**17EE31E1-ADVANCED INSTRUMENTATION SYSTEMS**

**(EEE)**

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| **Course Category:** | Professional Elective | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture-Tutorial-Practical:** | 3-0-0 |
| **Pre-requisite:** | Electrical & Electronic Measurements | **Sessional Evaluation:****External Evaluation:****Total Marks:** | 4060100 |

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| **Course Objectives:** | Students undergoing this course are expected to learn: |
| 1. The instruments used for measurement of process parameters like  level, flow, pressure and temperature. 2. The various types of analyzers used in industrial applications.3. The concepts of safety standards and risk analysis techniques.4. The concepts of instrumentation standards.5. The process flow diagrams and instrument loop diagrams. 6. Instrument hookup diagrams and piping & instrumentation diagrams. |
| **Course Outcomes:** | After completing the course the student will be able to : |
| **CO1** | Understand the concepts of flow, level, temperature and pressure measurement  |
| **CO2** | Acquire basic knowledge on the various types of analyzers used in industries. |
| **CO3** | Understand the role of safety instrumented system in the industry. |
| **CO4** | Understand the standards of instrumentation in hazardous locations. |
| **CO5** | Design, develop and interpret the documents used to define instruments and control system.  |
| **CO6** | Design, develop and interpret logic diagrams, hookup diagrams and cable routing diagrams. |
| **Course Content:** | **UNIT I****Measurement of process parameters:** Measurement of temperature- pressure- flow and level-application- selection- calibration methods. **UNIT II****Instruments for analysis:** Ion selective electrodes- gas &liquid chromatography -oxygen analyzers for gas and liquid –CO-CO2 -NO and SO analyzers- hydrocarbon and H2S analyzers-dust-smoke- toxic gas and radiation monitoring.**UNIT III****Safety instrumentation:** Introduction to safety instrumented systems- hazards and risk-process hazards analysis (PHA)- safety life cycle- control and safety systems-safety instrumented function-safety integrity level (SIL)-selection- verification and validation.**UNIT IV****Instrumentation standards:** Instrumentation standards-significance of codes and standards- overview of various types- introduction of various instrumentation standards-review- interpretation and significance of specific standards-examples of usage of standards on specific applications. **UNIT V****Documentation in process industries-I:** Block diagram of a typical process-instrumentation symbols-abbreviations and identification of instruments- mechanical equipment- electrical equipment- instruments and automation systems- process flow diagram (PFD)-piping and instrumentation diagram (P&ID).**UNIT VI****Documentation in process industries-II:** Instrument lists and specification- logic diagrams- instrument loop diagrams- instrument hookup diagrams-location plans for instruments - cable routing diagrams-typical control track rooms layout-vendors documents and drawings |
| **Text books****&****Reference books:** | **Text books:**1. “Instrumentation engineers handbook (Process Measurement & Analysis)”, by B.G.Liptak, 4th Edition, Chilton Book Co, CRC Press, 2005
2. “Industrial instrumentation”, by Al.Sutko, Jerry.D.Faulk, Delmar publishers, 1996.
3. “Safety instrumented systems: design, analysis, and justification”, by Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., 2nd Edition, ISA,2006.

**Reference books:**1. Safety - ANSI/ISA84.00.01-2004,

Part 1: Framework, definitions, system hardware and software requirements; ANSI/ISA84.00.01-2004 Part 2: Functional safety: safety instrumented systems for the process industry sector; ANSI/ISA84.00.01-2004Part 3: Guidance for the determination of the required safety integrity levels-informative. 1. Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): flow equations for sizing control valves

 ISA84 process safety standards and user resources, 2nd edition, ISA, 2011 ISA88 batch standards and user resources, 4th edition, ISA, 2011. |
| **e-Resources** | <http://nptel.ac.in/courses>http://iete-elan.ac.in<http://freevideolectures.com/university/iitm> |