GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering
Level: UG
Branch: Instrumentation and Control / Electronics and Instrumentation
Subject Code : BE050000101
Subject Name : Instrumentation Project Management

WEF Academic Year:	2024-2025
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	Sensor/ transducer, field transmitters, converters, final control element, basic instrumentation symbols, process control modes and techniques, Computer based control system architecture
Rationale:	For an Instrumentation and Control Engineer it is very important to know the kind of standard documents available in manufacturing processes along with necessary design, test and calibration procedures. This subject will help students to understand the project procedures and various stages of the project like planning, estimation, designing, installation, testing, calibration and commissioning of instruments and systems. The last topic of the syllabus will introduce students to the quality manufacturing process.

Course Outcome:

Sr. No	Course Outcomes	Marks% weightage
CO-1	Understand the importance of project management from industrial perspective	20
CO-2	Estimate cost for implementing various industrial projects	15
CO-3	Apply various engineering design criteria for optimized project management	25
CO-4	Evaluate and select various sensors and control valve for successful realization of specific project	15
CO-5	Follow standard practices as well as procedures for construction and startup of project	25

Teaching and Examination Scheme:

Teaching-Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial/Practical			
L	T	P	TW/SL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL (I)	ESE (V)	
45	30	0	15	90	03	70	30	20	30	50	200

**** Problem-Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.***

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Introduction to project management** Definition of project purpose - Scope, time, quality and organization structure. Basic and detailed engineering: Degree of automation, Project S curves, manpower considerations, inter-department and inter-organization interactions, Multi agency interaction. Types of projects and types of contracts e.g. EPC, BOOT etc. Risk Management in Instrumentation Projects, EPCM Contracting model	**5**	**10**
2	**Project management** functions Controlling, directing, project authority, responsibility, accountability, interpersonal influences and standard communication formats, project reviews. project planning and scheduling, life project engineering and management cycle phases, the statement of work (SOW), projects specifications, bar charts, milestones, schedules, work breakdown structures, cost breakdown structures and planning cycle. —Agile Learning, Risk Based Scheduling, PMIS, Stakeholder & communication.	**5**	**10**
3	**Project cost and estimation** Types and estimates, pricing process, salary and other overheads, man-hours, materials and support costs. program evaluation and review techniques (PERT) and critical path method (CPM), estimating activity time and total program time, total PERT/CPM planning crash times, software used in project management.	**5**	**10**
4	**Instrument Project Control** Project engineering documents and drawing: Process flow sheets, Mechanical flow sheets, Instrument index sheets, loop wiring diagram, panel drawings and specifications, plot plans, installation details, special drawings, purchase requisition, other documents. Information required: Process information, Instrument specifications and standards, Electrical specifications, bid documents, Project procedure, project schedule, Equipment Information, Vendor drawing Work coordination: Project manager, process engineer, equipment engineer, Electrical, purchasing and expediting and others Planning hints and Project check list. Document control System (EDMS), Engineering Documentation (C&E, Control Narratives, FBD, Ladder Logic). Loop-wise Detailing (AI, AO, DI, DO, Termination) Hook-up Diagrams & BOM FAT/SAT	**5**	**15**
5	**Engineering Design criteria** Pneumatic versus electronics system,	**10**	**25**

	Control centers, Future and spare capacity Specifications for various measurement and control groups: Flow, Pressure, Level, Temperature, Control valves, Control panels, Analytical instruments Transmission systems: Pneumatic & Electronic – Materials, Distribution, Terminations and Identification Process connections – Take-offs and Piping, Location of taps, Sealing instruments from process, Manifolds and gage valves Miscellaneous Design Criteria: Mounting instruments, Selections of units, charts, ranges; Instrument identification, Winterizing, Material of construction, Package equipment systems Electrical safety: NEC code, Purging and pressurization, Enclosures, Intrinsic safety, EPC Projects - Power Plant, Oil and Gas, Wastewater treatment, dairy and food, pharmaceuticals and chemical plants. Functional Safety (SIL, IEC 61511), LOPA, Process Safety Management (PSM) & MOC, Modern safety standards (OSHA, ISO 45001)		
6	**Construction and Start up Organizing:** Documents, schedule, cost control Ordering and Receiving equipment and Material: Purchase orders, Material status, storage Installing instrument systems: Procedures, Coordination, Good installation practices Calibration Testing: Process connections, Pneumatic lines, Electrical Loop checking: Flow transmitter , Temperature transmitter, Control valve, Miscellaneous checks Startup: Placing instruments in service, Tuning loop controls, evaluating process upsets and disturbances, Repairing or replacing defective equipment, special equipment, Construction Safety Practices (PTW, LOTO, confined space, work at height)	**10**	**20**
7	**Introduction to International quality systems** - ISO 9000 Quality management practices worldwide, certifying agencies. Quality, customers and ISO 9000 ISO 9000, IEI and Test standards and Calibration,	**5**	**10**
	Total	**45**	**100**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**20**	**20**	**10**	**10**

R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

The syllabus of *Instrumentation Project Management* directly contributes to

SDG 8	**Decent Work and Economic Growth**
SDG 9	**Industry, Innovation and Infrastructure**
SDG 12	**Responsible Consumption and Production**

Reference Book:

1. Applied Instrumentation in Process Industries by W.G. Andrew and H.B. Williams, Gulf Professional Publishing, 3rd ed. 2008, ISBN-13: 978-0872010475.
2. Project management: A systems approach to planning scheduling and controlling by Harlod Kerzner and Van Nostrand, John Wiley & Sons, 11th ed., 2013, ISBN: 978-1-118-02227-6.
3. Successful Instrumentation & Control Systems Design, by Michael D. Whitt, 2nd Edition, 2012, ISA, ISBN: 978-1-93600-745-5.
4. ISO- 9000 Concepts, Methods & Implementation by Tapan B. Bagchi, Wheeler pub., 1995. ISBN-81-85814-24-4
5. ISO- 9000 Guidelines for the chemical & process industries : By ASQC (American Society of Quality Control) , ISBN-13: 978-0873893527, www.asq.org Reference Books: Instrument Engineers Handbook: Process Control by Bela G Liptak, CRC Press, 3rd ed., 1995, ISBN 13: 978-0801982422.
6. Advanced Project Management: Best Practices on Implementation – Harold Kerzner
7. Project Management, Planning and Control – Albert Lester
8. Engineering Project Management – Neil G. Siegel
9. Project Management for Engineering, Business and Technology – John M. Nicholas

List of Tutorials:

1. Study of standards and symbols (ANSI / ISA Std.)
2. Study of specification sheets.
3. Development of Process & Instrument diagram of typical process
4. Development of Loop Wiring diagram.
5. Cable scheduling.
6. GA and mimic diagram of a control panel.
7. Development of Bar charts for certain project.
8. Prepare the cost estimation sheet for the project under consideration
9. Hands-on experience for engineering management software such as MS Project, Primavera, etc.
10. Designing of control valve for liquid/gas/vapor applications as per standard
11. Design of orifice plates for liquid/gas/vapor as per ISO 5167

12. Operating range calculation for transmitters considering different applications.
13. Preparation of Inspection Test Plan,
14. Usage of calibrating equipment for loop checking,
15. RTD, thermocouple simulation using simulators,
16. 4 -20 mA current loop simulators for loop checking
17. Dry and wet loop checking,
18. Usage of various instruments like calibrators, DW testers, etc
19. Understanding impulse tubing, Laying, bending, supporting and connection of impulse tubing,
20. Understanding impulse tube fittings.

List of learning website/ resources:

1. Functional Safety (SIL, IEC 61511)
   - IEC 61511 Standard (Free Download) – Bureau of Indian Standards publication available via Internet Archive Archive
   - Free Guide to IEC 61511 – eFunctionalSafety overview with lifecycle and SIL concepts eFunctionalSafety
   - Abhisam Quick Guide to Functional Safety & SIL – Free PDF for engineers Abhisam
2. LOPA (Layer of Protection Analysis)
   - While no single open-source textbook exists, Open Textbook Library and LibreTexts host risk analysis and safety engineering materials that include LOPA methodology Center for Open Education LibreTexts
   - □ Process Safety Management (PSM) & MOC
   - OSHAcademy Course 736 Study Guide: Introduction to PSM – Free PDF covering OSHA's 14 elements Archive
   - OSHA 3132 Process Safety Management Booklet – Public domain, practical compliance guide Occupational Safety and Health Administration
   - AIChE CCPS Key Principles of MOC (2024) – Guideline for Management of Change AIChE
3. Modern Safety Standards (OSHA, ISO 45001)
   - ISO 45001 Overview – International OH&S management system standard ISO - International Organization for Standardization
   - OSHA Publications – Free digital safety manuals and compliance guides Occupational Safety and Health Administration
4. Construction Safety Practices (PTW, LOTO, Confined Space, Work at Height)
   - Delhi Labour Department Safety Manual for Construction Workers – Covers PTW, confined space, work at height labour.delhi.gov.in
   - HSE Permit to Work Systems Guide – UK HSE free resource HSE
5. Document Control Systems (EDMS)

- OpenDocMan, Alfresco Community Edition, LogicalDOC – Leading open-source EDMS platforms The Digital Project Manager formkiq.com
- Engineering Documentation (C&E, Narratives, FBD, Ladder Logic)
- PLC Programming for Beginners (Free Guide) – Ladder logic examples and exercises electrical-world.com publicworks.jacksonms.gov
- InstTools Free Instrumentation Books – Includes tutorials on C&E diagrams and narratives Inst Tools

6. Loop-wise Detailing (AI, AO, DI, DO, Termination, Hook-up, BOM)
   - InstTools Wiring Diagrams of PLC/DCS Systems – Free resource for AI, AO, DI, DO wiring Inst Tools
   - Electrical Volt Wiring Diagrams – Detailed open-source guide Electrical Volt
7. FAT/SAT
   - Lessons in Industrial Instrumentation (Kuphaldt, CC License) – Covers FAT/SAT fundamentals The Public's Library and Digital Archive
8. Agile Learning, Risk-Based Scheduling, PMIS
   - Agile Practice Guide (PMI, free via GitHub Pages) cpske.github.io
   - InfoBooks Free Agile Methodology PDFs – Scrum, Kanban, XP, Lean InfoBooks.org
   - PMI Practice Standard for Scheduling – Free for PMI members Project Management Institute
9. Stakeholder & Communication
   - Open Textbook Library – Project Management (Adrienne Watt) – Includes stakeholder and communication planning Center for Open Education
10. Risk Management in Instrumentation Projects
    - PMBOK Guide (PMI) – Free foundational resource for risk management Project Management Institute
    - OpenStax Technology Texts – Free peer-reviewed engineering and risk-related materials OpenStax
11. EPCM Contracting Model
    - PwC EPCM Delivery Models (2024) – Free industry guide PwC
    - IChemE Engineering Contracts & Model Agreements – International model forms Institution of Chemical Engineers - IChemE
12. NPTEL / SWAYAM (https://nptel.ac.in/)
13. Virtual Labs by IITs (https://vlab.co.in/)
14. DTE Common Lab manual
15. ISA Website (http://www.isa.org)
16. IDC Technologies (http://www.idc-online.com)
17. MIT Open Course ware (https://ocw.mit.edu/ (engineering fundamentals))

Activities suggested under self-learning:

Sr. No.	PBL Category	Name of the activity	No. of hours per activity	Evaluation Criteria

1.	Industry / Research Laboratory Visit	Industry/Research laboratory visit	Visit=5h, Report preparation = 5h Total = 10h	Based on the report submitted. Report should contain observations and calculations Based on industry/lab data.
2.	Video Based Learning	Technical Video based learning related to the subject (MOOC/NPTEL Video)	Duration of video = 5h Report preparation=5h Total= 10h	Report/presentation based on the video learning outcomes.
3.		Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment At the end of course. Based on the certificate produced.
4.		Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation =5h Total= 10h	Based on quiz/report submitted
5.	Assignment/ Technical Writing / Research Writing	Assignment writing. Numerical Based assignment is preferable.	5 assignments of 2h each. Total= 10h	Based on the assignment submitted.
6.		Problem solving/Coding using C, C++, Python, SCILAB, MATLAB,MS-EXCEL or any Other relevant software	5 small coding-based assignments of 2h each. Total = 10h	Based on the coding solution submitted.
7	Complex Problem-Solving targeting relevant SDGs. / Mini Project	Complex problem solving	Maximum 2 problems. Study of the problem and	Based on the depth of the Solution submitted.

			solution finding, Total= 10h	
8	Research Paper Review / Analysis	Discussion on research paper Based on relevant subject	5 research paper =20 h	Summarize research paper and Evaluation critical parameters
9.	Poster/ Chart/ Power poin presentation	Poster/chart/power point preparation on technical topics	Duration=6h	Based on poster/chart Preparation and presentation skills
10	Micro Project	Working/non-working model on technical topics	Working=12h Non-working=8 h	Based on inter department/external evaluation
11	Group Discussion / Quiz / Simulation	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	Based on quiz scores and reflection report after each quiz.
12		Group Discussion on emerging/trending technical topics based on subject	Duration=1h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Case Study Analysis / Seminar	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation=5h Total= 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Other	Patent Search and Innovation Gap Identification	10h(Search + Report)	Based on number of relevant patents analyzed and Identification of innovation scope.

Note:

1. In alignment with Outcome-Based Education (OBE) and NBA accreditation requirements, the subject *Instrumentation Project Management* incorporates;

- Seminar activities -– 10 Marks

These activities are incorporated as integral Project-Based Learning (PBL) components. These activities are designed to foster experiential learning, encourage innovation, and strengthen problem-solving skills by engaging students in practical applications of power converter design, simulation, and analysis. The inclusion of PBL ensures that learners develop higher-order cognitive

abilities mapped to Bloom's taxonomy, while simultaneously enhancing teamwork, communication, and research competencies essential for professional engineering practice.

2. The hours allocated to specific activities should be proportionate to the total no. of PBL hours and marks.

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