ELECTRONIC SENSORS (EC700OE)

COURSE PLANNER

I. COURSE OVERVIEW:

The course has been designed on behalf of increasing the demand of Sensor Technology. In this course candidate will be taught every topic that is required and mentioned in the course content. Sensors science and engineering is relevant to virtually all aspects of life including safety, security, surveillance, monitoring, and awareness in general. Sensors are central to industrial applications being used for process control, monitoring, and safety. Sensors are also central to medicine being used for diagnostics, monitoring, critical care, and public health. The ability for a system to see (photonic technology), feel (physical measurements), smell (electronic noses), hear (ultrasonics), think/communicate (smart electronics and wireless), and move (sensors integrated with actuators), is progressing rapidly and suggests an exciting future for sensors.

II. PREREQUISITES:

1. Basic Electronics
2. Physics Concepts like magnetism, electrostatics, thermal etc.
3. Embedded Systems
4. Internet of Things

III. COURSE OBJECTIVES:

1 Learn the characterization of sensors.
2 Known the working of Electromechanical, Thermal, Magnetic and radiation sensors 3 Understand the concepts of Electro analytic and smart sensors
4 Able to use sensors in different applications

IV. COURSE OUTCOMES:

1 Learn about sensor Principle, Classification and Characterization.
2 Explore the working of Electromechanical, Thermal, Magnetic, radiation and Electro analytic sensors
3 Understand the basic concepts of Smart Sensors
4 Design a system with sensors

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems related to Electronics & Communication and Engineering.	3	Lectures and problem solving

PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems related to Electronics & Communication Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	Design Exercises, Assignments
PO3	**Design/development of solutions**: Design solutions for complex engineering problems related to Electronics & Communication Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Lectures, Assignments, Exams
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3	Lectures, Assignments, Exams
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Lectures and Design Exercises
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Electronics & Communication Engineering professional engineering practice.	3	Lectures, Assignments, Exams

Program Outcomes		**Level**	**Proficiency assessed by**
PO7	**Environment and sustainability**: Understand the impact of the Electronics & Communication Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	3	Lectures, Assignments, Exams
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	2	Group discussions

PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3	Document Preparation and Presentation
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	3	Discussions Exams, Seminars
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	3	Development of Mini Projects

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)- : None

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications,	1	Lectures, Assignments
	Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.		
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	2	Tutorials
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	3	Seminars, Projects

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) - : None

VII. SYLLABUS:

UNIT - I

Sensors / Transducers: Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges - Inductive Sensors: Sensitivity And Linearity of the Sensor –Types-Capacitive Sensors: Electrostatic Transducer, Force/Stress Sensors Using Quartz Resonators, Ultrasonic Sensors

UNIT - II

Thermal Sensors: Introduction, Gas thermometric Sensors, Thermal Expansion Type Thermometric Sensors, Acoustic Temperature Sensor ,Dielectric Constant and Refractive Index thermo sensors, Helium Low Temperature Thermometer, Nuclear Thermometer, Magnetic Thermometer, Resistance Change Type Thermometric Sensors, Thermo emf Sensors, Junction Semiconductor Types, Thermal Radiation Sensors, Quartz Crystal Thermoelectric Sensors, NQR Thermometry, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors

UNIT- III

Magnetic sensors: Introduction, Sensors and the Principles Behind, Magneto-resistive Sensors, Anisotropic Magneto resistive Sensing, Semiconductor Magneto resistors, Hall Effect and Sensors, Inductance and Eddy Current Sensors, Angular/Rotary Movement Transducers, Synchros.

UNIT – IV

Radiation Sensors: Introduction, Basic Characteristics, Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors, Fibre Optic Sensors Electro analytical Sensors: The Electrochemical Cell, The Cell Potential - Standard Hydrogen Electrode (SHE), Liquid Junction and Other Potentials, Polarization, Concentration Polarization, Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.

UNIT - V

Smart Sensors: Introduction, Primary Sensors, Excitation, Amplification, Filters, Converters, Compensation, Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface, the Automation

Sensors –Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing – Sensors for environmental Monitoring

TEXT BOOKS:

1. “Sensors and Transducers - D. Patranabis” –PHI Learning Private Limited., 2003.
2. Introduction to sensors- John veteline, aravind raghu, CRC press, 2011

REFERENCE BOOKS:

1. Sensors and Actuators, D. Patranabis, 2nd Ed., PHI, 2013.
2. Make sensors: Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media, 2014.
3. Sensors handbook- Sabrie soloman, 2n

NPTEL Web Course: https://nptel.ac.in/courses/106105034

NPTEL Video Course:
http://www.nptelvideos.in/2012/11/sensor.html GATE
SYLLABUS: Not Applicable

IES SYLLABUS: Not Applicable

VIII. COURSE PLAN:

Lecture No	Unit No.	Topics to be covered	Link for PPT	Link for PDF	Link for Small Projects/ Numericals(if any)	Course learning outcomes	Teaching Methodology	Reference
1	I	**UNIT I : Introduction to Sensors & Transducers**	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Learn about sensor Principle, Classification and Characterization.	Chalk & Talk	
2		Parameters, Characteristics, Environmental Parameters (EP), Characterization	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**		Chalk & Talk	
3		Introduction to Electromechanical Sensors:	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6Cmw	**Small Projects/ Numericals(if any) Link**	Learn about sensor Principle, Classification and Characteri	Chalk & Talk	

			usp=sharing	LHkswFQVT?usp=sharing		zation.		
4		Resistive Potentiometer, Strain Gauge,	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**		Role Play	**"Sensors and Transducers - D. Patranabis" – PHI Learning Private Limited., 2003.**
5		Resistance StrainGauge,	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Explore the working of Electromechanical sensors	PPT	
6		Semiconductor Strain Gauges	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**		Chalk & Talk	
7		Inductive Sensors	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Explore the working of Resistive Potentiometer and Strain Gauge	Seminar	

8		: Sensitivity and Linearity of the Sensor –Types-	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Explore the working of Resistive Potentiometer and Strain Gauge	Chalk & Talk
9		Capacitive Sensors: Force/Stress Sensors Using Quartz Resonators,	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Explore the working of Resistive Potentiometer and Strain Gauge	PPT
10		Capacitive Sensors::Electrostatic Transducer,	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Learn Inductive Sensors	Chalk & Talk
11		Ultrasonic Sensors	https://drive.google.com/drive/folders/1GMldjkJqlwfwmIGw_VEfuP-AJWc1_aNF?usp=sharing	https://drive.google.com/drive/folders/1-MtqAabBr9Pc7IrUKAV6CmwLHkswFQVT?usp=sharing	**Small Projects/ Numericals(if any) Link**	Learn Various parameters of Inductive Sensors	Chalk & Talk
12		MOCK TEST-1					
13		BRIDGE CLASS 1					
14		Student Presenatation					
	II						

15		**UNIT II Introduction to Thermal Sensors**	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Thermal Sensors	Chalk & Talk	
16		Gas thermometric Sensors ,Thermal Expansion Type	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Thermal Sensors	Chalk & Talk	
17		Thermometric Sensors & Acoustic Temperature Sensor	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Thermal Sensors	Chalk & Talk	**"Sensors and Transducers - D. Patranabis" – PHI Learning Private Limited., 2003.**
18		Dielectric Constant and Refractive Index thermo sensors	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Thermal Sensors	Role Play	
19		Helium Low Temperature Thermometer & Nuclear Thermometer ,	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Thermal Sensors	PPT	
20		Magnetic Thermometer & Resistance Change Type Thermometric Sensor	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Chalk & Talk	
21		Thermo emf Sensors Junction Semiconductor	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Seminar	
22		Thermal Radiation Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Radiation Sensors	Chalk & Talk	
I Mid Examinations								
23		Quartz Crystal Thermoelectric Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Thermoelectric	PPT	

						Sensors		
24		,NQR Thermometry, Spectroscopic Thermometry,	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Thermoelectric Sensors	Chalk & Talk	
25		Noise Thermometry & Heat Flux Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Thermoelectric Sensors	Chalk & Talk	
26		BRIDGE CLASS 2	-	-				
27	**III**	**UNIT III : Introduction to Magnetic sensors**	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Chalk & Talk	**"Sensors and Transducers - D. Patranabis" – PHI Learning Private Limited.,**
28		Principles behind Magneto-resistive Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Chalk & Talk	
29		Anisotropic Magneto resistive Sensing	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Chalk & Talk	
30		Anisotropic Magneto resistive Sensing (Contd..)	-	-	**Small Projects/ Numericals(if any) Link**	Understand the working of Magnetic Sensors	Role Play	
31		Semiconductor Magneto resistors	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Semiconductor Sensors	PPT	
32		Hall Effect and Sensors,	-	-	**Small Projects/ Numericals(if any) Link**	Learn Hall Effect	Chalk & Talk	

								2003.
33		Inductance and Eddy Current Sensor	-	-	**Small Projects/ Numericals(if any) Link**	Learn Eddy Current Effect	Seminar	
34		Angular/Rotary Movement Transducer	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Transducers	Chalk & Talk	
35		Synchros.	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Transducers	PPT	
36		MOCK TEST-1I	-	-				
37		Student Presenatation	-	-				
38	**I V**	**UNIT IV Introduction to Radiation Sensors & Basic Characteristics**	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Radiation Sensors	Chalk & Talk	
39		Reference Electrodes, Sensor Electrodes, Electro ceramics in Gas Media.	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Radiation Sensors	Chalk & Talk	
40		Types of Photo resistors/ Photo detectors, Xray and Nuclear Radiation Sensors,	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Nuclear Sensors	Chalk & Talk	
41		Fibre Optic Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Fiber Optic Sensors	Role Play	**Introduction to sensors- John vetelline, aravind raghu, CRC press, 2011**

42		Electro analytical Sensors: The Electrochemical Cell, The Cell Potential - Standard Hydrogenlectrode (SHE),	-	-	**Small Projects/ Numericals(if any) Link**	Explain Electro Analytical Sensors		
43		Liquid Junction and Other Potentials, Polarization, Concentration Polarization	-	-	**Small Projects/ Numericals(if any) Link**	Explain Polarizatio n	PPT	
44		BRIDGE CLASS 3	-	-	**Small Projects/ Numericals(if any) Link**		Chalk & Talk	
45	**V**	**UNIT V : Introduction to Smart Sensors :Primary Sensors & Compensation**	-	-	**Small Projects/ Numericals(if any) Link**	Understan d the basic concepts of Smart Sensors	Semina r	**Introd uction to sensor s- John vetelin e, aravin d raghu, CRC press, 2011**
46		Information Coding/Processing - Data Communication, Standards for Smart Sensor Interface,	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Interfaces in Data Communic ation	Chalk & Talk	
47		AutomationSensors – Applications	-	-	**Small Projects/ Numericals(if any) Link**	Understan d the basic concepts of Automatio n Sensors	PPT	
48		On-board Automobile Sensors (Automotive Sensors), & Home Appliance Sensors	-	-	**Small Projects/ Numericals(if any) Link**	Understan d the basic concepts of Automatio n Sensors	Chalk & Talk	
49		Aerospace Sensor	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Aerospace Sensors	Chalk & Talk	
50		Sensors for Manufacturing & Enviornmental Monitoring	-	-	**Small Projects/ Numericals(if any) Link**	Learn about Environme ntal Sensors	Chalk & Talk	

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	3	2	2	-	2	2	2	2	1	2	2
CO2	3	3	2	2	2	3	3	-	2	2	2	2	1	2	2
CO3	2	2	3	2	2	3	3	-	3	3	3	3	1	3	3
CO4	2	2	2	3	3	3	2	-	2	2	2	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) - : None

X. QUESTION BANK:

(JNTUH) UNIT – I

LONG ANSWER QUESTIONS

S. No.	Question	Blooms Taxnomy Level	Course Outcome
1.	Explain the function of a capacitive sensor in a robot end effectors?	Understand	CO1,CO2
2.	Explain the Principles of Sensors	Apply	CO3
3.	What is Strain Gauge	Knowledge	CO3
4.	Differentiate between sensor and transducer	Understand	CO3
5.	What is Electrostatic Transducer	Knowledge	CO1,CO2
6.	Write a short note on Semiconductor Strain Gauges	Understand	CO3
7.	Describe the environmental parameter of Sensor	Understand	CO1,CO2
8.	Discuss the working of Resistive Potentiometer	Understand	CO3
9.	How does stress sensor with a quartz resonator work?	Knowledge	CO1,CO2
10.	Write a short note on Ultrasonic Sensors	Understand	CO3

SHORT ANSWER QUESTIONS

S. No.	Question	Blooms Taxonomy Level	Course Outcome
1.	Explain the working principle of the variable inductance type transducer?	Knowledge	CO1,CO2

2.	What is an active and passive transducer?	Understand	CO3
3.	What are the types of electrochemical transducer?	Understand	CO1,CO2
4.	Explain electrical transducer?	Understand	CO5,CO6
5.	What are the advantages and disadvantages of an electrical transducer?	Knowledge	CO5,CO6
6.	Explain a mechanical transducer?	Understand	CO4
7.	How can we classify the transducer?	Knowledge	CO1,CO2
8.	What is a displacement transducer?	Understand	CO1,CO2
9.	What is an input and output transducer?	Knowledge	CO5,CO6
10.	Give some examples for passive transducer?	Knowledge	CO1,CO2

UNIT II

LONG ANSWER QUESTIONS

1.	Write a short note on Gas thermometric Sensors	Knowledge	CO1,CO2
2.	Explain Thermo emf Sensors	Understand	CO1,CO2
3.	What is Quartz Crystal Thermoelectric Sensors	Understand	CO1,CO2
4.	Explain the working of Helium Low Temperature Thermometer & Nuclear Thermometer	Understand	CO5,CO6
5.	What is Thermal Expansion Type Thermometric Sensors	Understand	CO4
6.	Write a short note on Spectroscopic Thermometry	Understand	CO1,CO2
7.	Describe Dielectric Constant and Refractive Index thermo sensors	Understand	CO4
8	Discuss the working of Magnetic Thermometer	Knowledge	CO1,CO2
9	What is Heat Flux Sensors	Knowledge	CO1,CO2
10	Write a short note on Thermal Radiation Sensors	Understand	CO4

SHORT ANSWER QUESTIONS

1.	Why use welding to create a thermocouple sensor?	Knowledge	CO3
2.	How is the temperature difference measured via a thermocouple sensor?	Knowledge	CO3
3.	How is the temperature difference related to the voltage difference measured at the open end of a thermocouple sensor?	Knowledge	CO1,CO2

4.	Why is a small, welded bead used to connect the thermocouple wires?	Knowledge	CO1,CO2
5.	How is temperature range calculated using a thermocouple sensor?	Knowledge	CO5,CO6
6.	What are the benefits of having my own thermocouple welding capability?	Apply	CO5,CO6
7.	What factors are considered when choosing the materials for a thermocouple sensor?	Understand	CO3
8.	What are the chief advantages of using capacitive welders for creating thermocouple junctions?	Understand	CO1,CO2
9	Do thermocouples tell you the temperature?	Knowledge	CO1,CO2
10	Why are two different metals required in a thermocouple?	Knowledge	CO1,CO2

UNIT III

LONG ANSWER QUESTIONS

1.	Write a short note on Magneto-resistive Sensors	Knowledge	CO5,CO6
2.	Explain the principle of operation of Magnetic Sensor.	Understand	CO1,CO2
3.	What is Anisotropic Magneto resistive Sensing	Understand	CO3
4.	Explain Inductance Current Sensor	Understand	CO1,CO2
5.	What is Eddy Current Sensors	Understand	CO3
6.	Write a short note on Angular Movement Transducers.	Knowledge	CO5,CO6
7.	Describe Hall Effect in Sensors	Knowledge	CO4
8.	Discuss the working of Synchros	Understand	CO5,CO6
9.	Describe one practical application of Magnetic sensor in detail.	Understand	CO5,CO6
10.	Write a short note on Semiconductor Magneto resistors	Understand	CO5,CO6

SHORT ANSWER QUESTIONS

1.	How is Hall potential developed?	Understand	CO1,CO2
2.	What is a Hall effect sensor?	Knowledge	CO3
3.	Explain Lorentz Force.	Knowledge	CO5,CO6
4.	Does Hall Voltage can be created with the conductor and insulator too?	Apply	CO5,CO6
5.	What Hall Coefficient signifies in the hall effect experiment?	Knowledge	CO1,CO2
6.	What hall effect experiment signifies?	Understand	CO1,CO2

7.	Explain the principle behind magnetic sensor	Knowledge	CO1,CO2
8.	How does Eddy current sensor work?	Knowledge	CO1,CO2
9.	What is magneto resistive sensing ?	Understand	CO5,CO6
10.	What are Sychros?	Knowledge	CO5,CO6

UNIT IV

LONG ANSWER QUESTIONS

1.	Write a short note on Nuclear Radiation Sensors	Understand	CO1,CO2
2.	Explain the working of X-Ray Sensor	Knowledge	CO1,CO2
3.	What are basic characteristics of radiation sensor.	Knowledge	CO5,CO6
4.	Explain the Fibre Optic Sensors.	Understand	CO3
5.	What are different types of photo detectors.	Understand	CO5,CO6
6.	Write a short note on Reference Electrodes	Understand	CO1,CO2
7.	Describe Liquid Junction	Understand	CO5,CO6
8	Discuss the working of Electro ceramics in Gas Media	Knowledge	CO1,CO2
9	What is Polarization in Electro analytical Sensor.	Apply	CO5,CO6
10	Write a short note on The Electrochemical Cell	Understand	CO5,CO6

SHORT ANSWER QUESTIONS

1.	When nuclear radiations pass through, gas ionization is produced.' This is the principle of which of the following detectors?	Knowledge	CO1,CO2
2.	Express the relation between conductivity and molar conductivity of a solution held in a cell.	Knowledge	CO5,CO6
3.	How does electrochemical series help us in predicting whether a redox reactions is feasible in a given direction or not?	Knowledge	CO5,CO6
4.	List the two factors that influence the value of cell potential of a galvanic cell.	Knowledge	CO1,CO2
5.	Define cell constant. Mention the SI unit of cell constant.	Understand	CO1,CO2
6.	How does specific conductance vary with temperature?	Knowledge	CO4
7.	Explain concentration cell with a suitable example.	Knowledge	CO1,CO2
8	State one difference between a primary battery and secondary battery.	Understand	CO1,CO2

9	Define the term 'Faraday Constant'. What is its numerical value?	Knowledge	CO5,CO6
10	List two differences between electrochemical cell and electrolytic cell.	Knowledge	CO5,CO6

UNIT V

LONG ANSWER QUESTIONS

1.	Write a short note on Information Coding in data communication.	knowledge	CO1,CO2
2.	Explain the concept of Excitation, Amplification in Smart sensing system.	knowledge	CO3
3.	What are Standards for Smart Sensor Interface	knowledge	CO1,CO2
4.	Explain different types of primary sensors	Understand	CO5,CO6
5.	What are On-board Automobile Sensors.	knowledge	CO5,CO6
6.	Write a short note on Sensors for environmental monitoring	Understand	CO4
7.	Describe Aerospace Sensors.	Understand	CO4
8.	Discuss the working of real time smart sensing environment.	Understand	CO1,CO2
9.	What are different ways to power a sensor in remote sensing applications.	Understand	CO5,CO6
10.	Write a short note on Filters, Converters, Compensation devices insmart sensing environment.	Understand	CO5,CO6

SHORT ANSWER QUESTIONS

1.	List the applications of photodiode.	Understand	CO4
2.	Explain the principle of Carbon-di-oxide sensing technology.	Knowledge	CO4
3.	List the advantages of TEDS.	Knowledge	CO4
4.	Write a short note on FDR soil moisture sensor	Knowledge	CO1,CO2
5.	Write a short note on TDR soil moisture sensor.	Knowledge	CO1,CO2
6.	Write a short note on gypsum block soil moisture sensor	Understand	CO5,CO6
7.	Write a short note on neutron probes soil moisture sensor.	Understand	CO1,CO2
8.	Classify the types of Sensors.	Understand	CO5,CO6
9.	Classify the sensors based on application and discuss the parameters considered during selection of sensors.	Knowledge	CO1,CO2
10.	Discuss the parameters considered during selection of sensors	Understand	CO5,CO6

XI. OBJECTIVE-TYPE QUESTIONS:
UNIT-1

1. The more correct a senor can measure, the more_____it is:

A) Accurate B) Precise C) Scaled D) Extent

Correct answer: A. Accurate

2. The smallest change which a sensor can detect is termed:

A) Accuracy B) Precision C) Resolution D) Scale

Correct answer: C. Resolution

3.Touch screen of mobile phone uses:

A) AFR Sensor

B) Pellistor

C) Viscometer

D) Tactile sensors

Correct answer: D. Tactile sensors

4. The thermistor whose resistance increase by increasing temperature:

A) NTC Thermistor B) PTC Thermistor C) None of these D) Any of these

Correct answer: B. PTC Thermistor

5. Sound to electrical energy transducer:

A) Microphone

B) AFR

C) Tactile sensor

D) Pellistor

Correct answer: A. Microphone

6. Which type of sensor is used to measure the distance between the vehicle and other objects in its environment:

A) Ultrasonic sensor B) Tactile sensor C) Motion sensor

D)None of these

Correct answer: A. Ultrasonic sensor

7. Which of following is the correct statement about digital sensors:

A) Digital sensors provide information on all possible values within specified limit Digital sensors are limited to a finite set of values

Correct answer: A. Digital sensors provide information on all possible values within specified limit

8. DHT22 sensor is used to sense:

A) Obstacles

B) Resistance

C) Position

D) Humidity

Correct answer: D. Humidity

9. Which of the following sensors is recommended for reliable temperature measurements in-process monitoring and control environments:

A) iwr6843

B) Rosemount 214C Sensor

C) DHT11

D) iwr6843

Correct answer: B. Rosemount 214C Sensor

UNIT-2

1. _sensor measures temperature.

a) Temperature

b) Air sensor

c) Glass sensor

d) Both a and b

2. Which of the following are the examples of temperature sensors?

a) Bimetallic devices

b) Thermometers

c) Silicon diode

d) All the above

3. The output obtained from the temperature sensor is of__form.

a) Current

b) Voltage

c) Both a and b

d) None of the above

4.Sensors are available in how many types?

a) 2

b) 3

c) 4

d) 5

5.Analog sensors generate___analog kind of output signals.

a) Discrete

b) Continuous

c) Both a and b

d) Does not generate

Which of the following are the examples of Analog sensors?

a) Accelerometer

b) Light sensors

c) Pressure sensors

d) All the above

Which of the following is the function of the accelerometer sensor?

a) Detects changes in position, orientation

b) Detects variation in velocity, shock

c) Detects variation in tilt and vibration

d) All the above

Analog accelerometers are classified based on_____.

a) Sensitivity

b) Configuration

c) Both a and b

d) Power dissipation

Are accelerometers available in digital and analog form?

a) Yes

b) No

c) Maybe

___sensors detect a quantity of light striking the sensor component.

a) Light sensor

b) Beam sensor

c) Velocity sensor

d) Speed sensor

10 Light sensors are of_____types. a) 2 b) 3 c) 4 d) 5

11 ___is used as a switch in Analog sensors.

a) LDR b) PN diode

c) Thyristor d) All the above

12 LDR switch automatically turns on or off depending on_____ factor.

a) Day light incident

b) Passing UV rays

c) Both a and b

d) Applying external force

UNIT-3

1. Hall effect is an

A. Magnetic

B. Electronic

C. Ionizing

D. Galvanic Ans - D

2. Hall effect is associated with.....

A. Solders

B. Thermistor

C. Semiconductor

D. None of these Ans - C

3. Hall effect generators are used to measure.....

A. Angular displacement

B. Magnetic field

C. linear displacement

D. All of above these Ans - D

4. Hall effect can be used to measure

A. carrier concentration

B. Magnetic field intensity

C. Electric field intensity

D. Mechanical field intensity Ans - A

5. Hall voltageis zero (0) when semiconductor is .....

A. P type

B. N type

C. Extrinsic

D. Intrinsic Ans - C

6. The hall voltage is proportional to.....

A. (Current through specimen)

B. (Current through specimen) ^{2}

C. (Current through specimen) ^{3}

D. (Current through specimen) ^{4}

E. Ans - A Solution

F. In any specimen the hall voltage is directly proportional to current through specimen.

G. Hall effect is clearly visible in .....

H. semiconductors

I. Metal

J. Pure conductors

K. Super conductors Ans - A

L. Hall coefficient depend on .....

M. Number of protons

N. Number of free charges

O. Number of neutrons

P. None of these Ans - B

Q. At equilibrium Hall effect force will be

R. ..... of Lorentz force.

S. Half

T. Equal

U. Double

V. Triple Ans - B

W. Hall effect sensors are used in.....

X. Fuel level indicators

Y. Flow meter

Z. Both A and B

None of these Ans - C

UNIT-4

1. Hall effect is directly proportional to.....

Flux Width

Flux Velocity

Magnetic flux density

All above these Ans – D

2. Hall effect is used for .....

- For ON application
- For OFF application
- For ON and OFF application
- None of these Ans – C

3. In the hall effect electrons experience is free electron

A. True

False Ans – A

4. Hall effect transducer can be used for to measuring.....

A. Angular displacement

B. Magnetic field

C. Linear displacement

D. All of above these Ans - D

5. At equilibrium conditions hall effect force and Lorentz force magnitude is same

A. True

B. False Ans – A

6. Which are the following are types of hall effect sensor?

A. Threshold Hall effect sensor

B. Linear Hall effect sensor

C. Both A and B

D. None of above these Ans - C

7. Hall effect is true for .....

A. They are a free from contact bounce problem

B. Hall effect cost less than electromagnetic switch

C. Hall effect operate as switches of high frequency

D. All of above these Ans – D

8. Hall effect sensor are used in flow meter instrument.

A. True

B. False Ans - A

9. Which of the following parameters cannot found in hall effect?

A. Conductivity

B. Polarity

C. Area of device

D. Carrie's concentration Ans - C

10. Find out hall effect coefficient when number of electrons in semiconductor is 10^{20}.

A. 0.00625

B. 0.0625

C. 0.625

D. 6.25

Ans – B

1. Which of above represents the output of hall effect transducer?

A. Applied voltage

B. Lorentz voltage

C. Hall potential

D. Emf Ans - C

2. Hall effect pickup use ON/OFF application.

A. True

B. false Ans - A

UNIT-5

1. ___is defined as the weight of the vapour in unit of the mixture.

A)Relative Humidity b) Specific Humidity

c) Absolute Humidity d)Atmospheric Humidity

2. In thermal conductivity humidity sensor one thermistor is sealed by _____ dry gas.
a)Hydrogen b)Oxygen c)Nitrogen d)Helium
3. What is the maximum resistance value of the LDR sensor at 10lux?
a) 4.5kohm b) 5kohm c) 6 kohm

d) 8kohm

4. LDR sensors are classified based on _____factors.

a) Photosensitive material b) Linearity

c) Both a and b d) Insulating material

5. Linear LDR sensors are alternatively named as_____.
a) Photodiodes b) SCR

c) Zener d) All the above

6. Which of the following are the advantages of the LDR sensor?
a) High sensitivity b) High light-dark resistance ratio c) Inexpensive d) All the above

7. Which of the following is the disadvantage of LDR sensor?
a) Narrow spectral response b) Less responsive device c) Provides low-temperature stability

d) All the above

8. Maximum sensors have_____transfer function.
a) Linear b) Nonlinear c) Zero d) Infinity

9. Which of the following are the typical kind of biometric materials used for the development of sensors?
a) Aptamers b) Molecularly imprinted polymers c) Both a and b d) None of the above

XII. GATE QUESTIONS: Not Applicable

XIII. WEBSITES:

1 www.wikipedia.com

2 www.google.com

3 www.ask.com

4 www.iaeng.org

XIV. EXPERT DETAILS:

1 Simons Lam (lam@cs.utexas.edu)

2 Dr.ShankarBalachandran,IIT Madras(ShankaR@cse.iitm.aC.in)

3 Bezwada Bruhadeswar (bezawada@iiit.ac.in)

XV. JOURNALS:

1. Elsever.com (international journal of computer and communication networking)
2. Iaeng (international association of engineers)

XVI. LIST OF TOPICS FOR STUDENTS SEMINARS:

1. Embedded system design process
2. GPS system and toy train applications
3. Overview of 8051
4. Programming of 8051
5. Applications using 8051
6. Instruction set in 8051
7. Assembly language programming process
8. Interfacing of display units
9. Serial data communication
10. Interfacing of key board & stepper motor
11. Classification of operating systems
12. Overview of RTOS
13. Inter task communication tools
14. ARM overview
15. Advantages and applications of ARM

XVII. CASE STUDIES / SMALL PROJECTS:

1. Atomization of house hold application
2. Industrial atomization system for temperature & pressure monitoring
3. Atomization of railway signalling system
4. GPS monitoring system
5. Theft control on motor vehicles using GSM & GPRS
6. Digital notice board
7. Embedded applications in army application.