

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
INSTRUCTION DIVISION
FIRST SEMESTER 2015-16
Course Handout Part II

Date: 03/08/2015

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No. : **INSTR C381**
Course Title : **Transducers And Measurement Systems**
Instructor-in-charge : SUREKHA BHANOT
Tutorial instructors : 1. Mr. Parikshit Singh 2. K Babu Ravi teja

1. COURSE DESCRIPTION:

INSTR C381 TRANSDUCERS AND MEASUREMENT SYSTEMS

3 1 3

Importance and types of measurement, generalized measurement system, functional elements, static & dynamic characteristics, primary sensing elements, modulating transducers, self generating transducers, inverse transducers, fiber optic transducers, MEMS based transducers, measurement techniques for motion, seismic, pressure, flow, temperature, level, humidity, pH, viscosity; signal conditioning techniques using bridge, op-amp, instrumentation amplifier, carrier, chopper, charge, isolation amplifier, data converters, filters, modulators; data acquisition systems.

2. SCOPE AND OBJECTIVE:

The objective of this course is to have a detailed study of measurement systems and to understand their application in the areas of monitoring, control and experimental engineering analysis.

3. TEXT BOOK:

T1 : Theory & Applications of Measurement Science, Surekha Bhanot, EDD Notes, Volume 1 & 2

4. REFERENCE BOOKS:

R1 : Doebelin E.O., Dhanesh Manik "Measurement Systems: Application and Design, McGraw-Hill, 2007

R2: Murthy, D.V.S. Transducers and Instrumentation, PHI, I ed., 1995.

R3: Jones, B.E. "Instrumentation, Measurement and feedback", TMH, 1978.

R4: Sawhney, A.K., Electrical & Electronics Measurement and Instrumentation, Dhanpat Rai&Co

R5 : Richard S Figliola & Donald E Beasley, Theory and Design for mechanical measurements, John Wiley & Sons

COURSE PLAN:

Lecture No.	Learning Objectives	Topics to be covered	Reference to book chapter
1	To understand the basic concept and role of Instrumentation	Definition of Measurement, types of application of instruments	T1(chap 1) R1(chap1)
2,3	To identify functional elements of an instrument, modes of an instrument	Functional elements of generalized measurement system, Active / Passive transducers, Analog / Digital mode of operation , Null and Deflection methods.	T1(Chap 2) R1(chap2)
4,5	To identify the desired, interfering and modifying inputs and methods of correction	Input output configuration of measurement system, Methods of correction of modifying and interfering inputs	T1(Chap 2) R1(chap 2)
6,7	To study static performance characteristics , statistical analysis of random errors	Calibration, Precision, Accuracy, Threshold, Resolution, Hysteresis, Linearity, Sensitivity, Drift, Span, Range, Normal distribution curve, Probable error	T1(Chap 3) R1(chap 3) R2(1.5.1) R3(1.4-1.5)
8,9	To study dynamic performance characteristics	Types of excitation inputs; step, ramp and frequency response of First and Second order systems	T1(Chap 3) R1(chap 3)
10,11	To learn about Resistive Transducers	Resistive potentiometer, strain gauges	T1(Chap 4) R1(4.3.2, 4.3.3)
12	To learn about Inductive transducers	LVDT, Synchros, Variable reluctance, eddy current	T1(Chap 5) R1(4.3.4, 4.3.5.4.3.6)
13, 14	To learn about Capacitive, Piezoelectric and Hall transducers	Capacitance pick ups, Piezoelectric & Hall effect transducers	T1(Chap 6,7) R1(4.3.4, 4.3.5.4.3.6)
15	To learn about Photoelectric Transducers	Photoemissive, Photoconductive, Photovoltaic, Phototransistor	T1 (Chap 8) R2 (7.6)
16	To learn about Fiber Optic Transducers	Methods and applications of fiber optics	T1 (Chap 8)
17	To learn about Feedback Transducer Systems	Inverse transducers, Force, Torque, Current, Temperature balance systems etc	T1(Chap 9) R3(9.1-9.8)
18	To learn about MEMS based Sensors	MEMS technology, MEMS based sensors	T1(Chap 10)
19,20	To learn about bridge circuits, Op-amps, IAs	Bridge circuits, op-amps, Instrumentation amplifiers	T1(Chap 11 & 12) R1(9.1, 9.2)

21	To learn about various types of amplifiers	Chopper amplifier, carrier amplifiers, isolation amplifier , charge amplifier	T1(Chap 12) R1(9.2)
22	To learn about Filters, Modulators	Analog Filters, Digital Filters, Amplitude modulation/demodulation	T1(Chap 13) R1(9.3)
23	To learn about Data converters	Different types of A/D and D/A converters	T1(Chap 14) R3(5.5)
24	To learn methods of measuring translational and rotational velocity	Moving coil moving magnet pickups, Eddy – current magnetic and photoelectric pulse counting, encoders	T1(Chap 15)
25,26	To learn methods of Force, Torque, shaft power measurement and use of elastic elements	Elastic elements (Bourdon tube, Bellows, Diaphragm), Strain gages, Torsion bar, Dynamometers	T1(Chap 16) R1(Chap 5)
27	To learn about seismic and acoustic measurements	Seismic displacement, velocity and acceleration pickups, sound measurement	T1(Chap 17) R1(6.9)
28	To learn fundamentals of pressure measurement, calibration	Units of pressure, Dead weight gages, manometers, elastic elements	T1(Chap 18) R1(6.2,6.3,6.4)
29	To learn techniques of high and low pressure measurement	Bridgman, Mcleod, Thermal conductivity, Ionization Gauge	T1(Chap 18) R1(6.7, 6.8)
30	To learn importance and techniques of flow measurement	Obstruction meters, Rotameters, Pitot static tube	T1(Chap 19) R1(7.2)
31,32	To learn techniques of flow measurement	Turbine meters, electromagnetic flow meters, ultrasonic flow meters, vortex shedding, laser Doppler velocity meter	T1(Chap 19) R1(7.2)
33	To learn techniques of flow measurement	Hot wire anemometer, mass flow meter, positive displacement meter	T1(Chap 19) R1(7.2)
34	To learn conventional techniques of temperature measurement	Thermal expansion methods – Bimetallic, Liquid in glass, pressure thermometer	T1(Chap 20)
35, 36	To learn techniques of temperature measurement using devices having electrical output	Thermocouples, RTDs, Thermistors, Semiconductor sensors	T1(Chap 20) R1(Chap 8)
37	To learn techniques of temperature measurement using Radiation methods	Radiation fundamentals, Radiation detectors, Unchopped and chopped broadband radiation thermometers	T1Chap 20) R1(Chap 8)
38	To learn methods of Level measurement	Direct and indirect methods, ultrasonic, radar, microwave;	T1(Chap 21)
39	To learn techniques of viscosity, density pH, humidity	Hydrometer, air bubbler, weighing system, electrode element hygrometers, wet and dry psychrometers	T1(Chap 22) R2(5.5)
40, 41	To learn about components of DAS	Data Loggers, elements of DAS	T1(Chap 23)

3 EVALUATION SCHEME:

Component	Duration	Weightage	Date & Time	Remarks
Mid Sem Test	90 min.	90 Marks	6/10 8:00 - 9:30 AM	50(CB)+40(OB)
Quizzes		50 Marks		CB+OB
Assignments*		40 Marks		
Compre. Exam.	3 hrs.	120 Marks	3/12 FN	CB(60)+OB(60)

* to be announced in the class.

5. CHAMBER CONSULTATION HOUR: To be announced in the class.

6. NOTICES: Instrumentation Notice Board

9. Makeup Policy:

Make-up will not be granted for any of the evaluation components without prior permission of the instructor-in-charge and on extremely genuine grounds.

Instructor-in-charge

INSTR C381