DEPARTMENT OF PHYSICS				*CLASS: I M.Sc. Physics*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
II	Major Elective-3	21P2PME3	Instrumentation And Methods	4	5	25	75	100

Nature of Course				
Knowledge and skill			Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	

Objectives:

- To impart aspects of basic concepts of instrumentation to the students.
- To enhance comprehension capabilities of students through understanding of electronic transducers.
- To Study analytical techniques and to characterize the samples.

Unit	Description	Hours	K-level	CLO
I	**Static performance characteristics of instruments:** Introduction – Errors and uncertaininties in performance parameters - Types of errors - Static Performance Parameters – Accuracy, Precision, Resolution, Threshold, Static Sensitivity – Linearity, Range – Hysteresis – Dead Band – Backlash – Drift - Impedance loading and Matching. **Self study:** Types of uncertainities	15	Up to K4	1
II	**Dynamic characteristics of Instruments:** Dynamic Response of systems - Periodic Input - Harmonic Signal - First order system to sinusoidal input – Second order system to sinusoidal input – Periodic input – Non harmonic signal – Response of instrument systems to step input and transient input – Compensation Techniques for improving dynamic response - First order system compensation – Second order system compensation. **Self study:** Fourier transform method	15	Up to K4	2
III	**Transducer –I :** Analog transducers - Electrochemical type – Potentiometric Resistive type – Inductive type – Self generating type - Non – self generating types - Capacitive type – Piezo-Electric transducers – Digital transducers: Frequency Domain - Electromagnetic Frequency Domain – Opto-Electrical Frequency Domain. **Self study:** Opto-electrical Transducer.	15	Up to K4	3

IV	**Transducer –II :** Moderate Pressure measurements - Manometers - Elastic Transducers – High Pressure measurement – Temperature measurements - Non-Electrical Methods – Bimetallic Thermometer – Liquid in Glass Thermometer – Pressure Thermometers – Electrical Methods of temperature measurement - Electrical Resistance Thermometers - Flow Measurement - primary or Quantity Meters – Positive Displacement Meters- Nutating Disc Meter – Sliding Vane Type . **Self study:** Lobed impeller meter.	15	Up to K4	4
V	**Thermal methods :** Introduction – Thermo gravimetry (TG) – Recording of results – Information from a TG curve – Factors affecting TG curves – Instrumental factors, sample characteristics – Instruments for TG – Applications of TG. Differential Thermal Analysis(DTA) - Introduction – Factors affecting the DTA curve – Instrumentation for DTA . **Self study:** Applications of DTA.	15	Up to K3	5

Books For Study:

1. Instrumentation Measurement and Analysis – B.C. Nakra & K.K. Chaudhry TMH New Delhi, Fourth Edition, 2017.
   Unit I : 2, 2.1, 2.1.1, 2.3, 2.3.1 - 2.3.11, 2.4.
   Unit II : 3, 3.3, 3.3.1, 3.4.1, 3.5, 3.7, 3.7.1, 3.7.2
   Unit III : 4, 4.1, 4.1.1, 4.2, 4.3, 4.4, 4.5, 4.9, 4.9.1, 4.9.2.
   Unit IV : 11.1, 11.1.1, 11.1.2, 11.2, 12, 12.1, 12.3, 12.4, 12.4.1, 12.4.2, 12.4.3, 12.5, 12.5.1, 13, 13.1, 13.2, 13.2.1, 13.2.2.

2. Instrumental methods of Chemical analysis, Gurdeep R.Chatwal and Sham K.Anand, Himalaya Publishing House Pvt, LTD.,Fifth revised edition 2012. 2003.
   Unit V: 41.1, 41.2, 41.3 (I), 41.3(III,IV).

Books For Reference:

1. Measurement System – E.D.Doebelin Mc-Graw Hill. (1990)
2. Principles of Industrial Instrumentation – Patranbis .D, TMH New Delhi, 1976.
3. C.S. Rangan, G.R. Sharma and V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw-Hill (1983).
4. H.H. Willard, L.L. Merrit and John A. Dean, Instrumental Methods of Analysis, 6th edition, CBS Publishers & Distributors (1986).
5. D.V.S. Murty, Transducers and Instrumentation, Prentice – Hall of India (P) Ltd., New Delhi (1995).

Web Resources :

1. **https://www.electronicdesign.com/technologies/communications/article/21796367/back-to-basics-impedance-matching-part-1**
2. **https://www3.nd.edu/~pdunn/www.text/ECdynsys.pdf**
3. **https://www.electrical4u.com/piezoelectric-transducer/**
4. **https://www.americanpiezo.com/piezo-theory/whats-a-transducer.html**
5. **https://www.britannica.com/technology/electrical-resistance-thermometer**
6. **https://circuitglobe.com/resistance-thermometer.html**
7. **https://www.sciencedirect.com/topics/materials-science/thermogravimetric-analysis**
8. **https://www.iitk.ac.in/che/pdf/resources/TGA-DSC-reading-material.pdf**
9. **https://www.hitachihightech.com/global/products/science/tech/ana/thermal/descriptions/dta.html**

Rationale for Nature of the course

Students can pursue career in Electronic industry, Instrumentation centres and Electrical and Mechanical Industry.

Activities having direct bearing on Skill development/ Employability/Entrepreneurship

Students will be trained in experiments involving Transducers (Electromechanical ,Thermo-electrical, Piezo electrical).

Students will study dynamic characteristics and performance characteristics of measuring device and will determine their operational range.

Course Designers:

1. Prof. V.Meenakshi Sundaram
2. Dr. M.Revathi

Lecture Schedule

Unit	Topics	Hrs	Mode
Unit I	Introduction, Errors and uncertaininties in performance parameters	**3**	Chalk and talk, Quiz and assignment
	Types of errors , Static Performance Parameters	**3**	
	Accuracy, Precision, Resolution, Threshold, Static Sensitivity	**3**	
	Linearity, Range, Hysteresis, Dead Band	**3**	
	Backlash ,Drift, Impedance loading and Matching.	**3**	
Unit II	Dynamic Response of systems	**2**	Chalk and talk, Quiz and assignment
	Periodic Input , Harmonic Signal , First order system to sinusoidal input	**3**	
	Second order system to sinusoidal input	**2**	
	Periodic input , Non harmonic signal	**2**	
	Response of instrument systems to step input and transient input	**3**	
	Compensation Techniques for improving dynamic response ,First order system compensation ,Second order system compensation.	**3**	
Unit III	Analog transducers , Electrochemical type	**2**	PPT, Chalk and talk, Quiz, assignment and seminar
	Potentiometric Resistive type, Inductive type	**3**	
	Self generating types , Non – se;f generating types	**3**	
	Capacitive type , Piezo-Electric transducers	**3**	
	Digital transducers, Frequency Domain	**2**	
	Electromagnetic Frequency Domain, Opto-Electrical Frequency Domain.	**2**	
Unit IV	Moderate Pressure measurements , Manometers	**2**	PPT, Chalk and talk, quiz, Group discussion
	Elastic Transducers, High Pressure measurement	**2**	
	Temperature measurements , Non-Electrical Methods , Bimetallic Thermometer	**2**	
	Liquid in Glass Thermometer , Pressure Thermometers	**2**	
	Electrical Methods of temperature measurement - Electrical Resistance Thermometers	**2**	
	Flow Measurement - primary or Quantity Meters	**2**	
	Positive Displacement Meters, Nutating Disc Meter , Sliding Vane Type	**3**	
Unit V	Introduction ,Thermo gravimetry (TG) ,Recording of results , Information from a TG curve	**3**	PPT, Chalk and talk, Quiz and Interaction
	Factors affecting TG curves , Instrumental factors, sample characteristics	**3**	
	Instruments for TG – Applications of TG	**3**	
	Differential Thermal Analysis(DTA) ,Introduction, Factors affecting the DTA curve	**3**	
	Instrumentation for DTA, Applications	**3**	

Pedagogy : Chalk and talk , materials, PPT, Quiz , Assignment , Seminar , Problem solving , Group discussion , interaction and field visit.

Course Learning Outcomes: On the successful completion of the course, students will be able to

CLOs	Course Learning Outcomes	Knowledge Level
CLO 1	Illustrate the static characteristics of instruments as well as integrate the statistical error analysis of output results.	Up to K4
CLO 2	Analyze the dynamic performance characteristics and formulate the governing equations of various instruments for improving dynamic response of systems.	Up to K4
CLO 3	Focus the complete knowledge of various transducers operation and correlate the applications of modern industrial transducers	Up to K4
CLO 4	Inspect different measuring techniques in transducers to measure physical quantities in the field of science and technology	Up to K4
CLO 5	Apply the principles of thermal analysis method and examine the thermal characterization of materials	Up to K3

Mapping of CLOs with PSOs

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

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

Learning Outcome Based Education (LOBE) & Assessment
Summative Examination – Blue Print
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 K4	2	K1 & K1	1	K1	2 (K4&K4)	1 (K4)
2	CLO 2	Up to K4	2	K2 & K3	1	K1	2 (K4&K4)	1 (K4)
3	CLO 3	Up to K4	2	K2 & K3	1	K2	2 (K1&K1)	1 (K2)
4	CLO 4	Up to K4	2	K3 & K4	1	K2	2 (K3&K3)	1 (K3)
5	CLO 5	Up to K3	2	K3 & K4	1	K3	2 (K2&K2)	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
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