GUJARAT TECHNOLOGICAL UNIVERSITY

INSTRUMENTATION AND CONTROL (APPLIED INSTRUMENTATION) (03)
INSTRUMENT DESIGN ENGINEERING
SUBJECT CODE: 2740305
M.E. 4TH SEMESTER

Type of course: Major Elective-V

Prerequisite: Electronics Instrumentation, Measuring Instruments, Analog and Digital Electronics, Process Instrumentation and Control

Rationale:
This course provides an overview and fundamentals of various types of Instruments Designing, their installation, commissioning and Reliability.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Design and Construction of Instruments Introduction ,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	5	10 %
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	5	10 %
3	Sampling	5	10 %

	Introduction ,Importance of Sampling ,Representative Sample, Parts of Analysis Equipment ,Time Lags, Construction Materials ,Sample System Components ,Probes ,Filters ,Coalescers ,Coolers, Pumps, Gas Pumps, Liquid Flow Measurement and Indication, Pressure Reduction and Vaporization, Typical Sample Systems, Gases, L iquids		
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	5	10 %
5	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 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 ,Risks to Life ,The Oil Industry ,Reliability of Oil Supply .Electrostatic Hazards ,The Use of Redundancy	10	30 %
6	Safety Introduction ,Electrocution Risk, Earthling (Grounding) and Bonding Flammable Atmospheres ,Other Safety Aspects, Conclusion	5	10%
7	EMC Introduction, Compatibility between Systems, The Scope of EMC, Interference Coupling Mechanisms ,Source and Victim, Emissions Susceptibility, Circuits, Layout, and Grounding, Layout and Grounding, Digital and Analog Circuit Design, Interfaces, Filtering, and Shielding,	5	20 %

	Cables and Connectors, Filtering, Shielding ,The Regulatory Framework Customer Requirements, The EMC Directive, Standards Relating to the EMC Directive		

Reference Books:

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

Course Outcome:

After learning the course the students should be able to

1. Understand control strategies for controlling distillation column.
2. Understand control strategies for controlling batch processes.
3. Understand control strategies for controlling Boiler.
4. Understand control strategies for controlling Heat Exchanger

List of Tutorials:

Student has to prepare various algorithms for developing control strategies techniques covered in this course with any computing tools (MatLab, Scilab, etc...).

Prepare research paper and submit report of various algorithms for developing control strategies techniques covered in this course.

List of Open Source Software/learning website:

- NPTEL

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.