, oil, pesticide, dyes and heavy metals. Phytoremediation.

Text Book

1. Vijaya Ramesh K (2004). Environmental Microbiology. 1st Edition, MJP Publishers (A unit of Tamil Nadu Book house), Chennai.

Reference Books

1. Mithell R (1974). Introduction to Environmental Microbiology. Prantice Hall. Inc., Englewood Cliffs, New Jersey.
2. Atlas, RN and Bartha R (1992). Microbial Ecology: Fundamentals and applications. 3rd Edition, Redwood city, Benjamin/Cummings.
3. Joseph C Daniel (1999). Environment Aspects of Microbiology. 1st Edition, Bright sun Publications, Chennai.
4. Subba Rao, N.S., (2000). Advances in Agricultural Microbiology, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi.
5. Metting, Jr. F.B., (1993). Soil Microbial Ecology, Harcel Dekker Inc., New York.

6. Atlas, M., (2000).Microbiology-Fundamentals and Applications, Collier MacMillan Publication, London

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-------------------------|---|---|----|----|-----|
| 17U3LNM1 | Basics of Biotechnology | | 2 | 25 | 75 | 100 |

Unit-I Biotechnology in Animal Husbandry **6h**

Introduction, history and scope of animal biotechnology, Biotechnology in India-DBT, Transgenic animal – Dolly.

Unit-II Biotechnology in Agriculture **6h**

Plant tissue culture – definition, history, techniques – microinjection and electroporation, advantages and disadvantages, transgenic plant – *Bt* cotton.

Unit-III Biotechnology in food industry **6h**

Single cell protein – sources, nutritive values and uses. Fermented foods – processing of idli, dosa batter, butter milk, cheese and yoghurt.

Unit-IV Environmental Biotechnology **6h**

Role of biotechnology in environmental protection-global warming, waste water treatment – activated sludge method, biogas production and advantages, bioremediation – superbug.

Unit-V Bioethics and biosafety **6h**

Ethical, legal and social implications of biotechnology, biosafety – positive and negative effects of GMO foods.

Textbooks

1. Satyanarayana U. 2015. Biotechnology. Books and Allied Ltd.

2. Kumaresan V. 2010. Biotechnology. Revised Edition. Saras Publications

References

1. Dubey RC. 2014. A text Book of Biotechnology. 5th edition. S. Chand.
2. Purohit SS and Mathur SK. 2002. Biotechnology – Fundamentals and Applications. Agro-Bios Publications.
3. Jogdand SN. 2010. EnvironmentalBiotechnology. 5th edition. Himalaya Publication

SEMESTER – IV

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------|---|---|----|----|-----|
| 17U4LMC4 | Animal Biotechnology | 2 | 2 | 25 | 75 | 100 |

UNIT I Introduction to animal cell culture

History, scope, minimal requirements for cell culture, culture media- definition, types - natural media, artificial media, serum media, serum free media, physiochemical properties of media – pH, CO₂, O₂, temperature and osmolality.

UNIT II Animal cell culture techniques

Primary cell culture – definition, techniques - mechanical, enzymatic disaggregation, primary explants, secondary culture – finite, continuous cell line, selection and maintenance.

UNIT III Characterization of cultured cells

Characteristics of cultured cells – cell adhesion, proliferation, differentiation, metabolism, initiation, evolution and development, measurement of growth parameters of cultured cell, cell synchronization, senescence and apoptosis.

UNIT IV Transgenic animals

Animal cloning – introduction, importance, methods - retroviral, micro injection, embryonic stem cell in transgenic mice, sheep and its applications.

UNIT V Embryo transfer technology

Animal propagation - In vitro fertilization technology, artificial insemination in cattle, embryo transfer technique and superovulation in farm animals.

TEXT BOOKS

1. P.K.Gupta 2017. Animal Biotechnology, first edition, Rastogi publication, Meerut.
2. U.Satyanarayana, 2015. Biotechnology. Books and Allied P (Ltd), Kolkata, India V.
3. Srivastava Singh and M.P. Yadhav. 2005, Animal Biotechnology. Oxford publishing
4. Kumaresan 2010. Animal Biotechnology, revised edition, Saras publication, Kanyakumari.

REFERENCE BOOKS

1. B.R.Glick, and J.J. Pasternak, 2003. Molecular Biotechnology, Principles and application of recombinant DNA. ASM Press, Washington.
2. M. Prakash and K.Arora, 1999. Cell tissue culture, Anormal Publication.
3. S.N.Jogdand, 2001. Advanced in biotechnology, Himalaya Publication, Mumbai.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------|---|---|----|----|-----|
| 17U4LSM3 | Bioinformatics | 2 | 2 | 25 | 75 | 100 |

UNIT I Overview of Bioinformatics

Introduction to Bioinformatics, history of Bioinformatics, scope of Bioinformatics, Bioinformatics- a multi-disciplinary approach, application of Bioinformatics.

UNIT II Biological Databases

Major bioinformatics databases- NCBI, Nucleotide database -Genbank, EMBL and DDBJ, protein database - primary sequence database- Swissprot and PIR, secondary sequence database- PROSITE, PRINTS and pfam, protein structural database- PDB, SCOP and CATH.

UNIT III Sequence Alignment

Retrieval of sequence – SRS and ENTREZ, sequence alignment, BLAST, FASTA, local and global alignment. Pair wise sequence alignment – Dot-matrix and K-tuple method, multiple sequence alignment – CLUSTALW, applications of multiple sequence alignment.

UNIT IV Phylogenetic analysis

Phylogenetic tree- structure of typical phylogenetic tree, rooted and unrooted tree, construction of phylogenetic tree, phenetic method - UPGMA and neighbour joining, cladistic method - maximum parsimony and maximum likelihood, phylogenetic softwares available in the web.

UNIT V Protein structure prediction

Protein structure – classification and protein structure prediction – *ab initio* modelling, comparative modelling - homology modelling, SWISS modeller, protein threading, evaluation of predicted structure - Ramachandran plot, molecular visualisation tools -Rasmol and Swiss PDB viewer.

TEXT BOOKS

1. S.C.Rastogi et al., 2006. Bioinformatics concepts, skills and applications.2nd edition, CBS
2. C.Subramanian, 2015. A text book of Bioinformatics. 1st edition, Dominant publishers,
3. B.G. Curran et al., 2010. Bioinformatics.1st edition, CBS Publishers and Distributors, Pvt.

REFERENCE BOOKS

1. Z. Ghoshand, B. Mallick. 2008. Bioinformatics: Principles and Applications. Oxford University Press, New Delhi.
2. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University Press, London.
3. N.J.Chikale and V.S.Gomase.2007. Bioinformatics.1st edition. Himalaya publishing house ltd,
4. Vittal R. Srinivas, 2005. Bioinformatics a modern approach. Prentice Hall of India pvt.Ltd.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------------------|---|---|----|----|-----|
| 17U4ZAC4 | Molecular Biology and Immunology | 1 | 2 | 25 | 75 | 100 |

UNIT-I

Nucleic acids, DNA structure - Watson and Crick model, Significance of DNA, RNA- structure, types of RNA- mRNA, tRNA and r RNA-structure and functions.

UNIT-II

DNA replication- mechanism, Protein synthesis- transcription, translation- initiation, elongation and termination, processing of post-translation processing.

UNIT –III

Operon Hypothesis, structure of Operon model, mechanism of Lac operon .

UNIT-IV

Immunology: Types of Immunity – Natural (Physical, Biochemical, Cellular, Genetic & other factors). Acquired (Humoral and Cell Mediated). Lymphoidal organs – Primary (Thymus and Bursa of Fabricius), Secondary (spleen and Lymphnode). Lymphocytes – T and B Cells.

UNIT-V

Immunoglobulin – Structure and Functions and types. Immune Response. Antigen – antibody reaction (Agglutination & Precipitation).

TEXT BOOKS

1. Gupta, P. K. 2011. Molecular Biology and Genetic Engineering, Rastogi Publications, Meerut,
2. Benjamin et al . 2004. Immunology, 4th Edition, A John Wiley & Sons INC Publication.

REFERENCE BOOKS

1. Burton E. Tropp, 2012. Principles of Molecular Biology, Jones & Bartlett Learning.
2. Kuby, J. 1997. Immunology. W.H. Freeman & Company, New York.
3. Karp, G.(2010). Cell and Molecular Biology: Concepts and experiments. VI Edition. John Wiley and Sons.Inc.
4. Cooper, G. M and Hausmen, R.E (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington.D.C,: Sinauer Associates, MA.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|--------------------|---|---|----|----|-----|
| 17U4RAC2 | Basic Microbiology | 4 | 4 | 25 | 75 | 100 |

Unit I

12 Hrs

Introduction and History of Microbiology – History and recent developments – Spontaneous generation – Biogenesis Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Fleming.

Unit II

12 Hrs

Morphology and structure of bacteria – types of bacteria based on morphology and flagella, Ultrastructure of bacteria eg. *E.coli*, flagella, fimbriae and Pili. Endospore – Structure, formation and significance.

Unit III

12 Hrs

Cell wall structure and staining of bacteria – Gram positive and Gram negative bacteria. Staining techniques – Simple, differential and special staining. Fungal staining.

Unit IV

12 Hrs

Sterilization and its methods – Principles – dry heat – moist heat – Radiation – Filtration. Disinfection-sanitization, antiseptics and fumigation..

Unit V

12 Hrs

Antibiotics and Biofertilizer - Antibiotics – mode of actions – antimicrobial resistance – Tests for sensitivity to antimicrobial agents. Biofertilizers -Mycorrhizae, Biopesticides- *Bacillus thuringiensis*.

Text Book

1. Dubey RC & Maheswari DK (2005). A text book of Microbiology, Revised Multicolour Edition, Published by S. Chand & Company Limited, New Delhi.

Reference Books

1. Prescott M (2005). Microbiology. 6th Edition, Tata McGraw – Hill, New Delhi.
2. Albert G Moat & John W Foster (2004). Microbial Physiology. 4th Edition, John Wiley & Sons, New York.
3. Robert F Boyd (1984). General Microbiology. Times Mirror / Mosby College Publishers.
4. Purohit SS (2005). Microbiology – Fundamentals and Applications. Reprinted & Published by Student Edition, Behind Nasrani Cinema, Chopasani Road, Jodhpur
5. Pelczar TR, Chan ECS & Kreig NR (2006) Microbiology. 5th Edition, Tata McGraw – Hill, New Delhi.
6. Schlegel, H.G., (1993). General Microbiology, Seventh edition, Cambridge University Press.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|--------------------|---|---|----|----|-----|
| 17U4LMP2 | Major Practical-II | 4 | 2 | 50 | 50 | 100 |

1. Isolation of DNA from Plant Tissue
2. Isolation of Chromosomal DNA from bacterial cells
3. Isolation of RNA from Chick liver
4. Preparation of media for animal cell culture
5. Cell viability test by trypan blue exclusion
6. To build query for retrieving scientific records and chemical structure from Pubmed and Pubchem Database
7. Retrieving sequence records with NCBI's Entrez Nucleotides and EMBL
8. Sequence similarity searching using NCBI BLAST and its variants
9. Understanding the homology between different eukaryotes and prokaryotes species using Multiple Sequence Alignment
10. Understanding evolutionary relationship (Orthology & Paralogy) using phylogenetic analysis.

Reference Books

1. Rajan S and Selvi Christy. 2011. Experimental procedure in Lifesciences. Anjana Publications.
2. Arumugam N and Dulsy Fatima. 2013. Practical Zoology. Saras Publications
3. Aparna M. 2013. Laboratory Instrumentation. Black Printers.
4. Shanmugam S, Sathish Kumar T and Panner Selvam. 2010. Laboratory Handbook on Biochemistry. PHI Learning Pvt Ltd.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-------------------------|---|---|----|----|-----|
| 17U4ZAP2 | Anc. Zoology Practicals | 1 | 2 | 50 | 50 | 100 |

1. Estimation of oxygen consumption of fish with reference to body weight
2. Estimation of oxygen consumption of fish with reference to temperature
3. Estimation of O₂ in water sample
4. Estimation of CO₂ in water sample
5. Isolation of DNA (Demo)
6. Isolation of RNA (Demo)
7. Lymphoid organs in chick (Demo)
8. Blood Grouping-man
9. Simple staining and gram staining
10. Hanging drop method

Spotters: Sphygmomanometer, Kymograph, Warburg respirometer, DNA, RNA and its types, Double Immunodiffusion, Antibody structure, gene cloning, DPT vaccines, Ecological pyramids, Alpha, Beta & Gamma Diversity, Red data book, National parks, Green House effect

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|----------------------------|----------|----------|----------|----------|----------|
| 17U4RAP1 | Ancillary Microbiology lab | 1 | 2 | 50 | 50 | 100 |

1. Examination of plant diseases – Blast disease in paddy, Blight of rice.
2. Isolation of Nitrogen fixing bacteria from root nodules of legumes
3. Study of morphology of cyanobacteria.
4. Enumeration of bacteria from soil.
5. Standard plate count technique (SPC)
6. MPN test
7. Microscopic observation of bacteria –Simple and Differential staining
8. Sterilization methods – moist heat, dry heat, filtration and radiation.
9. Aseptic transfer of microorganisms.
10. Preparation of culture media –solid (Selected and differential)and liquid

SEMESTER – V

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|--------------|---|---|----|----|-----|
| 17U5LMC5 | IMMUNOLOGY | 5 | 5 | 25 | 75 | 100 |

Unit -I Introduction to Immunology

History of Immunology, types of immunity –innate, specific, acquired, active and passive, organs of the immune system - primary and secondary lymphoid organs. Characteristic features of immunogens, antigens, haptens, epitopes, adjuvants. Cells of immunity-Neutrophils, macrophages, natural killer cells, null cells, basophils, mast cells, B cells & T Cells

Unit –II Components of Immune System

Immunoglobulins - Classes, Structure, biological properties and function, B cells - maturation, activation, proliferation, germinal centers, plasma cells, memory cells, class switching, T-cells - receptor, activation, maturation, differentiation, MHC- types, structure and function, self MHC restriction

Unit- III Immune Response

Complement – components, activation, complement pathways - Classical, Alternate, Biological activities. Hypersensitivity - Type I, II, III, IV reactions

Unit -IV Autoimmune disorder and Transplantation

Immune tolerance and autoimmunity - autoimmune diseases-mechanisms for the induction, Organ-Specific –Hashimoto’s thyroiditis , Grave’s disease, Myasthenia gravis, Systemic- SLE, scleroderma, Rheumatoid arthritis, Multiple sclerosis. Transplantation - types of graft, graft rejection, Graft Versus Host, Tissue typing, immunosuppressive agents.

Unit V Immunotechniques and Vaccine

Antigen-antibody interactions - Agglutination- hemagglutination, bacterial agglutination, passive agglutination, agglutination inhibition, Precipitation techniques- RID, ODD, Radio Immunoassay, ELISA- indirect, sandwich, competitive, Immunofluorescence assays - Fluorescence activated cell sorter (FACS) technique, ELISPOT, Vaccine-Active and passive immunization, attenuated, heat-killed, subunit vaccines, Vaccination schedule, route of administration, Production of polyclonal and monoclonal antibodies - Principles, Techniques and applications .

Textbook

1. Benjamin E, Coico R, Sunshine G. 2015. Immunology: A Short Course. 7th Edition Wiley
2. Owen JA, Punt J, Stranford. 2013. Kuby Immunology. W. H. Freeman & Company.

References

1. Abbas AK, Andrew H. Lichtman H, Shiv Pillai. 2015. Basic Immunology: Functions and disorders of the Immune System. Elsevier.
2. Tizard IR. 1995. Immunology –An Introduction. Saunders college publications.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---------------|---|---|----|----|-----|
| 17U5LME1 | BIOSTATISTICS | 6 | 5 | 25 | 75 | 100 |

Unit-1 Introduction to Biostatistics

Definition, Types – Descriptive & Inferential statistics, Terms – Population, sample, Unit, Variables, Constant, Parameter, Data, Inference, accuracy and precision. Collection of data- primary, secondary, qualitative and quantitative data. Classification and tabulation of data & Frequency distribution

Unit-II Diagrammatic and graphical representation of Data

Significance of Diagrams & Graphs: Diagrams – line, bar, pie, pictogram, cartogram, Significance and limitations of Diagrammatic representation. Graphic Representation - Types - Histogram, frequency polygon, frequency curve and cumulative frequency curve, Significance and limitations of graphical representations

Unit-III Measures of central tendency and dispersion

Central tendency - definition and characteristics-. Mean, median and mode. Dispersion - definition, methods of measuring dispersion - range, means deviation, standard deviation, variance, standard error, Measures of Skewness and kurtosis

Unit-IV Correlation and regression

Correlation - Definition & significance. Types - Positive and negative, simple and multiple, linear and non-linear, Methods of correlation analysis - Scatter diagram, graphical diagram and co-efficient of correlation. Regression – Definition, Types of regression analysis, Regression lines and equations, Regression co-efficient.

Unit-V Test of Hypothesis and Significance

Null and alternative hypothesis. Chi- square test, t-test, ANOVA - One-way.

Textbooks

1. Ramakrishnan P. 2010. Introduction to Biostatistics. Saras Publication
2. Veer Bala Rastogi. 2006. Fundamentals of Biostatistics. Ane Books India

References

1. Khan and Khanum. 2004. Fundamentals of Biostatistics, Ukaaz Publications, Hyderabad
2. Gurumani N. 2010. An Introduction to Biostatistics. MJP Publications, Chennai

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|--------------------------|---|---|----|----|-----|
| 17U5LMC6 | INDUSTRIAL BIOTECHNOLOGY | 5 | 5 | 25 | 75 | 100 |

Unit I Bioprocess Technology

Bioreactors – types - continuous stirred tank, bubble column, airlift, fluidized and packed bed. Features and operation of bioreactors – sterilization, inoculation, aeration, control system. Solid state fermentation, Media for industrial fermentation - substrates used as carbon, nitrogen, growth factor sources, sterilization - heat, physical methods. Isolation of microbes - enrichment methods, strains from unusual environment, preservation. Genetic improvement of strains-selection of mutants, genetic recombination. Culture methods - batch culture, fed - batch, semi-continuous, continuous.

Unit II Scale - up and Downstream process

Fermentation process - type I, II, III, Inoculum build up, pre-fermenter culture, production fermentation. Measurement and control of bioprocess parameters, Scale - up, Downstream process- solid liquid separation ,flotation, flocculation, filtration, centrifugation, release of intracellular products - cell disruption - mechanical, chemical and enzymatic, concentration, evaporation, extraction, membrane filtration, precipitation, purification by chromatography, formulation.

Unit III Enzyme Technology

Applications of enzymes, commercial production of enzymes - selection of organisms, formulation of medium, production process, recovery and purification. Regulation of microbial enzyme production - induction, feedback repression, nutrient repression. Genetic engineering for microbial enzyme production - cloning strategies. Immobilization-methods, choice of immobilization techniques, applications –production of L-amino acids, production of high fructose syrup, biosensors – types and applications

Unit IV Microbial production

Microbial production of organic solvents - ethanol, acetone and butanol, organic acids - citric acid, vinegar, antibiotics - penicillins, streptomycins, aminoacids - glutamic acid, L-lysine, Vitamin - B12, riboflavin.

Unit V Biopolymers and biomass

Microbial polysaccharide - general features, biosynthesis, production, applications – LPS, Xanthan, Dextran, alginate, polyhydroxyalkonates, polyhydroxybutyrate. Biomass – composition - cellulose, hemicelluloses, lignin, Production of alcohol and biogas from biomass.

Text book

1. Sathyanarayana U. 2017. Biotechnology, Book and Allied (P) Ltd.
2. Dubey RC. 2014. A Textbook of Biotechnology. S Chand

References

1. Stanbury PF. 2008. Principles of Fermentation technology, Elsevier publications.
2. Glazer AN, Nikaido H. 2007. Microbial Biotechnology. Second edition. Cambridge University Press.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---------------------|---|---|----|----|-----|
| 17U5LMC7 | PLANT BIOTECHNOLOGY | 3 | 3 | 25 | 75 | 100 |

Unit-I Introduction to Plant tissue culture

Plant tissue culture – Definition, history, Culture media- composition, types – MS, White, constituents –inorganic, organic supplements, growth regulators

Unit-II Plant Tissue culture methods

Callus culture - explants, factors affecting culture, applications, Organ Culture - Seed, Embryo, Anther, pollen, Cell culture - Isolation of single cells, suspension culture - types and synchronization, Protoplast-Isolation ,culture , regeneration, fusion-methods

Unit III Micropropagation, Germplasm conservation and cryopreservation

Micropropagation - definition, technique, Factors affecting micropropagation, *In vitro*
Clonal Propagation - Meristem and shoot tip culture, bud culture - single node, axillary, Organogenesis, Somatic embryogenesis, Applications of micropropagation, Germplasm conservation - types - *in-situ* and *ex-situ* and cryopreservation

Unit-IV Gene Transfer methods

Vector mediated - *Agrobacterium* mediated - Ti Plasmid, Virus mediated - Caulimoviruses and Gemini Viruses, Vectorless DNA transfer - Electroporation, Particle bombardment, microinjection, liposome, silicon carbide fibre mediated, Chemical methods - PEG mediated, Calcium phosphate co-precipitation, DEAE dextran method. Marker genes for plant transformation - selectable and reporter - Antibiotics resistance *npt-II*, *hpt*, *aadA*, Antimetabolite marker *dhfr*, Herbicide resistance genes - *bar*, *AroA* and *bxn*, *gfp*, bacterial luciferase.

Unit-V Genetically modified organisms

GMOs - Bt toxin, Longer shelf - life of fruits & vegetables, oils, golden Rice, Plantibodies, cloning of edible vaccines, Pest resistant, virus resistant, drought resistant, oxidative stress resistance- cytoplasm, plastids, cotton fibres, terminator seed technology.

Text Book

1. Satyanarayana U. 2017. Biotechnology. Books and Allied Pvt Ltd.
2. Chawla HS. 2017. An Introduction to Plant Biotechnology. CBS Publishers

References

1. Razdan MK. 2005. Introduction to Plant Tissue Culture. Oxford & Ibh.
2. Slater A. 2006. Plant Biotechnology – The Genetic Manipulation of Plants. Oxford press.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------|---|---|----|----|-----|
| 17U5RAC3 | Applied Microbiology | 2 | 2 | 25 | 75 | 100 |

Unit I

6Hrs

Microorganisms in food –Food preservation – Principles, Asepsis-anaerobic condition, high temperature, low temperature & drying, Food additives, Canning.

Unit II

6Hrs

Fermented foods – Dairy products –(Cheese, Bread) Vegetable –Sauerkraut. Food borne disease – Bacterial disease -Bacillus, Clostridium and fungal disease- Candida and Aspergillus.

Unit III

6Hrs

Contamination & spoilage – Meat & meat products, milk & milk products. Spoilage of canned foods. Detection of spoilage, Characterization, prevention and control.

Unit IV

6Hrs

Biofertilizer –Introduction and significance- Bacterial biofertilizer - Rhizobium –Algal biofertilizer- Azolla - Cyanobacteria and its Mass multiplication.

Unit V

6Hrs

Microbial production - Organic acid – (Citric acid), Antibiotics – (Penicillin), Enzyme – (α amylase), Alcohol- (Wine).

Text Book

1. Pelczar, M.J., E.C.S. Chan and N.R. Kreig. (2009). Microbiology, fifth edition. McGrawHill. Book Co. Singapore.

Reference Books

1. Adams MR & MO Moss (2005). Food Microbiology. 1st Edition. Reprinted, Published by New Age International (P) Limited. Publishers, New Delhi.
2. James M Jay (2004). Modern Food Microbiology. 4th Edition, CBS Publishers & Distributors, New Delhi.
3. Singh DP & SK Dwivedi (2005). Environmental Microbiology and Biotechnology. 1st Edition, New Age International (P) Ltd., Publishers, New Delhi.
4. Vijaya Ramesh K (2004). Environmental Microbiology. 1st Edition, MJP Publishers (A Unit of Tamil Nadu Book House) Chennai.
5. Patel A.H . (1996). Industrial microbiology .2nd edition ,Macillan India Ltd.
6. Kulshreshtha, S.K. 1994, Food Preservation, Vikas Publishing House Pvt. Ltd.,New Delhi

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------|---|---|----|----|-----|
| 17U5RSA1 | Mushroom Cultivation | 2 | 2 | 25 | 75 | 100 |

Unit I

6 Hrs

Introduction- History- Scope and importance of mushroom cultivation. Present status of mushroom industry in India.

Unit II

6 Hrs

Breeding conditions of mushroom strains -Pure Culture- Media- Preparation and maintenance of mother culture in test tube slants -Petriplates- saline bottle - poly propylene bags.

Unit III

6 Hrs

Cultivation Technology - Infrastructure - culture rack - thatched house - substrates - vessels- inoculation methods. Mushroom bed preparation. Mother spawn and commercial spawn preparation- types , methods of storage. Preservation technology- long term storage - short term storage.

Unit IV

6 Hrs

Cultivation and importance of edible mushroom in India. *Pleurotus species* & *Volvariella species* . Mushroom contamination - disease caused by viruses and fungi. Poisonous Mushrooms.

Unit V**6 Hrs**

Significance and applications - Nutritional and Medicinal values of Mushroom - protein - carbohydrates - vitamins - minerals - fibre content. Preparation of mushroom recipes – Pickles and soup.

Text Book

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

Reference Books

1. Aneja, K.R. (1993). Experiments in Microbiology, Plant pathology, Tissue culture and mushroom cultivation, Wishwa Prakashan, New Age International (P) Ltd., New Delhi.
2. Chang,S. and Miles, P.G. (2004). Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact, CRC Press online.
3. Swaminathan, M. (1990) .Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore.
4. Nita Bahl. (1996). Hand Book on Mushrooms. Oxford and IBH Publishing Company Ltd., New Delhi. 2.
5. Kapoor, J.N. (1989). Mushroom Cultivation, ICAR, New Delhi.
6. Banwari George, J. (1998). Basic food microbiology, 2nd Edition. CBS publishers and distributors, New Delhi.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|--|----------|----------|----------|----------|----------|
| 17U4LMP3 | PRACTICALS IN IMMUNOLOGY AND BIOSTATISTICS | 3 | 3 | 50 | 50 | 100 |

1. Lymphoid organs in chick
2. Preparation of Antigens
3. Blood Grouping
4. WBC Count – Total and Differential
5. Heamagglutination
6. Radial Immunodiffusion
7. Ouchterlony double diffusion
8. Immunoelectrophoresis
9. Western Blotting
10. ELISA
11. Collection and Tabulation of Data

12. Calculation of Mean, Standard Deviation
13. Correlation and Regression analysis
14. Chi-Square analysis
15. t-test analysis
16. ANOVA - One way

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|--|----------|----------|----------|----------|----------|
| 17U4LMP3 | LAB IN INDUSTRIAL BIOTECHNOLOGY AND PLANT BIOTECHNOLOGY | 3 | 3 | 50 | 50 | 100 |

1. Isolation of Yeast
2. Immobilization of yeast cells
3. Alcohol fermentation
4. Role of yeast in bread making
5. Production of penicillin
6. Antibiotic sensitivity test
7. Isolation of lipolytic microorganisms from butter
8. Isolation of antibiotic producing microbes from soil
9. Preparation of Plant Tissue culture media
10. Shoot Culture
11. Callus Induction
12. Isolation of Plant DNA

SEMESTER – VI

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-----------------------------|---|---|----|----|-----|
| 17U6LME2 | ENVIRONMENTAL BIOTECHNOLOGY | 7 | 6 | 25 | 75 | 100 |

Unit-I Sewage water and Treatment

Water pollution – nature of pollutants – organic, inorganic, microbial, radioactive materials, Sewage – composition, types, Measurement – detection of pathogenic organisms, coliform bacteria, Water Treatment : Primary, Secondary – Aerobic suspended growth treatment, Aerobic attached growth treatment, Anaerobic suspended growth treatment, Anaerobic attached growth treatment, Pond Treatment, Tertiary Treatment – Solids removal, nitrogen removal, phosphorous removal.

Unit-II Sludge and solid waste treatment

Sources and characteristics of sludge, Sludge thickening, stabilization, Composting – mechanism, methods, Vermi-composting, conditioning, disinfection of sludge, Heat drying, disposal of sludge – land filling, lagooning, septage disposal, solid waste disposal, separation and composting plants.

Unit- III Biodegradation and Bioremediation

Biodegradation – *Pseudomonas* uses, Factors affecting biodegradation, enzyme systems, Recalcitrant Xenobiotics, Types of bioremediation – *in situ*, *ex-situ* bioremediation, metabolic effects of microbes on xenobiotics, types of bioremediation reactions – aerobic and anaerobic, Biodegradation of hydrocarbons, pesticides and herbicides, Genetically engineered bacteria for bioremediation, Bioremediation of contaminated soil and water, Heavy metals – Metal microbe interaction, Mechanisms – metabolism dependent, metabolism independent, Extracellular precipitation and complexation

Unit-IV Biofertilizers and Biopesticides

Rhizobium, Azotobacter, Azospirillum, Blue green algae, Nostoc, VAM fungi, Azolla – production and application, Phosphate solubilizing bacteria. Biopesticides – Bacteria, fungi and virus - *Beauveria bassiana*, *Fusarium pallidorozeum*, *Trichoderma*, *Metarhizium* and *Pseudomonas fluorescens*

Unit-V Biofiltration and Bioleaching

Biofilters – micro-organisms used in biofilters - media, mechanisms, Microbial Leaching – microbes used, bioleaching - copper, uranium, gold, silver, silica.

Textbook

1. Satyanarayana U. 2017. Biotechnology. Books and Allied Pvt.
2. Dubey RC. 2014. A Textbook of Biotechnology. S Chand

Reference

1. Jogdand SN. 2015. Environmental Biotechnology. Himalaya Publishing House
2. Kumaresan V. 2014. Biotechnology. Saras Publications.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---------------------|---|---|----|----|-----|
| 17U6LMC8 | GENETIC ENGINEERING | 4 | 4 | 25 | 75 | 100 |

Unit-I Tools of Genetic Engineering

Introduction to genetic engineering- history of recombinant DNA technology, Molecular tools of genetic engineering -DNA modifying enzymes – exo & endo nucleases. Restriction Enzymes -nomenclature and classification, ligases, alkaline phosphatase, terminal transferase, reverse transcriptase, DNA Polymerase, Klenow polymerase. Linkers, adaptors, Homopolymer tailing.

Unit-II Cloning Vectors

Plasmids - pBR and pUC, Bacteriophage vectors- λ vectors, M13 vector, Cosmids, Yeast Vectors. Special vectors - expression vectors and shuttle vectors, artificial mini chromosome- BAC, YAC.

Unit III Methods of gene transfer

Physical, chemical and biological methods of Gene transfer: Bacterial Conjugation, Transformation, Transduction, Microinjection, Electroporation, Shotgun method, Ultrasonication, Liposome fusion, Calcium-mediated gene transfer.

Unit-IV Gene cloning strategies and selection of recombinants

Isolation and purification of nucleic acid, preparation of cDNA, Purification of plasmid DNA, Insertion of gene into vectors, Screening and selection of recombinants- blue-white, antibiotic and immunochemical methods. Hybridization techniques – Southern, Northern, Western, PCR- amplification of DNA – types of PCR & applications.

Unit-V Manipulation of gene expression in host cells

Manipulation of gene expression in prokaryotes, eukaryotes - selection of host cell for gene expression, regulatable promoters, integration of cloned DNA into the host chromosomes. Cloning in yeast- vectors for *Saccharomyces cerevisiae*, Mammalian cell expression vector. Gene expression to produce proteins, collection and purification of recombinant proteins. Human Genome project-mapping of the human genome, approaches for genome sequencing, benefits and applications of human genome sequencing.

Textbooks

1. Satyanarayana U. 2017. Biotechnology. Books and Allied Pvt.
2. Mitra S. 2015. Genetic Engineering. Principles and Practice. Second edition. Mcgraw Higher Ed.

Reference Book

1. Brown TA. 2010. Gene Cloning and DNA Analysis.6th Edition. Blackwell Publishing Ltd.
2. Primrose SB and Twyman RM. 2006. Principles of Gene Manipulation and Genomics.7th Edition Blackwell Publishing

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-----------------------|---|---|----|----|-----|
| 17U6LME3 | MEDICAL BIOTECHNOLOGY | 7 | 6 | 25 | 75 | 100 |

Unit I Gene Therapy

Gene therapy- approaches, types - *ex vivo*, *in vivo*. *Ex vivo* - vectors - viral, Human Artificial Chromosomes, Retroviruses, treating ADA deficiency, hypercholesterolemia, haemophilia. *In Vivo* - gene delivery by viruses system - retrovirus, Adenoviral, Adeno associated, treating Cystic Fibrosis. Non viral gene delivery - methods - pure DNA constructs, Lipoplexes, DNA molecular conjugates, efficiency of gene delivery. Antisense therapy - Cancer, AIDS.

Unit II DNA in Disease diagnosis and Medical Forensics

Nucleic acid hybridization - DNA probes, mechanism of action of DNA probes, Radioactive and Non Radioactive detection system, PCR and signal amplification, DNA chip - Microarray - techniques and applications. DNA in diagnosis - infectious diseases - Malaria, Chagas, AIDS, genetic diseases - Cystic fibrosis, sickle cell Anemia, Duchenne's muscular dystrophy. DNA fingerprinting, RFLP, VNTR and SNP in diagnosis.

Unit III Pharmaceutical products of DNA Technology

Human protein replacement - production of recombinant Insulin, recombinant hGH, Clotting Factor VIII. Therapeutic agents for human diseases - production of Tissue Plasminogen Activator, Interferons, Erythropoietin and DNase.

Unit IV Recombinant Vaccine and Monoclonal Antibodies

Recombinant Vaccines - types - Subunit vaccine against - Hepatitis B, Herpes Simplex virus, HIV, DNA Vaccine - delivery methods, screening of pathogenic genome for selecting DNA vaccines, Advantage, Attenuated - vaccine for cholera, typhoid, Vector Recombinant - vaccines against Vaccinia virus - production. Principles of Hybridoma technology, monoclonal antibodies production, purification. Production of Human Mouse MABs, production of MABs in *E. coli*, Applications of monoclonal antibodies - Diagnostics and Therapeutics.

Unit V- Assisted Reproductive Technology

Manipulations of Reproduction in animals - artificial insemination, Embryo transfer- superovulation, MOET, Embryo - splitting, biopsy, sexing. IVF- stages limitation, Embryo cloning. Manipulation of reproduction in humans - causes of infertility and applications of ART, techniques employed - IVF, ET, GIFT, ZIFT, IVC. Micromanipulation- intracytoplasmic sperm injection, Cryopreservation, Assisted Hatching, Negative aspects of ART.

Text book

1. Satyanarayana U. 2017. Biotechnology. Books and Allied Pvt.
2. Jogdand SN. 2008. Medical Biotechnology. Himalaya Publishing House.

Reference

1. Glick BR, Delovitch TL, Patten CL. 2014. Medical Biotechnology. ASM
2. Pongracz J, Keen M. 2008. Medical Biotechnology. Elsevier Health Sciences.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|----------------------|----------|----------|----------|----------|----------|
| 17U4LSM4 | FISHERIES TECHNOLOGY | 2 | 2 | 25 | 75 | 100 |

Unit-I Fish culture Techniques

Definition, Sewage Culture - Carp culture – pond culture, Reservoir culture , Integrated fish culture - Poultry cum fish, Dairy cum fish, Pig cum fish culture, Monosex culture - necessity, Tilapia culture, breeding methods, advantages.

Unit-II Fish Breeding and Genetic Manipulation

Methods of breeding-Natural, artificial – Stripping method, induced breeding - Hypophysation, Stages of hypophysation – Collection & preparation of pituitary extracts, selection of breeders, Injection, breeding, hatching. Ovaprim – advantages. Genetic manipulation - Transgenic fish production

Unit-III Fishing Techniques

Crafts – Trawlers - Beam, Pair, outrigger, Seiners, Dredgers, gill, nutters, lift nutters, Line vessels, Trap Setters. Fishing Gears – Nets-Surrounding, Trawler, Dredgers, lift, gill, trap nets. Electricity in fishing, electronic devices for fish detection, Bumper catching Devices.

Unit-IV Fish Preservation

Fish Spoilage – Chemical action, Autolysis, Microbial action, Principles of Fish preservation – Cleaning, low temperature, high temperature, dehydration, radiation, Use of salt and Preservatives, Methods of Preservation – Curing-Wet, dry, drying – Solar driers, monacuring, smoking, Pickling, icing, refrigeration, Deep freezing, Freeze drying, Canning.

Unit-V Fisheries Byproducts

Products – Liver oil, Body oil, fish meal, Fish silage, Fish glue, Isinglass, Leather, Cavier, Marconi, Shark Fin soup, Fish pulp, Fish paste, Ensilage, Amergris, Freshwater weeds, seaweeds

Textbooks

1. Zade SB, Khune CJ, Sitre SR, Tijare RV. 2011. Principles of Aquaculture. Himalaya Publishing House.
2. Santhnam R. 1990. Fisheries Science. Daya Publishing House, New Delhi.

Reference

1. Arumugam N. 2014. Aquaculture. Saras Publications.
2. Pandey K, Shukla JP. 2015. Fish and Fisheries. Rastogi Publications.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|----------------------|---|---|----|----|-----|
| 17U6RAC4 | Medical Microbiology | 4 | 4 | 25 | 75 | 100 |

Unit – I Micro flora of human body

12 Hrs

General features of normal flora. Microflora of human body, germ theory of diseases, Contribution of Robert Koch and his postulates and Edward Jenner. Non specific defense mechanisms- general factors- physical, mechanical and chemical barriers.

Unit – II Bacterial disease**12 Hrs**

Morphology, Culture, biochemical, pathogenicity, Lab diagnosis and prevention of bacterial diseases – *Staphylococcus aureus*, *Streptococcus pyogenes*, *Salmonella typhi*, *Vibrio cholera* and *Escherichia coli*.

Unit – III Fungal disease**12 Hrs**

Superficial Mycosis – black and white piedra, Cutaneous mycosis – Trichophyton, Subcutaneous mycosis – sporothrix, Systemic mycosis – Histoplasmosis, Opportunistic mycosis-Aspergillosis, Candidiasis.

Unit – IV Parasitology**12 Hrs**

Life cycle of *Entamoeba histolytica*, *Giardia intestinalis*, *Plasmodium vivax*, *Toxoplasma gondii*, & *Wuchereria bancrofti*.

Unit - V Viral Disease**12 Hrs**

DNA viruses – Pox, Adeno, Herpes, Hepatitis. RNA viruses – Picorna, Rhabdo, Retero, Orthomyxo .

Text Book

1. Ananthanarayan R & Jayaram Paniker CK (2005). Text Book of Microbiology. 7th Edition, Orient Longman Private Limited.

Reference Books

1. Baron EJ, Peterson LR and Finegold SM (1994). Bailey and Scott's – Diagnostic Microbiology. 9th Edition, Mosby Publications.
2. Morag C 7 MC Timbury (1994). Medical virology. 10th Edition, Churchill Livingstone, London.
3. Patric R Murray (1990). Medical Microbiology. Mosby Publications.
4. Satish Gupte (2006). The Short Text books of Medical Microbiology. 9th Edition, Jaype Brothers, Medical Publishers (P) Ltd., New Delhi.
5. Chakraborty P. (1995). A Text Book of Microbiology, New Central Book Agency (P) Ltd., Kolkata.
6. Rajan, S. (2009). Medical Microbiology, MJP Publishers, Chennai.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---|---|---|----|----|-----|
| 17U4LMP4 | LAB IN GENETIC ENGINEERING AND FISHERIES TECHNOLOGY | 3 | 3 | 50 | 50 | 100 |

1. Extraction of genomic DNA from Bacterial Cells
2. Extraction of Plasmid DNA from Bacterial Cells
3. Agarose gel electrophoresis
4. Quantification of nucleic acid
5. Restriction Digestion
6. Ligation
7. Competent cell preparation & Transformation
8. Selection of recombinants – Blue White Colony Selection
9. SDS – PAGE
10. Determination of pH in water samples.
11. Estimation of salinity
12. Estimation of dissolved oxygen.
13. Visit to a fish farm and tissue culture lab

Spotter - Placoid scales, stenoid scales, cycloid scales, channa, Penaeus, Crossostrea , raft culture, Pinctada, argulus, lernaea,artemia,diatoms, Gears and Crafts, solar dryers

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|--|---|---|----|----|-----|
| 17U4LMP4 | LAB IN ENVIRONMENTAL BIOTECHNOLOGY AND MEDICAL BIOTECHNOLOGY | 3 | 3 | 50 | 50 | 100 |

1. Estimation of chloride in water
2. Estimation of nitrates in drinking water
3. Estimation of biological oxygen demand
4. Identification and enumeration of coliform bacteria
5. Isolation of xenobiotic degrading bacteria
6. Isolation of lipase producing bacteria
7. Isolation of cyanobacteria
8. ELISA
9. Separation of serum and plasma
10. Isolation of lymphocytes
11. Immunoelectrophoresis

Spotters – Activated sludge, Vermicomposting, Azolla, Trichoderma, Karyotyping, Syndromes, Diseases - Cystic fibrosis, sickle cell Anemia, Duchenne’s muscular dystrophy, DNA fingerprinting, RFLP, SNP

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|-----------------------|----------|----------|----------|----------|----------|
| 17U6RAP2 | Anc. Microbiology Lab | 1 | 2 | 50 | 50 | 100 |

1. Study of morphology of cyanobacteria.
2. Enumeration of bacteria from soil.
3. Standard plate count technique (SPC)
4. Methylene Blue Reductase Test
5. Resazurin dye reduction test
6. Isolation and identification of pathogenic bacteria from clinical specimens using selection plate methods
7. Isolation & identification of UTI infection
8. Kirby – Bauer disc diffusion technique.

**Ancillary Papers for B.Sc.,
Microbiology**

(2017 RCZ batch)

| SEM | Sub Code | Title of the paper | H | C |
|------------|-----------------|---|----------|----------|
| III | 17U3ZAC1 | Essentials of Invertebrates and Chordates | 2 | 1 |
| | | Anc Zoology Practicals -I | 2 | * |
| IV | 17U4ZAC2 | Applied Zoology | 4 | 2 |

| | | | | |
|----|----------|---|---|---|
| | 17U4ZAP1 | Lab for III & IV Semester ancillary Paper | 2 | 2 |
| V | 17U5ZAC3 | Fundamentals of Physiology and Microbiology | 2 | 2 |
| | 17U5ZSA1 | Sericulture and Moriculture | 2 | 1 |
| | | Anc Zoology Practicals -II | 2 | * |
| VI | 17U6ZAC4 | Molecular Biology, Biotechnology & Immunology | 4 | 2 |
| | 17U6ZAP2 | Lab for V and VI semester Ancillary papers | 2 | 2 |

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---|---|---|----|----|-----|
| 17U3ZAC1 | ESSENTIALS OF INVERTEBRATES & CHORDATES | 1 | 2 | 25 | 75 | 100 |

UNIT - I

Parasitic protozoa (Life history of Plasmodium in detail), Organization of Polyp and Medusa, Parasitic adaptations -Tapeworm and *Ascaris*.

UNIT - II

Mouth parts in insects, Metamorphosis in insects, Respiration in arthropods, Water vascular system in starfish.

UNIT - III

Migration in fishes, Developmental stages of Frog. Parental care in amphibians, Golden age of reptiles

UNIT - IV

Identification of poisonous and non-poisonous snakes, Poisonous snakes of South India, Flight Adaptation in birds, Migration in birds.

UNIT-V

Adaptive radiation in mammals, Exoskeleton in fishes, birds and mammals, Marsupials.

Text books

1. Nair, N.C., S. Leelavathy, N. Soundarapandian, T. Murugan, and N. Arumugam. 2006. A text book of Invertebrates, Saras Publication,
2. Thangamani, A., S. Prasanakumar, L.M. Narayanan and N. Arumugam. 2005. A text book of Chordates. Saras publication, Nagercoil.

Reference books

1. Kotpal, R.L. 2012. Modern Text Book of Zoology Invertebrates, Rastogi Publications, Meerut.
2. Parker & Hashwell, Textbook of Zoology Vol. I (Invertebrates) A.Z.T.B.S. Publishers & Distributors, New Delhi.
3. Jordan, E.L. and P.S.Verma. 2013. Invertebrate Zoology, S. Chand & Co.
4. Hickman C. P. Jr., Hickman & L.S. Roberts. Integrated principles of zoology, Mosby college publication. St. Louis.
5. Iyer, E.K., And T.N. Ananthkrishnan, Manual of zoology Vol. I, Invertebrata, Part I and II S.Viswanathan (Printers and Publishers)
6. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGrawHill Higher Education.
7. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
8. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.
9. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers, Inc.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-----------------|---|---|----|----|-----|
| 17U4ZAC2 | Applied Zoology | 4 | 2 | 25 | 75 | 100 |

UNIT-I

AQUACULTURE: Definition, Scope-Aquaculture in India - Culturable organisms: Fin fishes, Shell fishes, Feed organisms, Algae, Daphnia and Seaweeds - Integrated fish farming: Paddy cum fish culture, Poultry cum fish culture.

UNIT – II

Culture of Indian major carps: seed collection, culture practices, feeding, pond fertilization, weed, predator control - Culture of marine prawn: seed collection, culture method (Pokkali, pond, pen, cage culture), harvesting, Preservation - Oyster farming: biology, pearl formation, farming operation (spat collection, culture methods (on bottom, off bottom), harvesting, cleaning, preservation) - Sea weed culture – uses, culture methods (pond culture, field culture),

UNIT – III

APICULTURE: Definition, Scope - Bee colony - Types of honey bees - Bee keeping (primitive hives and modern hives) - Bee keeping equipments - Honey: Chemical composition, Nutritional and Medicinal values – Bee wax - bee venom.

UNIT –IV

DAIRY FARMING: Definition, Scope - Livestock in India - Dairy animals: Gir, Red sindhi, Jersey, Buffaloes, Goat - Management of model dairy farm - Livestock diseases: Foot and mouth diseases, Rinder pest. - Nutritive value of milk - Milk products- Powdered milk, Processed cheese, Ice cream, Ghee

UNIT -V

POULTRY: Definition, scope - Nutritive value of eggs - Commercial layers – Sexing (vent, colour and Feather sexing) - Poultry house: Types, construction of poultry house - Deep litter system – Feeder - Cage system - Layer rearing (Chick, Growers, Layers) - Poultry diseases: Ranikhet, Fowlfox and polyneuritis.

TEXT BOOKS

1. Ahsan, J. and Sinha, S.P. 2009. A Handbook on Economic Zoology. S. Chand & Company Ltd., New Delhi.
2. Tomar, B.S. and Singh, N. 2011. Economic Zoology. Emkay Publications. New Delhi.

REFERENCE BOOKS

1. Shukla, G.S. and V.B. Upahyay. 2011. Economic Zoology. Rastogi Publications. Meerut.

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|------------------|---|---|----|----|-----|
| 17U4ZAP1 | Anc. Zoology Lab | 2 | 2 | 50 | 50 | 100 |

Earthworm body setae

Mouth parts of Cockroach, Honeybee and housefly

Cockroach salivary glands

Frog- brain, Fifth cranial nerve, urinogential system and Osteology

Trypanosoma, *Obelia*, Ephyra larva, *Taenia*, *Ascaris Lumbricoides*, *Dracunculus medinensis*, Hirudo, Appendages of Prawn, Asterias, Trochophore larva, Nauplius, Bipinaria, Amphioxus, Placoid scales, feather of birds, Axolotle larva, Poisonous snakes of South India, Glachodium

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
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|-------------|--------------|---|---|---|---|---|

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|----------|---|---|---|----|----|-----|
| 17U5ZAC3 | Fundamentals of Physiology and Microbiology | 2 | 2 | 25 | 75 | 100 |
|----------|---|---|---|----|----|-----|

Unit-I

Digestive system of man: structure of alimentary canal, digestive glands (secretion and its functions only). Respiratory system in man: structure of lungs, O₂ and Co₂ transport.

Unit-II

Nervous system of man: structure of neuron, conduction of nerve impulse through myelinated and non-myelinated nerve. Excretory system: structure of kidney, nephrons and formation of urine.

Unit-III

Reproductive system of man: structure of male and female reproductive system. Menstrual cycle, oestrogen, androgen, prolactin, relaxin and birth control methods

Unit-IV

Microbiology: Five kingdom concept. Sterilization and disinfection, autoclave, laminar air flow and hot air oven. Culture medium (Solid and Liquid) and its composition, types of culture medium, bacterial growth, growth rate, growth curve. Preservation and pasteurization of milk.

Unit-V

Microbial diseases: Cholera, tuberculosis, botulism, rabies and AIDS-causative organism, pathogenicity, mode of transmission, symptoms and preventive measures.

Textbooks

1. Rastogi SC. 2007. Essentials of Animal Physiology. New Age International
2. Baveja CP. 2017. Textbook of Microbiology. Arya Publications.

Reference Books

1. Hill RW, Wyse GA and Anderson M. 2012. Animal Physiology. Sinauer Publications.
2. Surinder Kumar. 2012. Textbook of Microbiology. Jaypee Brothers medical Publishers

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|-----------------------------|---|---|----|----|-----|
| 17U5ZSA1 | Sericulture and Moriculture | 1 | 2 | 25 | 75 | 100 |

Unit-I

Sericulture: importance, sericulture industry in India and services of Central Silk Board

Unit-II

Moriculture; varieties of mulberry, optimum conditions for mulberry cultivation. Different methods of propagation-seedling, vegetative propagation (cutting, grafting and layering). Harvesting methods and preservation of leaves.

Unit-III

Lifecycle of mulberry silkworm, *Bombyx mori*, Brief account on Eri, Tasar and Muga silkworms.

Unit-IV

Rearing of silkworm: rearing house and rearing appliances. Silk reeling. Testing of raw silk-visual and mechanical tests.

Unit-V

Silkworm disease: causes and prevention of pebrine, Flacheric septicaemia, muscardine and grasserie.

Text books

1. Johnson M and Kesary M. 2008. Sericulture. 4th edition
2. Ganga G and Sulochanachetty J. 2000. An Introduction to Sericulture. Oxford & IBH

Reference Books

1. Ravindranathan KR. 2003. Economic Zoology. Dominant Publishers and distributors
2. Venkatanarasaiah P. 2013. Sericulture. APH Publishing Corporation

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|-------------|---|---|---|----|----|-----|
| 17U6ZAC4 | Molecular Biology, Biotechnology & Immunology | 2 | 4 | 25 | 75 | 100 |

Unit-I

Molecular Biology: Nucleic acids: molecular structure of DNA and RNA, Types of RNA, DNA replication, protein synthesis. Fine structure of gene: Cistron, recon, muton, lac Operon, genetic code, mutation-molecular basis of mutation, gene mutation, chromosomal aberrations, mutagens.

Unit-II

Biotechnology: transgenic animals (Dolly and transgenic fish), hybridoma technology (Mab production). Gene cloning – vectors (pBR322 to phage).

Unit-III

Biofertilizers (Rhizobium and Azospirillum), Biopesticides (Bt toxin). Biosensors – structure and application. Application of genetically engineered bacteria – superbug, role of *Thiooillus thiooxidants* on ore leaching.

Unit-IV

Immunology: Types of Immunity – natural and acquired, active and passive, antigen-antibody reaction (Precipitation and agglutination).

Unit-V

Lymphoid organs – primary and secondary lymphocytes. Stem, T and B cells, Macrophages. Immunoglobulins – structure and functions.

Text books

1. Gupta PK. 2011. Molecular Biology and Genetic Engineering. Rastogi Publications
2. Satyanarayana U. 2007. Biotechnology. Allied Books
3. Benjamin et al., 2004. Immunology. 4th edition. John Wiley & sons.

Reference Books

1. Burton ET.2012. Principles of Molecular Biology. Jones & Bartlett learning.
2. Kuby J. 1997. Immunology. WH Freeman & Company. NY.
3. Dubey RC.2005. A textbook of Biotechnology. S Chand

| COURSE CODE | COURSE TITLE | C | H | I | E | T |
|--------------------|---------------------|----------|----------|----------|----------|----------|
| 17U4ZAP2 | Anc. Zoology Lab | 2 | 2 | 25 | 75 | 100 |

1. Estimation of oxygen consumption of fish with reference to body weight
2. Estimation of oxygen consumption of fish with reference to temperature
3. Estimation of O₂ in water sample
4. Estimation of CO₂ in water sample
5. Isolation of DNA (Demo)
6. Isolation of RNA (Demo)
7. Lymphoid organs in chick (Demo)
8. Blood Grouping-man
9. Simple staining and gram staining
10. Hanging drop method

Spotters: Sphygmomanometer, Kymograph, Warburg respirometer, DNA, RNA and its types, Double Immunodiffusion, Antibody structure, gene cloning, DPT vaccines, Ecological pyramids, Alpha, Beta & Gamma Diversity, Red data book, National parks, Green House effect

