Birla Institute of Technology & Science, Pilani
Hyderabad Campus

~~BITS Pilani, Hyderabad Campus~~
FIRST SEMESTER ~~2017~~2019-~~2018~~2020~~:~~
Course Handout Part II
~~Date: 20 July 2018~~2019~~01~~-08-2019

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 F312
Course Title : TRANSDUCERS AND MEASUREMENT SYSTEMS
Credits : 3
Instructor-in-charge : R. N. Ponnalagu
~~Schedule : Mon, Wed, Fri 3.00 to 3.50 pm~~
~~Tutorial : Mon 8.00 to 8.50 am~~
~~Classroom : I 114~~

COURSE DESCRIPTION:

This course deals with importance and types of transducers used in instrumentation and measurement. Different types of passive and active transducers. Generalized measurement system, functional elements, static & dynamic performance characteristics and error analysis. Measurement techniques for Velocity, Temperature, Pressure, Flow, Motion, Seismic, Level, Humidity, pH, Viscosity etc. Interfacing transducers with instrumentation systems.

SCOPE AND OBJECTIVE OF THE COURSE:

The objective of the course is to impart knowledge on the various types of sensors and transducers, their measurement techniques and applications instrumentation systems. The course also introduces basics of LabVIEW programming.

COURSE OUTCOMES

After learning the course, students will be able to

- Use the concepts in common methods for converting a physical parameter into an electrical quantity
- Select a suitable sensor/transducer for a given application/specification.
- Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers
- Design a real-life instrumentation system.

~~1. COURSE DESCRIPTION:~~

~~Importance and types of transducers used in instrumentation and measurement. Different types of passive and active transducers. Generalized measurement system, functional elements,~~

~~static and dynamic performance characteristics and error analysis. Measurement techniques for Temperature, Pressure, Flow, Force, Torque, Level, Motion, Velocity, Humidity, pH, Viscosity etc. Interfacing transducers with instrumentation systems.~~

~~[1.] SCOPE AND OBJECTIVE:~~

~~To understand the concept and importance of various sensors and transducers in measurement and instrumentation systems. The end result of this course is to make the student capable of select suitable transducer, design and develop instrumentation systems.~~

[2.] TEXT BOOK (T):

Title	Author	Edition	Publisher	Library #	ISBN
Introduction to Measurements and Instrumentation	Arun N Ghosh	4th 2012	PHI	620.0028 GHO-A (3rd Edition)	9788120346253

2.[3.] REFERENCE BOOKS:

Title	Author	Edition	Publisher	Library #	ISBN
R1: Transducers and Instrumentation	DVS Murthy	2nd 2013	PHI	530.7 MUR-D	9788120335691
R2: Instrumentation Measurement and Analysis	Nakra and Chaudhry	4th 2017	McGraw Hill		9789385880629
R3: A Course in Electronic Measurements and Instrumentation	A K Sawhney	2015	Dhanpat Rai & Co	621.37 SAW-A	9788177001006
R4: Theory and Design for Mechanical Measurements	RS Figliola	3rd 2005	John Wiley & Sons	530.8 FIG-R	9788126516391
R5: Doebelin's Measurement Systems	E O Doeblin	6th	Tata McGraw Hill	681.2 DOE-E	9780070699687

COURSE PLAN

Lecture #	Topics to be covered	~~Brief~~Learning Objectives	Chapter in the Text Book~~Reference~~
1-~~3~~2	**Introduction to Transducers and measurement system**	**Definition, classification of transducers and generalized measurement system**	**T1 (5.1~~,~~- 5.3, 1.2)** **Class notes**
~~4~~3-6	**Study of performance characteristics and error analysis.**	**Calibration, Precision, Accuracy, Threshold, Resolution, Hysteresis, Linearity, Sensitivity, Drift, Span, Range, Mean, Deviation, Normal distribution curve, Probable errors.**	**Class notes**
7-~~8~~10	**Resistance type Transducers**	**Use of resistance type transducers for temperature, pressure, displacement, moisture and other measurements.**	**T1 (6.2**, 10.3**)** **R1 (6.1**.1-6.1.6**)**
~~9~~11-~~10~~12	**Inductive type Transducers**	**Different types of inductive type transducers and their use in thickness and displacement measurements.**	**T1 (6.2)** **R1 (6.2)** Class notes
1~~1~~3-15~~2~~	**Capacitive type Transducers**	**Use of capacitive type transducers for displacement, thickness and moisture measurements.**	**T1 (6.2)** **R1 (6.3)**
16~~3~~-~~14~~18	**Thermoelectric** and piezo electric **transducers**	**Thermocouple for temperature measurement** and Piezo electric transducers for mechanical measurements ~~.~~	**T1 (10.~~1~~4)** **R1 (7.1**, 7.2~~)~~**),** **R2 (12.5.2**, 4.5**)**
~~15-16~~	~~Piezoelectric transducers~~	~~Use of Piezoelectric transducers for mechanical measurements.~~	~~R1 (7.2)~~ ~~R2 (4.5)~~
~~17~~19-~~18~~21	**Magentostrictive** and hall effect **transducers**	**Use of Magentostrictive transducers for force and torque measurements** and applications of hall effect transducers	**T1 (6.5)** **R1 (7.3**, 7.4~~)~~**)**
~~19-20~~	~~Hall effect transducers~~	~~Use of Hall effect transducers for voltage and current measurements.~~	~~R1 (7.4)~~
21-~~2~~22	**Electro-mechanical transducers**	**Study of various types of Electro-mechanical transducers and their use.**	**T1 (9.5)** **R1 (7.5**.1, -7.5.2**)**
23-25~~4~~	**Photoelectric transducers**	**Study of various types of Photoelectric transducers and their use.**	**R1 (7.6)**
~~25~~26-~~26~~27	**Digital transducers** and Proximity sensors	**Study of encoders** and proximity sensors **and their use.**	**T1 (6.6**- 6.7**)** **R1 (7.8)** **R2 (4.9)**
2~~8~~7-~~29~~28	~~Motion~~ Acceleration **measurement**	**Study of absolute and relative displacement, velocity and acceleration.**	**R1 (6.1.3, 6.2.2, 6.3.2)** **R2 (7)**
~~29~~30-~~30~~31	**Force** and ~~,~~ **torque** ~~and~~ measurement ~~shaft power~~	~~Elastic elements (Bourdon tube, Bellows, Diaphragm),~~ **Strain gages,** load cell, **Torsion bar, Dynamometer** and ~~s.~~ **Inverse transducers**~~, Force,~~	**T1 (9)** **R1 (5.3, 5.4)**

		~~measurement~~	~~Torque, Current, Temperature balance systems.~~	
~~31~~32-~~32~~34		**Pressure measurement**	**Fundamentals of pressure measurement and** ~~calibration. To learn~~ **techniques of high and low pressure measurement.** Elastic elements (Bourdon tube, Bellows, Diaphragm), **Dead weight gages, manometers, elastic elements. Bridgman, McLeod, Thermal conductivity, Ionization Gauge.**	**T1 (8)** **R1 (5.2)**
~~33~~35-~~34~~36		**Flow measurement**	**Obstruction meters, Rota meters, Pitot static tube meters, Turbine meters, electromagnetic flow meters, ultrasonic flow meters, vortex shedding, laser Doppler velocity meter. Hot wire anemometer, mass flow meter, positive displacement meter.**	**T1 (11)** **R1 (5.8)**
~~35-36~~		~~Temperature measurement~~	~~Temperature measurement using conventional, Radiation methods, Thermal expansion methods.~~	~~T1 (10.1,10.2, 10.5, 10.6, 10.8)~~ ~~R1 (5.1)~~
37-38		**Level measurement**	**Direct and indirect methods, ultrasonic, radar, microwave**	**T1 (12)** **R1 (5.6)**
39-40		**Viscosity, density, pH, humidity measurement**	**Hydrometer, air bubbler, weighing system, electrode element hygrometers, wet and dry psychrometers.**	**T1 (13.1, 13.2, 13.5, 13.7)** **R1 (5.5, 5.7, 6.1.6, 6.3.3, 7.9.4)**
41-42		**Interfacing transducers with instrumentation systems.**	**Discussing various methods with examples.**	**Class notes**
Basics of LabVIEW programming				

3.[4.] EVALUATIONSCHEME:

Component	Duration	Weightage		Date & Time	Nature of Component ~~Remarks~~
		%	Marks		
Midsem	1h 30m	25	75	28/9, 11.00 -- 12.30 PMTo be announced10.10.2018 3.30 to 5.00 pm	CB
Comprehensive Exam	3 hours	40	120	0702.12.20182019 AN 2.00 to 5.00 pm	CB
Quiz (Announced/ surprise)	-	15	45	During Lecture / Tutorial	CB
Project	-	20	60	To be announced	OB
Total		**100**	**300**		

CB → Close book; OB → Open book

4.[5.] **CHAMBER CONSULTATION HOUR:** To be announced in classWednesday, 4 - 5 pm

5.[6.] **Makeup Policy:** Make-up only to those who apply before start of test Make-up will be given on **genuine** grounds only. Prior application should be made for seeking the make- up examination. No make-up will be given for the surprise quiz.

6.[7.] **NOTICES & OTHER INFORMATION:** Please refer course CMS page regularly.

7.[8.] Academic Honesty and Integrity Policy:

Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

R. N. Ponnalagu
Instructor-in-charge- INSTR F312