FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Technology

Semester II

Course Code: 102450207

Course Title: INSTRUMENTATION FOR ENERGY SYSTEMS

Type of Course: Program Elective IV

Course Objectives: To familiarize the working principles of measuring instruments and facilitate performing error analysis.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	30/15	20/10	70/35	30/15	150/75

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	INSTRUMENTATION SYSTEM AND ELECTRICAL ENERGY MEASUREMENT: Measurement terminologies, precision, range, accuracy, span, linearity, sensitivity, resolution, random errors, systematic errors, relative and absolute errors, uncertainty analysis of single and multiple measurements – calibration of instruments – range –resolution – span – linearity, sensitivity- signal conditioning system; Electrical Energy Measurement: Power factor, load factor, harmonic analyzer, lighting and lamination measurement, digital data processing and data acquisition system.	10
2	TEMPERATURE AND PRESSURE MEASUREMENT: Working principle of various temperature devices, thermocouples, thermistor, RTD, measurement analysis, infrared camera; Working principle of pressure transducers and laser induced fluorescence (LIF), quantification, basics of algorithm used for quantification- calibration of Pressure measuring equipment, principles and operation of various vacuum pumps and gauges.	11
3	FLOW MEASUREMENT: Variable head flow meters- rota meters-working principle of hot wire/film anemometry and particle image velocimetry, quantification, electromagnetic flow meters, ultrasonic flow meters.	8

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4	AIR POLLUTION AND ENERGY MEASUREMENTS: Particulate sampling techniques, SO2, Combustion Products, opacity, odour measurements - Measurement of liquid level, Humidity, O2, CO2 in flue gases- pH measurement, moisture analyzer.	**10**

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
20	20	20	15	15	10	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1	A Course in Mechanical Measurements and Instrumentation,Sawhney A K and Puneet Sawhney, DhanpatRai and Co.
2	Measurement Systems - Application and Design Doebelin EO, McGraw-Hill.
3	Instrumentation Devices and Systems, Rangan C S, Sharma G R and Mani V S V Tata McGraw-Hill.
4	Experimental methods for engineers, Holman JP, McGraw-Hill.
5	Mechanical Measurements, Bechwith, Marangoni and Lienhard, Addison-Wesley.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Analyze the error components in the measuring instruments for given conditions and perform electrical measurements.	**35 %**
CO-2	Select appropriate method of measurement of temperature and pressure for a given application and estimate the error	**35 %**
CO-3	Select appropriate method of measurement of flow for a given application and estimate the error.	**30 %**

List of Practicals / Tutorials:

1	Study of measurement terminologies
2	Study of uncertainty analysis of single and multiple measurements
3	Study of Electrical Energy Measurement
4	Study of Working principle of various temperature devices, thermocouples, thermistor, RTD
5	Study of Working principle of pressure transducers and laser induced fluorescence (LIF)
6	Study of principles and operation of various vacuum pumps and gauges
7	Study of Variable head flow meters
8	Study of ultrasonic flow meters
9	Study of Particulate sampling techniques
10	Study of measurement of O2, CO2 in flue gases

Supplementary learning Material:

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Curriculum Revision:	
Version:	**1**
Drafted on (Month-Year):	Apr-20
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Next Review on (Month-Year):	Apr-22

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