GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT: SENSOR AND INSTRUMENTATION

SUBJECT CODE: 2154101

B.E. 5th Semester

Type of course: Professional Core Course

Prerequisite: NA

Rationale: To understand the concepts of measurement technology and also learn the various sensors used to measure various physical parameters, the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION: Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.	09	20%
2	MOTION, PROXIMITY AND RANGING SENSORS: Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).	09	20%
3	FORCE, MAGNETIC AND HEADING SENSORS: Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.	07	15%
4	OPTICAL, PRESSURE AND TEMPERATURE SENSORS: Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors- flow and level measurement, Radiation Sensors- Smart Sensors	11	25%

	-Film sensor, MEMS & Nano Sensors, LASER sensors.		
5	SIGNAL CONDITIONING AND DAQ SYSTEMS: Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.	09	20%

Reference Books:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.
3. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
4. Hans Kurt Tönshoff (Editor), Ichiro , "Sensors in Manufacturing" Volume 1, Wiley-VCH April 2001.
5. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
6. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2011.
7. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

Course Outcomes:

Upon Completion of the course the students will be able to

1. Familiar with various calibration techniques and signal types for sensors.
2. Apply the various sensors in the Automotive and Mechatronics applications
3. Describe the working principle and characteristics of force, magnetic and heading sensors.
4. Understand the basic principles of various pressure and temperature, smart sensors.
5. Ability to implement the DAQ systems with different sensors for real time applications

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.