GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Applied Instrumentation

Subject Code : ME02067031

Subject Name : Instrument Design Engineering

WEF Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite :	Fundamental knowledge of sensor measurement and design
Rationale :	This course covers the fundamentals of various sensor designs, installation and provides essential knowledge so that students will be able to readily apply this knowledge in R&D organization and Industry.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Understanding concept and importance of sensor design and installation	UN
02	Applying concept of design on various process parameters	AP
03	Analyze various technique of instrumentation reliability with respect to process instrumentation	AN

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Design and Construction of Instruments:** Instrument Design ,The Designer's Viewpoint ,Marketing Special Instruments ,Elements of Construction ,Electronic Components and Printed Circuits ,Surface-Mounted Assemblies ,Interconnections Materials, Mechanical Manufacturing, Processes, Functional Components, Construction of Electronic Instruments ,Site Mounting ,Panel Mounting Bench-Mounting Instruments ,Rack-Mounting Instruments ,Portable Instruments Encapsulation, Mechanical Instruments ,Kinematic Design ,Proximity Transducer, Load Cell ,Combined Actuator Transducer	10	22
2	**Instrument Installation and Commissioning** Introduction, General Requirements ,Storage and Protection, Mounting and Accessibility ,Piping Systems ,Air Supplies, Pneumatic Signals, Impulse Lines, Cabling ,General Requirements ,Cable Types ,Cable Segregation, Grounding, General Requirements ,Testing and Pre-Commissioning ,General Pre-Installation Testing ,Piping and Cable Testing ,Loop Testing Plant Commissioning	10	22
3	**Reliability in Instrumentation and Control** Reliability Principles and Terminology, Definition of Reliability, Reliability and MTBF The Exponential Failure Law, Availability Choosing, Optimum Reliability, Compound Systems, Reliability Assessment ,Component Failure Rates ,Variation of Failure Rate with Time ,Failure Modes, The Effect of Temperature on Failure Rates, Estimating Component Temperature ,The Effect of Operating Voltage on Failure Rates ,Accelerated Life Tests, Component Screening, Confidence Limits and Confidence Level ,Assembly Screening ,Dealing with the Wear-out Phase ,Estimating System Failure Rate ,Parallel Systems, Environmental Testing ,System Design ,Signal Coding, Digitally Coded Systems ,Performance Margins in System Design, Coping with Tolerance ,Component Tolerances ,Temperature Effects, Design Automation ,Built-in Test Equipment ,Sneak Circuits, Building High-Reliability Systems, Reliability Budgets ,Component Selection, The Use of Redundancy ,Redundancy with Majority Voting ,The Level of Redundancy ,Analog Redundancy ,Common Mode Faults ,The Human Operator in Control and, Instrumentation ,The Scope for Automation ,Features of	15	34

	the Human Operator, User-Friendly Design ,Visual Displays, Safety Procedures Safety Monitoring ,Types of Failure ,Designing Fail-Safe Systems ,Relay Tripping Circuits, Mechanical Fail-Safe Devices ,Control System Faults Circuit Fault Analysis ,Software Reliability ,Comparison with Hardware Reliability, The Distinction between Faults and Failures, Typical Failure Intensities ,High-Reliability Software ,Estimating the Number of Faults ,Structured Programming ,Failure-Tolerant Systems, Electronic and Avionic Systems ,Radio Transmitters ,Satellite Links, Aircraft Control Systems ,Railway Signaling and Control ,Robotic Systems ,Nuclear Reactor Control Systems ,Requirements for Reactor Control, Principles of Reactor Control ,Types of Failure ,Common Mode Faults Reactor Protection Logic ,Process and Plant Control .Additional Hazards in Chemical Plants, Hazardous Areas		
4	**Telemetry** Introduction, Communication Channels ,Transmission Lines ,Radio Frequency Transmission ,Fiber-Optic Communication, Signal Multiplexing ,Pulse Encoding Carrier Wave Modulation, Error Detection and Correction Codes, Direct Analog Signal Transmission, Frequency Transmission, Digital Signal Transmission Modems Data Transmission and Interfacing, Standards	10	22
	Total	**45**	**100**

Reference Book:

1. Instrumentation reference book , Walt Boyes. —4th ed. Elsevier Inc

Suggested Course Practical List:

Student has to prepare various Instrumentation design concept, compare hardware testing along with software simulation using any computing tools (MatLab,LabVIEW, Scilab, etc...). Prepare research paper on various topics like instrumentation testing, installation technique, reliability check this course.

List of Laboratory/Learning Resources Required:

Major Equipment:
Electronics Laboratory, computer facility, analog and digital sensors
List of Open Source Software/learning website: Virtual Lab, NPTEL

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