Ref No:

Sri Krishna Institute of Technology,
Bangalore

COURSE PLAN

Academic Year 2019-20

Program:	B E – Electrical & Electronics Engineering
Semester :	6
Course Code:	17EE662
Course Title:	Sensors and Transducers
Credit / L-T-P:	3 / 3-0-0
Total Contact Hours:	40
Course Plan Author:	Chaitra A S

Academic Evaluation and Monitoring Cell

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Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	EE
Semester:	6	Academic Year:	2019-20
Course Title:	Sensors and Transducers	Course Code:	17EE662
Credit / L-T-P:	3/ 3-0-0	SEE Duration:	180 Minutes
Total Contact Hours:	40 Hours	SEE Marks:	80 Marks
CIA Marks:	20 Marks	Assignment	1 / Module
Course Plan Author:	Chaitra A S	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : 80 %	SEE Target:	100.00%

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute.

Module	Content	Teaching Hours	Blooms Learning Levels
1	**Sensors and Transducers:** Introduction, Classification of Transducers**,** Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers.	10	L2 Understand L2 Understand
2	**Sensors and Transducers (continued):** Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers, Induction Potentiometers, Micro Electromechanical Systems	10	L2 Understand L2 Understand
3	**Signal Condition:** Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronic Amplifiers **Data Acquisition Systems and Conversion::** Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion	10	L2 Understand L2 Understand
4	**Data Transmission and Telemetry:** Data/Signal Transmission, Telemetry. **Measurement of Non – Electrical Quantities:** Pressure Measurement .	10	L2 Understand L2 Understand
5	**Measurement of Non – Electrical Quantities (continued):**Temperature Measurement, Flow Measurement – Introduction, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Metes, Wire Anemometers. Measurement of Displacement, Measurement of Velocity/ Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power, Measurement of Liquid Level, Measurement of Viscosity	10	L2 Understand L2 Understand
-	**Total**	**50**	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2, 3, 4, 5	Electrical and Electronic Measurements and instrumentation ,R.K Rajput, S.Chand,3rd Edition, 2013.	16,17,18,19,20,21,22	In Lib / In Dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1,2	A course in electronics and electrical measurement and instrumentation, J.B Gupta, Katson books, 13th edition,2008	12,13,14	In Lib / In Dept
3,4,5	A course in electronics and electrical measurement and instrumentation, A.K Sawheny, Dhanpat Rai, 2015	6,8,10,12,14	In Lib / In Dept
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	Basics of transducers https://nptel.ac.in/courses/112107242/25		
C2	Working of various transducers https://nptel.ac.in/courses/103105064/41 https://www.youtube.com/watch?v=1uPTyjxZzyo		
C2	Basics of sensors https://www.youtube.com/watch?v=1uPTyjxZzyo		
C2	Working of various sensors, load cell https://nptel.ac.in/courses/108105064/5 https://nptel.ac.in/courses/108105064/34		
C3	Signal conditioning https://nptel.ac.in/courses/108105062/8		
C3	Data aquaistion https://nptel.ac.in/courses/108105088/7 https://nptel.ac.in/courses/108105062/10		
C4	Data transmission and telemetry https://nptel.ac.in/courses/106105082/		
C4	Measurement of pressure https://nptel.ac.in/courses/106105082/		
C5	Measurement of temperature https://nptel.ac.in/courses/103105130/31		
C5	Measurement of flow https://nptel.ac.in/courses/108105064/15		
	Lab : https://www.youtube.com/watch?v=P9e7hUNPGVs -		
D	**Software Tools for Design**	**-**	**-**
E	**Recent Developments for Research**	**-**	**-**
	Aerospace sensors https://ieeexplore.ieee.org/abstract/document/6891996		

F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1	Strain Gauges https://nptel.ac.in/courses/108105064/4		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	15EE46	OP-Amp and LIC	Signal processing circuits and A/D & D/A Converters	4	-	L3

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Avanced type of thermal sensors	Higher Study	Gap A Seminar on advanced type of thermal sensors.	
2	Smart sensors	Higher Study	Gap A seminar on Applications of smart sensors.	Understand L2

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Instr Method	Assessment Method	Blooms' Level
1	15EE662.1	Discuss need of transducer, their classification, advantages and disadvantages.	10	Lecture/ PPT	Test and Assignment	L2 Understand
2	15EE662.2	Understanding of working and recent trends of various transducer and sensors.	10	Lecture/ PPT	Test and Assignment	L2 Understand
3	15EE662.3	Discuss the basics of Signal conditioning and Signal conditioning equipment.	10	Lecture/ PPT	Test and Assignment	L2 Understand
4	15EE662.4	Discuss configuration of Data Acquisition system and data conversion.		Lecture/ PPT	Test and Assignme	L2 Understand

					nt	
5	15EE662.5	Understand the different type of data transmission and telemetry.	7	Lecture/ PPT	Test and Assignment	L2 Understand
6	15EE662.6	Understand temperature, Pressure and flow measurement using various transducer.	7	Lecture/ PPT	Test and Assignment	L2 Understand
-	-	**Total**	**51**	-	-	**L2-L4**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Local oscillators in radar receivers and modulators in microwave transmitters	CO1	L2
1	Propagation and transmission of high microwave frequency signals	CO1	L4
2	Conventional Radio Resources for phase control	CO2	L3
2	Services medical, security, home, entertainment, and communication industries	CO2	L2
3	Printed circuit boards of radio receivers, mother boards	CO3	L2
3	Transmission and reception of signals of any frequency	CO3	L3
4	Mathematical modeling of light, electromagnetic radiation, sound, heat, fluid pollution	CO4	L3
4	A driven element used in feeding the elaborate directional antennas like horn, yagi-uda antennas	CO4	L4
5	Horn-Transmission in wider bandwidth, increasing the directivity and reduces the spurious responses of the parabolic reflector, short range radar system(speed enforcement cameras), Loop- Finding directions in radars, aircraft and radio receivers	CO5	L2
5	Helical-Circularly polarized radio waves for satellite communication, Parabolic-direct the radio waves in radio telescopes, Yagi-Uda-high directivity for log distance communication, Log-Periodic-Wide bandwidth UHF terrestrial TV	CO5	L2

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes													-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	15EE662.1	Discuss need of transducer, their classification, advantages and disadvantages.	3	2											3			L2
2	15EE662.2	Understanding of working and recent trends of various transducer and sensors.	3	2	1										2			L2
3	15EE662.3	Discuss the basics of Signal conditioning and Signal conditioning equipment.	3	2											2			L2
4	15EE662.4	Discuss configuration of Data Acquisition system and data conversion.	3	2											2			L2
5	15EE662.5	Understand the different type of data transmission and telemetry.	3	2											2			L2
6	15EE662.6	Understand temperature, Pressure and flow measurement using various transducer.	3	2											2			L2
-	**15EE662.**	Average																-

-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Avanced type of thermal sensors	Seminar	2nd week / date	Dr XYZ, Inst	List from B4 above
2	Smart sensors	Seminar	3rd Week		

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
2	Aerospace Sensors,Sensors for environmental monitoring	Placement, GATE, Higher Study, Entrepreneurship.	Presentation by students & Mini Project	3rd week / date		List from B4 above
3	Radiation Sensors like X-ray and nuclear radiation sensors		Presentation	4th week	Self	List from B4 above
2						

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Sensors and Transducers	10	2	-	-	1	-	2	CO1, CO2	L2, L2
2	Sensors and Transducers(continued)	10	2	-	-	1	-	2	CO1, CO2	L2, L2
3	Signal Condition Data Acquisition Systems and Conversion	10	-	2	-	1	1	2	CO3, CO4	L2, L2
4	Data Transmission and Telemetry Measurement of Non – Electrical Quantities	10	-	2	-	1	1	2	CO3, CO4	L2, L2
5	Measurement of Non – Electrical Quantities (continued)	10	-	-	4	1	1	2	CO5	L2, L2
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	15	CO1, CO2,	L2, l2, l2, l2
3, 4	CIA Exam – 2	15	CO3, CO4	L2, L2, L2, L2
5	CIA Exam – 3	15	CO5	L2, L2
1, 2	Assignment - 1	05	CO1, CO2,	L2, l2, l2, l2
3, 4	Assignment - 2	05	CO3, CO4	L2, L2, L2, L2
5	Assignment - 3	05	CO5	L2, L2
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		L2,L2
	Final CIA Marks	**20**	**-**	**-**

D1. TEACHING PLAN - 1

Module - 1

Title:	Sensors and Transducers	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Discuss need of transducer, their classification, advantages and disadvantages.	CO1	L2
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Introduction	Co1	L2
2	Classification of Transducers, Advantages and Disadvantages of Electrical Transducers	Co1	L2
3	Transducers Actuating Mechanisms	Co1	L2
4	Resistance Transducers	Co2	L2
5	Variable Inductance Transducers	Co2	L2
6	Capacitive Transducers, Piezoelectric Transducers	Co2	L2
7	Hall Effect Transducers	Co2	L2
8	Thermometric Transducers, Photoelectric Transducers	Co2	L2
9	Single Stub Matching using Smith chart	CO2	L4
10	Numericals in Single Stub Matching using Smith chart	CO2	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Use in Measuring instruments	CO1	L2
2	Resistance Transducers – used to sense temperature for the measurement and control eg: oven, Variable Inductance Transducers – use in accelerometers, Capacitive Transducers - use to measure both linear and angular displacements , Piezoelectric Transducers – to measure acceleration, Hall Effect Transducers – determing carrier concentration in semiconductors, Thermoelectric Transducers – use in control engineering , Photoelectric Transducers – use in PV cell and photoelevtric tachometer.	CO2	L2

d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Define the term "instrumentation".	CO1	L1
2	Enumerate the elements of a measurement system.	CO1	L1
3	What is transducer?	CO1	L1
4	What are the functions of a transducer in an electronic instrumentation	CO1	L2
5	How transducers are classified?	CO1	L1
6	Explain briefly with diagrams important transducer actuating mechanisms.	CO1	L2
7	Describe briefly the following: 1) Thermistors and resistance thermometers 2) wire resistance strain gauge	CO1	L2
8	Give the classification of variable inductance transducer.	CO1	L2
9	Explain briefly any two of the following transducer: 1) Self – generating variable inductance transducer-Electromagnetic type 2) Variable reluctance transducer 3) Mutual inductance transducer 4) LVDT	CO1	L2
10	What is the principal on which a capacitive transducer works?	CO1	L1
11	What are the advantages and disadvantages of capacitive transducer?	CO1	L1
12	Give the applications of capacitive transducer.	CO1	L2
13	What is piezoelectric transducer? List the advantages and disadvantages of piezoelectric transducer.	CO1	L2
14	How are piezoelectric transducer are classified?	CO1	L2
15	Explain briefly the following: 1) Photoemissive cell 2) Photocunductive cell 3) Photoelectric cell	CO1	L2
16	Define the followings: 1) sensitivity 2)linearity 3)Resolution 4)Hysteresis 5)Accuracy 6)Precision	CO1	L2
e	**Experiences**	-	-
1		CO1	L2
2			

Module – 2

Title:	Sensors and Transducers(continued)	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Understanding of working and recent trends of various transducer and sensors.	CO2	L2
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
11	Stain Gages	CO2	L2
12	Stain Gages	CO2	L2
13	Stain Gages	CO2	L2
14	Stain Gages	CO2	L2
15	Load Cells	CO2	L2
16	Proximity Sensors, Pneumatic Sensors, Light Sensors	CO2	L2
17	Tactile Sensors, Fiber Optic Transducers, Digital Transducers	CO2	L2
18	Recent Trends – Smart Pressure Transmitters, Selection of Sensors	CO2	L2
19	Rotary – Variable Differential Transformer, Synchros and Resolvers	CO2	L2
20	Induction Potentiometers, Micro Electromechanical Systems	CO2	L2
		CO2	

c	**Application Areas**	CO2	**-**
-	Students should be able employ / apply the Module learnings to . . .	CO2	-
1	Wheastone bridge is most commonly used in strain gauges. Proximity Sensors- used in counting moving objects and counting of objects , Pneumatic Sensors -used for measurment of displacements of fraction of mm in ranges, Light Sensors – used in controlling of outdoor, street lights and home appliances, Tactile Sensors – used in robotics and medical field, Fiber Optic Transducers – fibre optic telecommunication, Digital Transducers - Robotics	CO2	L2
2	Apply in developing more intelligent devices.	CO2	L2
		CO2	
d	**Review Questions**	CO2	-
-	The attainment of the module learning assessed through following questions	CO2	-
1	What is strain gauge?	CO2	L2
2	Explain briefly with neat diagrams, any two of the following: 1) Wire wound strain gauge 2)Foil type strain gauge 3) Semiconductor strain gauge 4) Capacitive strain gauge	CO2	L2
3	What is a load cell?	CO2	L1
4	Explain briefly any two of the following: 1) Hydraulic load cell 2) Pneumatic load cell 3) Strain gauge load cell	CO2	L2
5	Describe briefly the following sensors: 1) Eddy current proximity sensor. 2) Capacitance proximity sensor.	CO2	L2
6	Write a short notes on “Pneumatic sensor”	CO2	L2
		CO2	
e	**Experiences**	-	-
1		CO3	L2
2			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	17EE662	Sem:6	I	Marks:	20	Time:	75 minutes
Course:	Sensors and Transducers						

-	-	**Note: Answer all questions, each carry equal marks. Module : 1, 2**	**Marks**	**CO**	**Level**
1	a	What is transducer .Define the followings: 1) sensitivity 2)linearity 3)Resolution 4)Accuracy	05	CO1	L1
	b	Describe briefly the following: 1) Thermistors and resistance thermometers 2) wire resistance strain gauge	05	CO2	L2
	c	The resistivity of semiconductor material was known to be 0.00912Ωm at room temperature. The flux density in the Hall model was 0.48Wb/m^2. Calculate the hall angle for a Hall co efficient of 3.55x 10^{-4} m^3/coloumb.	05	CO2	L3
		OR			
1	a	Explain LVDT with advantages and disadvantages.	05	CO2	L2
	b	A parallel plate capacitive transducer uses plates of area 250mm^2 which are separated by a distance 0.2mm. a)Calculate the value of capacitance when the dielectric is air having a permittivity of 8.85 x 10^{-2} F/m. b)Caculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18mm.Also calculate the ratio of per unit change of capacitance to per unit change of	06	CO2	L3

		displacement. If a mica sheet 0.01mm thick is inserted in the gap , calculate the value of original capacitance and change in capacitance for the same displacement. Also calculate the ratio of per unit change of capacitance to per unit change of displacement. The dielectric constant of mica is 8.			
	c	Explain Hall effect with neat diagram and expression	04	CO2	L2
2	a	What is strain gauge?Explain briefly with neat diagrams, any two of the following: 1) Wire wound strain gauge 2)Foil type strain gauge	6	CO3	L2
	b	What is a load cell? Explain briefly two of the following: 1) Hydraulic load cell 2) Pneumatic load cell	5	CO2	L2
	c	A simple electrical strain gauge of resistance 120Ω and having a gauge factor of 2 bonded to steel having an elastic limit stress of 400MN/m2 and modulus of elasticity is 200 GN/m2. Calculate the change in resistance, 1) due to change in stress equal to 1/10 of the elastic range 2)due to chane of temperature of 20°C if the material is advance alloy. The resistance temperature coefficient of advance alloy is 20 x 10^{-6}/°C.	4	CO2	L3
		OR			
2	a	Describe briefly the following sensors: 1) Eddy current proximity sensor. 2) Capacitance proximity sensor.	6	CO2	L2
	b	Write a short notes on "Pneumatic sensor"	4	CO2	L2
	c	A strain gauge is bonded to a beam which is 12cm long and has a cross sectional area of 3.8cm^2. The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load the resistance of the gauge changes by 0.015Ω. If the modulus of elasticity for steel is 207GN/m^2, calculate: 1) The change in length of the steel beam. 2) The amount of force applied to the beam.	5	CO1	L3

b. Assignment -1

Sem:	6	Marks:	5 / 10	Time:	90 – 120 minute

SNo	Assignment Description	Marks	CO	Level
1	Define the term "instrumentation".	2	CO1	L1
2	Enumerate the elements of a measurement system.	3	CO1	L1
3	What is transducer?	1	CO1	L1
4	What are the functions of a transducer in an electronic instrumentation	3	CO1	L2
5	How transducers are classified?	4	CO1	L1
6	Explain briefly with diagrams important transducer actuating mechanisms.	4	CO1	L2
7	Describe briefly the following: 1) Thermistors and resistance thermometers 2) wire resistance strain gauge	6	CO2	L2
8	Give the classification of variable inductance transducer.	2	CO2	L2
9	Explain briefly any two of the following transducer: 1) Self – generating variable inductance transducer-Electromagnetic type 2) Variable reluctance transducer 3) Mutual inductance transducer	6	CO2	L2

	4) LVDT			
10	What is the principal on which a capacitive transducer works?	5	CO2	L2
11	What are the advantages and disadvantages of capacitive transducer?	4	CO2	L2
12	Give the applications of capacitive transducer.	4	CO2	L2
13	What is piezoelectric transducer? List the advantages and disadvantages of piezoelectric transducer.	5	CO2	L2
14	How are piezoelectric transducer are classified?	3	CO2	L2
15	Explain briefly the following: 1) Photoemissive cell 2) Photocunductive cell 3) Photoelectric cell	6	CO2	L2
16	Define the followings: 1) sensitivity 2)linearity 3)Resolution 4)Hysteresis 5)Accuracy 6)Precision	5	CO1	L2
17	A linear resistance potentiometer is 50mm long and is uniformly wound with a wire having a resistance of 10000Ω. Under normal conditions, the slider is at the centre of the potentiometer. (1) Find the linear displacements when the resistance of the potentiometer are measured by a Wheatstone bridge for two cases are:(a) 3800Ω and (b) 7500Ω (2) If it is possible to measure a minimum value of 12Ω resistance with the above arrangement, find the resolution of the potentiometer.	5	CO2	L3
18	In a linear voltage differential transformer the output voltage is 2V at maximum displacement. At a certain load, the deviation from linearity is maximum and it is ±0.0004V from straight line through origin, find the linearity at the given load.	5	CO2	L3
19	The output of LVDT is connected to a 5V voltmeter through an amplifier whose amplification factor is 250. An output of 2mv appears across the terminals of LVDT when the core moves through a distance of 0.5mm.If the multimeter has 100 divisions and the scale can be read to a 1/5 of a division. Calculate: 1) The sensitivity of LVDT 2)The resolution of the instrument at mm	5	CO2	L3
20	A parallel plate capacitive transducer uses plates of area 250mm^2 which are separated by a distance 0.2mm. a)Calculate the value of capacitance when the dielectric is air having a permittivity of 8.85 x 10^{-2} F/m. b)Calculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18mm.Also calculate the ratio of per unit change of capacitance to per unit change of displacement. If a mica sheet 0.01mm thick is inserted in the gap , calculate the value of original capacitance and change in capacitance for the same displacement. Also calculate the ratio of per unit change of capacitance to per unit change of displacement. The dielectric constant of mica is 8.	5	CO2	L3
21	A capacitive transducer uses two quartz diaphragm of area 675mm^2 separated by a distance of 3.8mm. A pressure of 850KN/m^2 when applied to the top diaphragm produces a deflection of 0.55mm. The capacitance is 330pF when no pressure is applied to the diaphragms. Determine the value of capacitance after the application of a pressure of 850 KN/m^2 .	5	CO2	L3
22	A capacitive transducer, used in pressure measuring instrument has a spacing of 4.2mm between its diaphragms. A pressure of 600 KN/m2 produces an average deflection of	6	CO2	L3

	0.28mm of the diaphragm of the transducer. A transducer which has a capacitance of 250pF before the application of pressure is connected in an oscillation circuit having a frequency of 120kHZ. Determine the change in frequency of oscillator after the application of pressure to the transducer.			
23	A 2mm thick quartz piezoelectric crystal having a voltage intensity of 0.055Vm/N is subjected to a pressure of 1.8 MN/ m^2.Calculate the voltage output and charge density of the crystal . Take the permittivity of quartz as $40.6x10^{-12}$ F/m.	3	CO2	L3
24	A piezoelectric material measuring 5mm x 5mm x 1.5mm is used to measure a force. Its voltage sensitivity is 0.055Vm/N. Calculate the force if voltage developed is 110v.	5	CO2	L3
25	What is strain gauge?	1	CO3	L1
26	Explain briefly with neat diagrams, any two of the following: 1) Wire wound strain gauge 2)Foil type strain gauge 3) Semiconductor strain gauge 4) Capacitive strain gauge	6	CO3	L2
27	What is a load cell	1	CO3	L1
28	Explain briefly any two of the following: 1) Hydraulic load cell 2) Pneumatic load cell 3) Strain gauge load cell	6	CO4	L2
29	Describe briefly the following sensors: 1) Eddy current proximity sensor. 2) Capacitance proximity sensor.	5	CO4	L2
30	Write a short notes on "Pneumatic sensor"	4	CO4	L2
31	A simple electrical strain gauge of resistance 120Ω and having a gauge factor of 2 bonded to steel having an elastic limit stress of 400MN/m2 and modulus of elasticity is 200 GN/m2. Calculate the change in resistance, 1) due to change in stress equal to 1/10 of the elastic range 2)due to change of temperature of 20°C if the material is advance alloy. The resistance temperature coefficient of advance alloy is 20 x 10^{-6}/°C.	5	CO3	L3
32	A strain gauge is bonded to a beam which is 12cm long and has a cross sectional area of 3.8cm^2. The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load the resistance of the gauge changes by 0.015Ω. If the modulus of elasticity for steel is 207GN/m^2, calculate: 1) The change in length of the steel beam. 2) The amount of force applied to the beam.	5	CO3	L3

D2. TEACHING PLAN - 2

Module – 3

Title:	Signal Condition Data Acquisition Systems and Conversion	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Discuss the basics of Signal conditioning and Signal conditioning equipment.	CO3	L2
2	Discuss configuration of Data Acquisition system and data conversion.	CO4	L2
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**

21	Introduction	CO3	L2
22	Functions of Signal Conditioning Equipment	CO3	L2
23	Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers	CO3	L2
24	Electrical and electronic Amplifiers	CO3	L2
25	Electrical and electronic Amplifiers	CO3	L2
26	Introduction	CO4	L2
27	Objectives and Configuration of Data Acquisition System	CO4	L2
28	Data Acquisition Systems	CO4	L2
29	Data Conversion	CO4	L2
30	Data Conversion, Numerical on antenna parameters	CO4	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	DC signal conditioning is used in potentiometers and resistance strain gauges and in data acquisition systems. AC signal conditioning is used for systems where signals have to be transmitted long via cables.	CO3	L3
2	Data acquisition systems are used in power plants, solar applications, and places where temperature and pressure is to be measured. Converters are used in data acquisition systems.	CO4	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Explain general measurement system with a block diagram.	CO3	L2
2	State the limitation of mechanical amplification.	CO3	L2
3	What are the advantages of electrical signal conditioning?	CO3	L1
4	Explain briefly the following functions of signal conditioning equipment 1)Amplification 2) Modification or modulation 3) Impedance matching 4) Data processing 5) Data transmission.	CO3	L2
5	Explain briefly any two of the following amplifiers 1) Mechanical amplifiers 2) Fluid amplifiers 3) Electrical and Electronics amplifiers.	CO3	L2
6	State the generalities that can be listed for an ideal electronic amplifier.	CO3	L2
7	What are DC and AC amplifiers? Explain briefly.	CO3	L2
8	What do you mean by modulated and unmodulated signals?	CO3	L2
9	What is an OP-Amp ? State its limitations as well.	CO3	L2
10	Explain briefly the term “Common Mode Rejection Ratio”	CO3	L2
11	State applications of OP-Amp.	CO3	L2
12	Enumerate some of the commonly used OP-Amp circuits.	CO3	L1
13	Explain briefly the following: 1) Buffer amplifier 2) Differential amplifier	CO3	L2
14	state the advantages of differential amplifier	CO3	L1
15	What is an attenuator? How are the attenuators are classified?	CO3	L2
16	What do you mean by the terms “filtering” and “filter”? How are filters classified?	CO3	L2
17	What is a data acquisition system ?Eplain analog data acquisition system with suitable block diagram.	CO4	L2
18	Draw the block diagram of a generalised data acquisition system and explain it briefly.	CO4	L2
19	What are the objectives of a data acquition system?	CO4	L2

20	What are the factors that decide the configuration of a data acquisition system?	CO4	L2
21	Explain single channel and multichannel analog multiplexed data acquisition system.	CO4	L2
22	Write a note on "Automated data acquisition system".	CO4	L2
23	Explain briefly a digital acquisition system.	CO4	L2
24	Explain with a neat diagram the working of a single channel data acquisition system	CO4	L2
25	Give application of data acquisition system.	CO4	L2
26	Explain briefly the procedure of analog to digital conversion.	CO4	L2
27	Define the following terms: 1) Quantizing 2) Coding	CO4	L2
28	Describe briefly the components use in A/D conversion.	CO4	L2
29	Explain briefly the following: 1) successive approximation A/D converter. 2) Flash A/D converter.	CO4	L2
30	Explain briefly the following: 1) Weighted resistor D/A converter. 2) R-2R ladder D/A conveter.	CO4	L2
31	Explain briefly the followings: PAM ii) PWM	CO4	L2
e	**Experiences**	-	-
1		CO6	L2
2			

Module – 4

Title:	Data Transmission and Telemetry Measurement of Non – Electrical Quantities	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Understand the different type of data transmission and telemetry.	CO5	L2
2	Understand temperature, Pressure and flow measurement using various transducer.	CO6	L2
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
31	Data/Signal Transmission	CO5	L2
32	Telemetry	CO5	L2
33	Telemetry	CO5	L2
34	Telemetry	CO5	L2
35	Telemetry	CO5	L2
36	Pressure Measurement	CO6	L2
37	Pressure Measurement	CO6	L2
38	Pressure Measurement	CO6	L2
39	Pressure Measurement	CO6	L2
40	Pressure Measurement	CO6	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Data transmission and telemetry is used in remote environmental monitoring, automatic meter reading.	CO5	L2
2	Use in hydraulic press, press fitting , die casting machine and so on	CO7	L2

d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Define the terms "Data transmission" and "telemetry".	CO5	L2
2	What is the difference between "transmitter" and "telemeter"	CO5	L2
3	Explain any two of the following: 1) Mechanical transmission 2) Hydraulic transmission 3) pneumatic transmission 4) Magnetic transmission	CO5	L2
4	Discuss briefly the working of a general telemetering system , with the help of a block diagram.	CO5	L2
5	How are the telemetry systems classified?	CO5	L1
6	List the advantages and disadvantages of land line telemetry system.	CO5	L2
7	Explain briefly the followings: i) Voltage Telemetry System ii) Current Telemetry System.	CO5	L2
8	Discuss the working of a position telemetry system with the help of a neat diagram.	CO5	L2
9	Write a short notes on RF telemetry system.	CO5	L2
10	What do you mean by the term "modulation" and "demodulation"	CO5	L2
11	Explain briefly the following: 1) Amplitude modulation 2) Frequency modulation.	CO5	L2
12	Explain briefly the followings: i) PAM ii) PWM iii) PPM iv) PCM	CO5	L1
13	What is modem? Explain	CO5	L2
14	Explain briefly the following telemetry system: 1) Frequency modulation (FM) telemetry system 2) pulse amplitude modulation telemetry system.	CO5	L2
15	Define the following terms: i) Pressure ii) Atmospheric Pressure iii) Gauge Pressure iv) Absolute Pressure v) Static Pressure.	CO6	L1
16	Describe the construction and working of hot – filament ionization gauge.	CO6	L2
17	Describe the construction and working of "Dead Weight Tester".	CO6	L2
18	Explain any two electric pressure transducers i)Resistance type transducer ii) Reluctance type transducer iii)Photoelectric transducer	CO6	L2
19	Explain pirani vacuum gauge with neat diagram.	CO6	L2
20	Explain Bridgeman gauge with neat diagram	CO6	L2
e	**Experiences**	-	-
1		CO7	L2
2			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:		17EE662	Sem:	6	Marks:	30	Time:	75 minutes		
Course:		Sensors and Transducers								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 3, 4**						**Marks**	**CO**	**Level**
1	a	Explain general measurement system with a block diagram.						5	CO3	L1
	b	Explain briefly the following amplifiers 1) Mechanical amplifiers 2) Fluid amplifiers						5	CO3	L2
	c	Explain briefly the following: 1) Buffer amplifier 2) Differential amplifier						5	CO3	L2
		OR								

1	a	Draw the block diagram of a generalized data acquisition system and explain it briefly.	5	CO4	L2
	b	Explain briefly the following: 1) successive approximation A/D converter. 2) Flash A/D converter.	5	CO4	L2
	c	Explain briefly the following: 1) Weighted resistor D/A converter. 2) R-2R ladder D/A converter.	5	CO4	L2
2	a	Define the terms "Data transmission" and "telemetry".Explain the following: 1) Hydraulic transmission 2) pneumatic transmission	5	CO4	L2
	b	Explain briefly the followings: i)Voltage Telemetry System ii) Current Telemetry System.	5	CO4	L2
	c	Explain briefly the following telemetry system: 1) Frequency modulation (FM) telemetry system 2) pulse amplitude modulation telemetry system.	5	CO4	L2
		OR			
2	a	Define the following terms: i) Pressure ii) Atmospheric Pressure iii) Gauge Pressure iv) Absolute Pressure v) Static Pressure.	5	CO5	L2
	b	Describe the construction and working of hot – filament ionization gauge.	5	CO5	L2
	c	Explain pirani vacuum gauge with neat diagram.	5	CO5	L2

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Sem:	5	Marks:	5 / 10	Time:	90 – 120 minutes

SNo	Assignment Description	Marks	CO	Level
1	Explain general measurement system with a block diagram.	5	CO5	L2
2	State the limitation of mechanical amplification.	3	CO5	L1
3	What are the advantages of electrical signal conditioning?	4	CO5	L2
4	Explain briefly the following functions of signal conditioning equipment 1)Amplification 2) Modification or modulation 3) Impedance matching 4) Data processing 5) Data transmission.	5	CO5	L2
5	Explain briefly any two of the following amplifiers 1) Mechanical amplifiers 2) Fluid amplifiers 3) Electrical and Electronics amplifiers.	6	CO5	L2
6	State the generalities that can be listed for an ideal electronic amplifier.	5	CO5	L2
7	What are DC and AC amplifiers? Explain briefly.	5	CO5	L2
8	What do you mean by modulated and unmodulated signals?	4	CO5	L2
9	What is an OP-Amp ? State its limitations as well.	4	CO5	L2
10	Explain briefly the term "Common Mode Rejection Ratio"	2	CO5	L2
11	State applications of OP-Amp.	5	CO5	L2
12	Enumerate some of the commonly used OP-Amp circuits.	5	CO5	L2
13	Explain briefly the following: 1) Buffer amplifier 2) Differential amplifier	6	CO5	L2
14	state the advantages of differential amplifier	4	CO5	L2
15	What is an attenuator? How are the attenuators are classified?	5	CO5	L2
16	What do you mean by the terms "filtering" and "filter"? How are filters classified?	5	CO5	L2
17	A three stage amplifier has a first voltage gain of 100, second stage voltage gain of 200 and third stage voltage gain of 400.	3	CO5	L3

	Find the voltage gain in dB.			
18	A multistage amplifier employs five stages each of which has a power gain of 30. What is the total gain of the amplifier in dB?	3	CO5	L3
19	What is a data acquisition system ?Eplain analog data acquisition system with suitable block diagram.	5	CO6	L2
20	Draw the block diagram of a generalized data acquisition system and explain it briefly.	5	CO6	L2
21	What are the objectives of a data acquition system?	5	CO6	L2
22	What are the factors that decide the configuration of a data acquisition system?	5	CO6	L2
23	Explain single channel and multichannel analog multiplexed data acquisition system.	6	CO6	L2
24	Write a note on "Automated data acquisition system".	5	CO6	L2
25	Explain briefly a digital acquisition system.	5	CO6	L2
26	Explain with a neat diagram the working of a single channel data acquisition system	5	CO6	L2
27	Give application of data acquisition system.	3	CO6	L2
28	Explain briefly the procedure of analog to digital conversion.	5	CO6	L2
29	Define the following terms: 1) Quantizing 2) Coding	2	CO6	L2
30	Describe briefly the components use in A/D conversion.	5	CO6	L2
31	Explain briefly the following: 1) successive approximation A/D converter. 2) Flash A/D converter.	6	CO6	L2
32	Explain briefly the following: 1) Weighted resistor D/A converter. 2) R-2R ladder D/A conveter.	6	CO6	L2
33	Explain briefly the followings: PAM ii) PWM	4	CO6	L2
34	Define the terms "Data transmission" and "telemetry".	2	CO7	L2
35	What is the difference between "transmitter" and "telemeter"	2	CO7	L2
36	Explain any two of the following: 1) Mechanical transmission 2) Hydraulic transmission 3) pneumatic transmission 4) Magnetic transmission	6	CO7	L2
37	Discuss briefly the working of a general telemetering system , with the help of a block diagram.	5	CO7	L2
38	How are the telemetry systems classified?	4	CO7	L2
39	List the advantages and disadvantages of land line telemetry system.	3	CO7	L2
40	Explain briefly the followings: i)Voltage Telemetry System ii) Current Telemetry System.	6	CO7	L2
41	Discuss the working of a position telemetry system with the help of a neat diagram.	5	CO7	L2

42	Write a short notes on RF telemetry system.	3	CO7	L2
43	What do you mean by the term "modulation" and "demodulation"	3	CO7	L2
44	Explain briefly the following: 1) Amplitude modulation 2) Frequency modulation.	6	CO7	L2
45	Explain briefly the followings: i) PAM ii) PWM iii) PPM iv) PCM	4	CO7	L2
41	What is modem? Explain	5	CO7	L2
42	Explain briefly the following telemetry system: 1) Frequency modulation (FM) telemetry system 2) pulse amplitude modulation telemetry system.	5	CO7	L2
43	Define the following terms: i) Pressure ii) Atmospheric Pressure iii) Gauge Pressure iv) Absolute Pressure v) Static Pressure.	5	CO8	L2
44	Describe the construction and working of hot – filament ionization gauge.	5	CO8	L2
45	Describe the construction and working of "Dead Weight Tester".	5	CO8	L2
46	Explain any two electric pressure transducers i)Resistance type transducer ii) Reluctance type transducer iii)Photoelectric transducer	6	CO8	L2
47	Explain pirani vacuum gauge with neat diagram.	5	CO8	L2
48	Explain Bridgman gauge with neat diagram	5	CO8	L2

D3. TEACHING PLAN - 3

Module – 5

Title:	Loop and Horn Antenna and Antenna Types	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Understand temperature, Pressure and flow measurement using various transducer.	CO6	L2
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
41	Temperature Measurement	CO9	L2
42	Temperature Measurement	CO9	L2
43	Temperature Measurement	CO9	L2
44	Flow Measurement – Introduction	CO10	L2
45	Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Metes	CO10	L2
46	Measurement of Velocity/ Speed, Measurement of Acceleration	CO10	L2
47	Measurement of Displacement	CO10	L2
48	Measurement of Force, Measurement of Torque	CO10	L2
49	Wire Anemometers., Measurement of Shaft Power	CO10	L2
50	Measurement of Liquid Level, Measurement of Viscosity	CO10	L2
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Use in thermometer, resistance temperature detector, thermocople and so on	CO9	L2
2	Use in rotameter, elbow meter, ultrasonic flow meter, anemometer,DC and AC tachometer	CO10	L2
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	What is temperature? How are temperature measuring instruments classified?	CO9	L2

2	Explain briefly the construction and working of a resistance thermometer.	CO9	L2
3	What are the adv and disadvantages of resistance thermometer?	CO9	L2
4	What are thermistors? What are their advantages ?	CO9	L2
5	Give a comparision between "thermistor" and "metal resistors"	CO9	L2
6	List the factors which should be considered while selecting resistance thermometers.	CO9	L2
7	What is a "seeback effect"?	CO9	L2
8	Explain with a neat diagram the construction and working of a thermoelectric pyrometer.	CO9	L2
9	What are the desirable properties of thermoelectric materials?	CO9	L2
10	Explain briefly the working of radiation pyrometer.	CO9	L2
11	State the advantages and disadvantages of thermocouples.	CO9	L2
12	State the advantages and disadvantages of radiation pyrometer.	CO9	L2
13	Describe with a neat sketch the working of an optical pyrometer.	CO9	L2
14	State the advantages and disadvantages of an optical pyrometer.	CO9	L2
15	List the applications of flow measurments.	CO10	L2
16	How are the flow measurments are classified?	CO10	L2
17	Describe briefly the following: 1) Rotameter 2) Elbowmeter.	CO10	L2
18	Explain with a neat sketch the working of any electromagnetic flow meter.	CO10	L2
19	What are hot wire anemometers?	CO10	L2
20	Explain briefly how small displacement can be measured by linear or differential transformers.	CO10	
21	Explain with a neat diagram the method of measuring linear velocity with the use of moving magnet type transducer.	CO10	
22	What is tachometer? How are tachometers are classified?	CO10	
23	Why are electrical tachometers preferred to mechanical tachometers?	CO10	
24	Explain briefly any two of the following electrical tachometers: 1) DC tachometer generator 2) AC tachometer generator 3) Photoelectric tachometer.	CO10	
25	Explain briefly any two of the following torque measrment methods: 1) Gravity balance method 2) Mechanical torsion meter. 3) Electrical torsion meter.	CO10	
26	What is a dynamometer? How are dynamometers are classified?	CO10	
27	Explain briefly the following: 1) Prony brake dynamometer 2) Rope brake dynamometer.	CO10	
e	**Experiences**	-	-
1		CO10	L2
2		CO9	

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs Code	15EE662	Sem:	6	Marks:	30	Time:	75 minutes
Course:	Sensors and Transducers						

-	-	**Note: Answer all questions, each carry equal marks. Module : 5**	**Marks**	**CO**	**Level**
1	a	What is temperature? How are temperature measuring instruments classified?	5	CO9	L2
	b	Give a comparison between "thermistor" and "metal resistors"	5	CO9	L2
	c	Explain with a neat diagram the construction and working of a thermoelectric pyrometer.	5	CO9	L2
		OR			
2	a	What are the desirable properties of thermoelectric materials?	5	CO9	L2
	b	Explain briefly the working of radiation pyrometer.	5	CO9	L2
	c	Describe with a neat sketch the working of an optical pyrometer.	5	CO9	L2

3	a	Describe briefly the following: 1) Rate meter 2) Quantity meter.	5	CO10	L2
	b	Explain with a neat sketch the working of any electromagnetic flow meter.	5	CO10	L2
	c	Explain briefly how small displacement can be measured by linear or differential transformers.	5	CO10	L2
4	a	Explain with a neat diagram the method of measuring linear velocity with the use of moving magnet type transducer.	5	CO10	L2
	b	Explain briefly the following electrical tachometers: 1) DC tachometer generator 2) AC tachometer generator	5	CO10	L2
	c	What is a dynamometer? How are dynamometers are classified?	5	CO10	L2

b. Assignment – 3

Sem:	6	Marks:	5 / 10	Time:	90 – 120 minutes

SNo	Assignment Description	Marks	CO	Level
1	What is temperature? How are temperature measuring instruments classified?	5	CO9	L2
2	Explain briefly the construction and working of a resistance thermometer.	5	CO9	L2
3	What are the adv and disadvantages of resistance thermometer?	4	CO9	L2
4	What are thermistors? What are their advantages ?	4	CO9	L2
5	Give a comparison between "thermistor" and "metal resistors"	5	CO9	L2
6	List the factors which should be considered while selecting resistance thermometers.	4	CO9	L2
7	What is a "seeback effect"?	2	CO9	L2
8	Explain with a neat diagram the construction and working of a thermoelectric pyrometer.	5	CO9	L2
9	What are the desirable properties of thermoelectric materials?	4	CO9	L2
11	Explain briefly the working of radiation pyrometer.	5	CO9	L2
12	State the advantages and disadvantages of thermocouples.	4	CO9	L2
13	State the advantages and disadvantages of radiation pyrometer.	5	CO9	L2
14	Describe with a neat sketch the working of an optical pyrometer.	5	CO9	L2
15	State the advantages and disadvantages of an optical pyrometer.	4	CO9	L2
16	List the applications of flow measurements.	4	CO9	L2
17	How are the flow measurements are classified?	4	CO9	L2
18	Describe briefly the following: 1) Rate meter 2) Quantity meter.	5	CO9	L2
19	Explain with a neat sketch the working of any electromagnetic flow meter.	5	CO9	L2
20	What are hot wire anemometers?	2	CO10	L2
21	Explain briefly how small displacement can be measured by linear or differential transformers.	5	CO10	L2
22	Explain with a neat diagram the method of measuring linear velocity with the use of moving magnet type transducer.	5	CO10	L2
23	What is tachometer? How are tachometers are classified?	4	CO10	L2
24	Why are electrical tachometers preferred to mechanical tachometers?	5	CO10	L2
25	Explain briefly any two of the following electrical tachometers: 1) DC tachometer generator 2) AC tachometer generator 3) Photoelectric tachometer.	6	CO10	L2
26	Explain briefly any two of the following torque measurement	6	CO10	L2

	methods: 1) Gravity balance method 2) Mechanical torsion meter. 3) Electrical torsion meter.			
27	What is a dynamometer? How are dynamometers are classified?	4	CO10	
28	Explain briefly the following: 1) Prony brake dynamo meter 2) Rope brake dynamometer.	6	CO10	L2

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Sensors and Transducers					Month / Year	May /2018	
Crs Code:	17EE662	Sem:	6	Marks:	80	Time:	180 minutes	
Module	**Note**	Answer all FIVE full questions. All questions carry equal marks.				**Marks**	**CO**	**Level**
1	a	What is transducer .Define the followings: 1) sensitivity 2)linearity 3)Resolution 4)Accuracy 5) Precision				6	CO1	L2
	b	Describe briefly the following: 1) Thermistors and resistance thermometers 2) wire resistance strain gauge				6	CO1	L2
	c	The resistivity of semiconductor material was known to be 0.00912Ωm at room temperature. The flux density in the Hall model was 0.48Wb/m^2. Calculate the hall angle for a Hall co efficient of 3.55x 10^{-4} m^3/coulomb.				4	CO1	L2
		OR						
-	a	Explain LVDT with advantages and disadvantages.				6	CO2	L2
	b	A parallel plate capacitive transducer uses plates of area 250mm^2 which are separated by a distance 0.2mm. a)Calculate the value of capacitance when the dielectric is air having a permitivity of 8.85 x 10^{-2} F/m. b)Calculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18mm.Also calculate the ratio of per unit change of capacitance to per unit change of displacement. If a mica sheet 0.01mm thick is inserted in the gap , calculate the value of original capacitance and change in capacitance for the same displacement. Also calculate the ratio of per unit change of capacitance to per unit change of displacement. The dielectric constant of mica is 8.				5	CO2	L2
	c	Explain Hall effect with neat diagram and expression				5	CO2	L2
2	a	What is strain gauge?Explain briefly with neat diagrams, any two of the following: 1) Wire wound strain gauge 2)Foil type strain gauge				6	CO3	L2
	b	What is a load cell? Explain briefly two of the following: 1) Hydraulic load cell 2) Pneumatic load cell				5	CO3	L2
	C	A simple electrical strain gauge of resistance 120Ω and having a gauge factor of 2 bonded to steel having an elastic limit stress of 400MN/m2 and modulus of elasticity is 200 GN/m2. Calculate the change in resistance, 1) due to change in stress equal to 1/10 of the elastic range 2)due to change of temperature of 20°C if the material is advance alloy. The resistance temperature coefficient of advance alloy is 20 x 10^{-6}/°C.				5	CO3	L2
		OR						
	a	Describe briefly the following sensors:				6	CO4	L2

		1) Eddy current proximity sensor. 2) Capacitance proximity sensor.			
	b	Write a short notes on "Pneumatic sensor"	5	CO4	L2
	c	A strain gauge is bonded to a beam which is 12cm long and has a cross sectional area of 3.8cm^2. The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load the resistance of the gauge changes by 0.015Ω. If the modulus of elasticity for steel is 207GN/m^2, calculate: 1) The change in length of the steel beam. 2) The amount of force applied to the beam.	5	CO4	L2
3	a	Explain general measurement system with a block diagram.	5	CO5	L2
	b	Explain briefly the following amplifiers 1) Mechanical amplifiers 2) Fluid amplifiers	6	CO5	L2
	c	Explain briefly the following: 1) Buffer amplifier 2) Differential amplifier	5	CO5	L2
		OR			
-	a	Draw the block diagram of a generalized data acquisition system and explain it briefly.	4	CO6	L2
	b	Explain briefly the following: 1) successive approximation A/D converter. 2) Flash A/D converter.	6	CO6	L2
	c	Explain briefly the following: 1) Weighted resistor D/A converter. 2) R-2R ladder D/A converter.	6	CO6	L2
4	a	Define the terms "Data transmission" and "telemetry".Explain the following: 1) Hydraulic transmission 2) pneumatic transmission	5	CO7	L2
	b	Explain briefly the followings: i)Voltage Telemetry System ii) Current Telemetry System.	5	CO7	L2
	C	Explain briefly the following telemetry system: 1) Frequency modulation (FM) telemetry system 2) pulse amplitude modulation telemetry system.	6	CO7	L2
		OR			
-	a	Define the following terms: i) Pressure ii) Atmospheric Pressure iii) Gauge Pressure iv) Absolute Pressure v) Static Pressure.	5	CO8	L2
	b	Describe the construction and working of hot – filament ionization gauge.	6	CO8	L2
	C	Explain pirani vacuum gauge with neat diagram.	5	CO8	L2
5	a	Give a comparision between "thermistor" and "metal resistors"	5	CO9	L2
	b	Explain with a neat diagram the construction and working of a thermoelectric pyrometer.	6	CO9	L2
	C	Explain briefly the working of radiation pyrometer	5	CO9	L2
		OR			
	a	Explain with a neat sketch the working of any electromagnetic flow meter.	5	CO10	L2
	b	Explain with a neat diagram the method of measuring linear velocity with the use of moving magnet type transducer.	5	CO10	L2
	C	Explain briefly the following electrical tachometers: 1) DC tachometer generator 2) AC tachometer generator	6	CO10	L2

2. SEE Important Questions

Course:		Sensors and Transducers						Month / Year		May /2019	
Crs Code:		15EE662	Sem:	6	Marks:	80		Time:		180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.						-		-	
Module	Qno.	Important Question						**Marks**		**CO**	**Year**
1	1	What is transducer .Define the followings: 1) sensitivity 2)linearity 3)Resolution 4)Accuracy						5		CO1	2018
	2	Describe briefly the following: 1) Thermistors and resistance thermometers 2) wire resistance strain gauge						6		CO2	2018
	3	The resistivity of semiconductor material was known to be 0.00912Ωm at room temperature. The flux density in the Hall model was 0.48Wb/m^2. Calculate the hall angle for a Hall co efficient of 3.55x 10^{-4} m^3/coulomb.						5		CO2	2018
	4	Explain LVDT with advantages and disadvantages.						6		CO2	2018
	5	A parallel plate capacitive transducer uses plates of area 250mm^2 which are separated by a distance 0.2mm. a)Calculate the value of capacitance when the dielectric is air having a permitivity of 8.85 x 10^{-2} F/m. b)Calculate the change in capacitance if a linear displacement reduces the distance between the plates to 0.18mm.Also calculate the ratio of per unit change of capacitance to per unit change of displacement. If a mica sheet 0.01mm thick is inserted in the gap , calculate the value of original capacitance and change in capacitance for the same displacement. Also calculate the ratio of per unit change of capacitance to per unit change of displacement. The dielectric constant of mica is 8.						5		CO2	2018
	6	Explain Hall effect with neat diagram and expression						5		CO2	2018
2	1	What is strain gauge?Explain briefly with neat diagrams, any two of the following: 1) Wire wound strain gauge 2)Foil type strain gauge						6		CO3	2018
	2	What is a load cell? Explain briefly two of the following: 1) Hydraulic load cell 2) Pneumatic load cell						6		CO3	2018
	3	A simple electrical strain gauge of resistance 120Ω and having a gauge factor of 2 bonded to steel having an elastic limit stress of 400MN/m2 and modulus of elasticity is 200 GN/m2. Calculate the change in resistance, 1) due to change in stress equal to 1/10 of the elastic range 2)due to change of temperature of 20°C if the material is advance alloy. The resistance temperature coefficient of advance alloy is 20 x 10^{-6}/°C.						5		CO3	2018
	4	Describe briefly the following sensors: 1) Eddy current proximity sensor. 2) Capacitance proximity sensor.						6		CO4	2018
	5	Write a short notes on “Pneumatic sensor”						5		CO4	2018
	6	A strain gauge is bonded to a beam which is 12cm long and has a cross sectional area of 3.8cm^2. The unstrained resistance and gauge factor of the strain gauge are 220Ω and 2.2 respectively. On the application of load the resistance of the gauge changes by 0.015Ω. If the modulus of elasticity for steel is 207GN/m^2, calculate: 1) The change in length of the steel beam. 2) The amount of force applied to the beam.						5		CO4	2018
3	1	Explain general measurement system with a block diagram.						5		CO5	2018
	2	Explain briefly the following amplifiers						6		CO5	2018

		1) Mechanical amplifiers 2) Fluid amplifiers			
	3	Explain briefly the following: 1) Buffer amplifier 2) Differential amplifier	6	CO5	2018
	4	Draw the block diagram of a generalized data acquisition system and explain it briefly.	5	CO6	2018
	5	Explain briefly the following: 1) successive approximation A/D converter. 2) Flash A/D converter.	6	CO6	2018
	6	Explain briefly the following: 1) Weighted resistor D/A converter. 2) R-2R ladder D/A converter.	6	CO6	2018
4	1	Define the terms "Data transmission" and "telemetry".Explain the following: 1) Hydraulic transmission 2) pneumatic transmission	6	CO7	2018
	2	Explain briefly the followings: i)Voltage Telemetry System ii) Current Telemetry System.	6	CO7	2018
	3	Explain briefly the following telemetry system: 1) Frequency modulation (FM) telemetry system 2) pulse amplitude modulation telemetry system.	6	C07	2018
	4	Define the following terms: i) Pressure ii) Atmospheric Pressure iii) Gauge Pressure iv) Absolute Pressure v) Static Pressure.	5	C08	2018
	5	Describe the construction and working of hot – filament ionization gauge.	5	C08	2018
	6	Explain pirani vacuum gauge with neat diagram.	5	CO8	2018
5	1	Give a comparison between "thermistor" and "metal resistors"	6	C09	2018
	2	Explain with a neat diagram the construction and working of a thermoelectric pyrometer.	7	C09	2018
	3	Explain briefly the working of radiation pyrometer	7	C09	2018
	4	Explain with a neat sketch the working of any electromagnetic flow meter.	7	CO10	2018
	5	Explain with a neat diagram the method of measuring linear velocity with the use of moving magnet type transducer.	7	CO10	2018
	6	Explain briefly the following electrical tachometers: 1) DC tachometer generator 2) AC tachometer generator	6	CO10	2018

Course Outcome Computation

Academic Year:

Odd / Even semester

INTERNAL TEST	**T1**						**T2**						
Course Outcome	**CO1**		**CO2**		**CO3**		**CO4**		**CO5**		**CO6**		**CO7**
QUESTION NO	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**	**Q1**
MAX MARKS													10
USN-1													
USN-2													4
USN-3													6
USN-4													4

USN-5	10
USN-6	9
Average CO Attainment	

LV Threshold : 3:>60%, 2:>=50% and <=60%, 1: <=49%
CO1 Computation :(2+2+2+3)/4 = 10/4=2.5

PO Computation

Program Outcome	PO1		PO3		PO3		PO1		PO12		PO12		PO6		
Weight of CO - PO	3		1		3		2		2		3		3		
Course Outcome	CO1		CO2		CO3		CO4		CO5		CO6		CO7		
Test/Quiz/ Lab	T1						T2						T3		
QUESTION NO	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2
MAX MARKS														-	10
USN-1															
USN-2														1	5
USN-3														2	10
USN-4														1	
USN-5														3	10
USN-6														3	10
Average CO Attainment														2	