Autonomous Program Structure
Final Year B. Tech. Seventh Semester
(Instrumentation and Control)
Academic Year: 2019-2020 Onwards

Course Code	Course Title	Teaching Scheme Hours /Week			Examination Scheme				Marks	Credit
			Lecture	Tutorial	Practical	In Semester	End Semester	Oral	Practical		
IN 4101	Process Instrumentation and Control	3	0	0	50	50	0	0	100	3
IN 4102	Industrial Automation	3	0	0	50	50	0	0	100	3
HS 4101	Management Information system	3	0	0	50	50	0	0	100	3
OE 4101	Open Elective –I	3	0	0	50	50	0	0	100	3
IN 4103	Industrial Automation Lab	0	0	2	0	0	50	0	50	1
IN 4104	Project Phase-I	0	2	14	100	0	50	0	150	9
	Total	**12**	**2**	**16**	**300**	**200**	**100**	**0**	**600**	**22**
	Grand Total	**30**			**600**				**600**	**22**

OE4101: Open Elective-I

A. System Engineering and Management

B. Bio-Informatics

C. Avionics

***List of HS –Courses(Mandatory) Course Code: 4101**

1. E & TC : Mangement for Engineers
2. Comp : Organizational Behavior
3. Instru : Management Information systems
4. IT : Green Computing
5. Mech : Economics for Engineers
6. Advanced Entrepreneurship Development**

**Prerequisite: Basic Course ED

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MKSSS's Cummins College of Engineering for Women
Karvenagar, Pune-411052

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IN 4101: Process Instrumentation & Control

Teaching Scheme
Lecture: 3 Hr/week

Examination Scheme
In Semester: 50 Marks
End Semester: 50
Marks Credit: 3

Course Prerequisite: Principle and applications of various Sensors and Transducers, Basics of control systems, Principle of actuators and final control element and their applications.

Course Objectives:
1. To delineate the principles of multi-loop controllers and nonlinear systems
2. To design the multi variable control systems for interacting processes
3. To develop and analyze the control loops for various process applications

Course outcomes: The student will be able to
1. identify the characteristics of given process
2. compare the features of different control strategies
3. select appropriate control strategy for given application
4. develop the instrumentation and control loops for various processes

Unit 1: Multi-Loop Control & Nonlinear Systems (07)
SLPC and MLPC features, Feedback, feed forward control, cascade control, ratio control, selective control, split-range control
Nonlinear Elements in Loop: Limiters, Dead Zones, Backlash, Dead Band Velocity Limiting, Negative Resistance, Improvement in nonlinear process performance through Deterministic Control Loop Calculations, Calculations of the measured variable, final control element selection, cascade control design, Real time implementation issues

Unit 2: Multivariable Control (07)
Concept of Multivariable Control: Interactions and it's effects, Modelling and transfer functions, Influence of Interaction on the possibility of feedback control, important effects on Multivariable system behaviour Relative Gain Array, effect of Interaction on stability and multiloop Control system. Multiloop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements.

Unit 3: Heat exchanger and Boiler controls (07)
Types, gain and time constants, degrees of freedom. Basic controls in Heat exchangers, Steam Heaters, Condensers, fired heaters and vaporizers. Advanced Control Override, Feed forward Control.
Types, Components, Boiler controls like Drum level control (1,2,3,5 element), Airfuel ratio control, Combustion controls, Steam temperature and pressure control, Safety interlocks, Burner management system, startup and shutdown procedures, boiler safety standards

Unit 4: Distillation Column control (07)
Mass and Energy balance, column feed control, column pressure control, control of overhead and bottom composition, distillate reflux flow control. Frequency response, lag in liquid and vapour flow, concentration lag, predicting the behaviour of control system

Unit 5: Reactor and pumps and compressor control (07)

Types of reactions and reactors, factors governing the conduct of reaction, stability of reactors, time constant, effects of lag, flow control, temperature control, pH control, end point detection of continuous and batch reactors. Sequential & logic control in batch process, batch production management.

Pumps: Types, Basic Controls, Multipump system controls. Compressors: Types, Basic Controls.

Text Books:

1. Process Control Systems‑F.G. Shinskey, TMH.
2. Instrument Engineers' Handbook: Process Control: B.G. Liptak, Chilton.
3. Optimization of Industrial Unit Processes ‑ Bela G. Liptak

Reference Books:

1. Boiler Control Systems: David Lindsey, Mc GRAW‑HILL

IN 4102: Industrial Automation

Teaching Scheme
Lecture: 3 Hr/Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50
Marks Credit: 3

Prerequisite: Basics of control system components.

Course Objectives:
1. Understand the basic concepts of automation and its requirements.
2. To develop automation project and its documentation.
3. To learn and apply of standards and recommended practices to automation.
4. To understand the activities followed in automation projects.

Course Outcomes: The student will be able to
1. Select appropriate automation tool for the given application.
2. Identify protocols required for the given system.
3. Design a PLC/ DCS based system for the given application.
4. Analyze the safety systems in process industry.

Unit 1: Introduction Plant wide control systems and Automation Strategy: (06)
Introduction to Industrial Automation, Introduction to automation tools Performance criteria Control system audit, Performance criteria, Development of (URS) for automation, (FDS) for automation tools.

Unit 2: Instrumentation Communication Protocols : (07)
Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, HART Protocol, Foundation Fieldbus H1and HSE, Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.

Unit 3: PLC based automation: (07)
Logic development using (Ladder, FBD, SFC, Structure Text), Analog control loop configuration in PLC (PID controller configuration), Interfacing HMI and SCADA. PLC based automation project development.

Unit 4: Distributed Control System Basics: (07)
DCS introduction, Architecture of different makes, comparison, specification, latest trend and developments, function Blocks, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS and other automation tools.

Unit 5: Distributed Control System Engineering and Design (06)
DCS detail Engineering, configuration and programming, Development and configuration of User Interface (UI), database management, reporting, alarm management, diagnosis, security and user access management.

Unit 6: Process safety and Safety Management Systems (06)
Introduction to process safety, Process Hazard Analysis, Safety Integrity Level (SIL), Introduction to IEC 61511, SIS Application of safety system

Text Books:

1. S.K.Singh , “Computer aided process control”, PHI.
2. Garry Dunning , “Introduction to Programmable Logic Controllers” , Thomson Learning.
3. Krishna Kant , “Computer Based Process control” , PHI

Reference Books:

1. Samuel Herb, “Understanding Distributed Process Systems For Control”, ISA.
2. Webb & Reis, “Programmable Logic Controllers: Principles and Applications” , PHI.

HS 4101: Management Information System

Teaching Scheme
Lecture: 3 Hr/Week

Examination Scheme
In Semester: 50 Marks
End Semester:50
Marks Credit: 3

Prerequisite: NA

Course Objectives:
1. To introduce the students to the Management Information Systems
2. Its application in organizations and related technology
3. The course would expose the students to the managerial issues relating to information systems.
4. Help them identify and evaluate various options in Management Information Systems.

Course Outcomes: The student will be able to
1. Identify the functionalities and use of Management information system in industry.
2. Analyze various factors of Management Information System in organization e.g. sales, profit, digital marketing.
3. Develop various information system like erp, crm, data warehouse, etc
4. Analyze various parameters of technology solutions in any organization.

Unit 1: Introduction to Management Information Systems (06)
Need, Purpose and Objectives - Contemporary Approaches to MIS - Information as a strategic resource - Use of information for competitive advantage - MIS as an instrument for the organizational change.

Unit 2: Information System in Business (08)
Introduction to Information System; System Concepts; System & Sub System; System Feedback; Types of Information System; Applications; System Development Life Cycle (SDLC)

Unit 3: Management of Information Systems, Technology, and Strategy (08)
The Technology: Computer and Computer Processing; Role of Information Technology in Organization; Information System and Strategy; Strategic Analysis. The Information Center, Plant Operation management and digitization.

Unit 4: Systems Analysis and Design (06)
Systems Development Life Cycle - Alternative System Building Approaches - Prototyping - Rapid Development Tools - CASE Tools - Object Oriented Systems

Unit 5: Decision Support Systems (06)
Group Decision Support Systems - Executive Information Systems - Executive Support Systems - Expert Systems and Knowledge Based Expert Systems - Artificial Intelligence

Unit 6: Enterprise Information System (06)
Use of Information systems in Various Business Processes; Role of IS in Cross Functional Systems and EIS; Information Systems for Managerial Decision Support and Strategic Advantage Information, Management and Decision Making; Decision Support Systems (DSS); Group Support Systems; Executive support Systems. Tools / software used for MIS system, typical architecture of MIS

Text Books:

1. Management Information Systems, Laudon and Laudon, 7th Edition, Pearson Education Asia
2. Management Information Systems, Jawadekar, Tata McGraw Hill
3. Management Information Systems - Sadagopan, Prentice Hall
4. Analysis and Design of Information Systems, Rajaraman, Prentice Hall

Reference Books:

1. Decision Support Systems and Intelligent Systems, Turban and Aronson, Pearson Education Asia
2. Management Information Systems, Schultheiss, Tata McGraw Hill
3. Management Information Systems, Davis and Olson, Tata McGraw Hill
4. Management Information Systems - Jayant Oke

OE 4101A: System Engineering and Management

Teaching Scheme
Lecture: 3 Hr/Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50
Marks Credit: 3

Prerequisite: Process Loop Components

Course Objectives:
1. Know the basic concepts of Project Engineering and Management.
2. Understand various engineering documents.
3. Apply standards, and recommended practices.
4. Know the activities followed in instrumentation projects.

Course Outcomes: The student will be able to
1. Identify different phases of Project Life cycle.
2. Develop documentation for project planning phases like project statement, work distribution, scheduling for the given project.
3. Develop instrumentation detailed instrumentation engineering documents as per standards.
4. Prepare procurement, installation and commissioning document of a given project..

Unit 1: Basic Concept of Project Management (06)
Definition, Types and Life cycle phases of project, Basics of Project management, Project Planning, Scheduling, Cost estimation.

Unit 2: Instrumentation Project Documentation and Standards (08)
Importance of documents, Introduction to ISA standards, Preliminary documents (PFD, Material balance, P&ID etc.) and detail engineering (Process data sheets, instrument index, instrument specification sheet, calculation sheets) .

Unit 3: Control Panels and Wiring Documentation (08)
Instrument Cable Types, Control centers and Panels, Specification, Control room engineering, GA drawings, Terminal Strip reports for panels, Cable trays, Loop wiring diagrams, logic diagram, Instrument Installation sketches.

Unit 4: Procurement Activities (08)
Vendor registration, Tendering and bidding process, Bid evaluation, Purchase orders, contracting,

Unit 5: Installation and testing (06)
Inspection and Testing: Factory Acceptance Test (FAT) Team, Planning, documentation, Customer or Site Acceptance Test (CAT or SAT), Team, Planning, documentation. Test and inspection reports.

Unit 6: Commissioning Activities (06)
Pre-commissioning planning activities, documents required for Cold Commissioning and hot commissioning, Performance trials and final hand over, Calibration records,

Assignments:

1. Development of SOW/WBS/Organization structure for any I&C Project
2. Study of Process flow diagram and Material Balance sheet.
3. Development of P&ID (ISA S5.1, ISA S5.3)
4. Development of Instrument Index sheet
5. Development of Specification sheets (ISA S20)
6. Development of GA and mimic diagram of a control panel (ISA S5.5)
7. Development of Loop Wiring Diagram/Logic diagram (ISA S5.4 and ISA S5.2)
8. Preparation of Inquiry, Quotation, Comparative statement, Purchase orders
9. Preparing documents for FAT/SAT or CAT
10. Preparing commissioning documents.

Text Books:

1. Applied instrumentation in process industries by Andrew & Williams (Gulf Publishing)
2. Management systems by John Bacon (ISA)
3. Process control Instrument Engineers Handbook by Liptak.

Reference Books:

1. Instrument Installation Project Management (ISA).
2. Successful Instrumentation & Control Systems Design , by Michael D. Whitt (ISA)

OE 4101B: Bio-Informatics

Teaching Scheme
Lecture: 3 Hr/Week

Examination Scheme
In Semester: 50 Marks
End Semester: 50
Marks Credit: 3

Prerequisite: Advanced-Digital Signal Proceesing knowledge

Course Objectives:
1. To develop advanced skills to critically analyze and solve problems in biotechnology.
2. To be enable to evaluate data using bioinformatics.
3. To be able to identify potential uses and opportunities of this data.
4. To be able to understand the recent developments in a specialized area of biotechnology.

Course Outcomes: The student will be able to
1. Apply basic concepts of bioinformatics to biological data analysis.
2. Classify different types of biological database.
3. Apply various techniques, algorithms and tools to nucleic acid and protien sequence analysis.
4. Apply various techniques, algorithms and tools to used for phylogenetic analysis.

Unit 1: Introduction to Bio-Informatics **(05)**
Defination, applications, Protein and DNA structure, Biological Data Acquisition: The form of biological information. Retrieval methods for DNA sequence, protein sequence

Unit 2: Bio-Informatics Databases **(07)**
Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence, Information on various databases and bioinformatics tools available. For eg; nucleic acid sequence database (GenBank, EMBL, DDBJ), protein sequence databases (SWISS-PROT, TrEMBL, PIR, PPB)

Unit 3: Algorithms for bioinformatics **(07)**
Introduction to various machine learning techniques and their applications in bioinformatics. Genetic algorithm, Support Vector Machine, Neural Network and their practical applications towards the development of new models, methods and tools for bioinformatics

Unit 4: Sequence Analysis **(07)**
Various file formats for biomolecular sequences - genbank, fasta, gcg, msf, nbrf-pir, etc Basic concepts of sequence similarity, identity and homology, paralogues. Sequence based database searches - BLAST and FASTA algorithms

Unit 5: Sequence Alignment **(07)**
Pair wise and Multiple Sequence Alignments (MSA). Basic concept of sequence alignment, Pair wise alignment (Needleman and Wunsch, Smith and Waterman algorithms), MSA (Progressive and Hierarchical algorithms). Their use for analysis of Nucleic acid and protein sequences and interpretation of results

Unit 6: Phylogeny **(06)**
Phylogeny analysis, definition and description of phylogenetic trees and its types. Various computational methods in phylogenetic and molecular evolutionary analysis

Text Books/Reference Books:

1. Hooman Rashidi, Lukas K. Buehler, 'Bioinformatics Basics: Applications in Biological Science and
Medicine' (2nd Edition) (May 2005)
2. Des Higgins (Ed),Willie Taylor (Ed), 'Bioinformatics: Sequence, Structure and Databanks - A practical approach' (1st Edition) (October 2000)
3. N.J. Chikhale and Virendra Gomase, 'Bioinformatics- Theory and Practice' (1st Edition)(July 2007)
4. Bioinformatics: Databases and Systems, by Stanley I. Letovsky
5. Bioinformatics Databases: Design, Implementation, and Usage (Chapman & Hall/ CRC Mathematical Biology & Medicine), by SorinDraghici
6. Data base annotation in molecular biology, principles and practices, Arthur M.Lesk
7. Current topics in computational molecular biology, Tao, Jiang, Ying Xu, Michael Q.Zang

OE 4101C: Avionics

Teaching Scheme
Lecture: 3 Hr/week

Examination Scheme
In Semester: 50 Marks
End Semester:50Marks
Credit: 3

Prerequisite: Basics of Control Systems, Basics of Communication System

Course Objectives:
1. To integrate the digital electronics with cockpit equipment
2. To understand the various principles in flight disk and cockpit panels.
3. To understand the communication techniques used in aircraft.
4. To explain the modern era of flight control system

Course Outcomes: The student will be able to
1. Relate the concepts of digital electronics to flight instrumentation.
2. Identify instrumentation involved in flight desk and cockpit panels.
3. Identify various equipments and communication techniques used in aircraft
4. Identify specialized systems in avionics such as instrument landing system and electronic war fare.

Unit 1: Introduction to Avionics **(07)**
Basics of Avionics-Basics of Cockpits-Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system – Typical avionics System and Sub systems – Design and Technologies.

Unit 2: Digital Avionics Bus Architecture **(07)**
Avionics Bus architecture–Data buses MIL–RS 232- RS422-RS 485-AFDX/ARINC-664-MIL STD 1553 B–ARINC 429–ARINC 629- Aircraft system Interface

Unit 3: Flight Deck and Cockpit **(07)**
Control and display technologies CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – ARINC 818-Civil cockpit and military cockpit: MFDS, PFDS-HUD, HMD, HMI

Unit 4: Avionics Systems **(07)**
Communication Systems – Navigation systems – Flight control systems – Radar electronic Warfare – Utility systems Reliability and maintainability Fundamentals- Certification-Military and civil aircrafts.

Unit 5: On Board Navigation Systems **(07)**
Over view of navigational aids, Flight planning, Area navigation, required time of arrival, RNAV architecture , performance aspects, approach and landing challenges, regulatory and safety aspects, INS, GPS and GNSS characteristics.

Unit 6: Basics of Final Control Element **(07)**
Basics of pneumatic, hydraulic and electric actuators, Function of DC Servo motor, AC Servo motor function of pneumatic, hydraulic actuators.

Text Books:

1. R.P.G. Collinson, “Introduction to Avionics”, Chapman & Hall Publications, 1996.
2. N. S. Nagaraja(1996),Elements of electronic navigation, 2 edition, Tata McGraw Hill, New Delhi.

Reference Books:

1. Cary R .Spitzer, “The Avionics Handbook”, CRC Press, 2000.
2. Middleton, D.H. “Avionics Systems”, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. “Digital Avionics Systems”, Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Brain Kendal, “Manual of Avionics”, The English Book House, 3rd Edition, New Delhi, 1993

IN 4103: Industrial Automation Lab

Teaching Scheme
Practical: 2 Hr/Week

Examination Scheme
Oral: 50 Marks
Credit: 1

Prerequisite: Basics of control system components, Basics of Process Instrumentation

Course Objectives:
1. To understand the basic concepts of automation and its requirements.
2. To develop automation project.
3. To understand the principles of multi-loop controllers and nonlinear systems.
4. To understand the activities followed in automation projects.

Course Outcomes: The student will be able to
1. Prepare User Requirement Specification document for given application.
2. Analyze the performance of different controllers for various processes.
3. Implement interfacing of various automation tools using third party software.
4. Develop and implement PLC/ DCS programming for various industrial applications

List of Experiments: (students are expected to perform any 8 experiments)
1. Automatic control of Single Capacity Process
2. Automatic control of Two Capacity Process
3. Automatic control of Temperature and Set Point Programming
4. Comparison of Feedback and Feed Forward Control
5. Preparing URS and FDS for any small automation project.
6. Prepare cause and effect document for any small process and also develop logic diagram
7. Develop and implement any PLC and/or DCS program using FBD and SFC programming language.
8. Interfacing of PLC to any SCADA through Modbus protocol and/or OPC.
9. Developing and implementing any control loop using PLC system.
10. Developing and implementing any control loop using DCS system
11. Developing and configuring Graphic User Interface for any control loop.
12. Configuration of any HART device to PLC and/or DCS system.
13. Configuration of any Foundation Fieldbus device to PLC and /or DCS system.
14. Configure and implement different alarms in PLC and/or DCS system.
15. Configuring and implementing any Advanced process control function block
16. Preparing a HaZOp document for any small process (Case Study)

IN 4104: Project Phase I

Teaching Scheme
Tutorial: 2 Hr/Week
Practical: 14 Hr/Week

Examination Scheme
In semester: 100 Marks
Oral: 50 Marks
Credit: 9

Course Outcomes: The student will be able to

1. Identify and define technical problem related to various fields.
2. Implement and test the designed stages involved in solving the defined problem statements.
3. Work in a team and abide by the norms of professional ethics.
4. Prepare and present technical documentation of the developed system.

The students are expected to work in suitable size groups. The work contribution of each group member should be apporaching towards the final solution. The work should be completed in the stipulated time.