Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Academic Year 2023-2024

Course Structure for M.Sc. - II: Electronic Science

Semester	Paper Code	Title of Paper	No. of Credits
IV	PSEL241	Control System	4
	PSEL242	Advanced Power Electronics	4
	PSEL243	Fundamentals of Artificial Intelligence	4
	PSEL244	Wireless Sensor Network	4
	PSEL245	Practical Course – Project	4

PSEL241: Control System (4 Credits)

Objectives:

1. To make student familiar with basic concepts of control theory.
2. To understand the use of transfer function models for analysis physical systems and introduce the control system components.
3. To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of system.
4. To get acquainted with the methods for analyzing the time response and Stability of system.
5. To Introduce and analyze the frequency response and Stability of System stems.
6. To introduce stability analysis and design of compensators.
7. To Introduce concept of root locus, Bode plots, Nyquist plots.
8. To get acquainted with Concepts of PI, PD,PID controllers.
9. To understand the knowledge of fuzzy set , fuzzy logic and fuzzy system.

Course Outcome: **On completion of the course, learner will be able to -**

CO1: Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
CO2: Determine the (absolute) stability of a closed-loop control system.
CO3: Perform time domain analysis of control systems required for stability analysis.
CO4: Perform frequency domain analysis of control systems required for stability analysis.
CO5: Apply root-locus, Frequency Plots technique to analyze control systems.
CO6: Express and solve system equations for stability using different plots.
CO7: Differentiate between various digital controllers and understand the role of the controllers.
CO8: Understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.
CO9: Understand the basic features of membership functions and operations on fuzzy set.

Unit-1: Basics of Control system (15L)

Elements of control system, concept of closed loop control and open-loop control, continuous and discrete state control, control strategies such as feedback and feed forward, mathematical models of systems, transfer function and its use, obtaining transfer function, block diagram reduction rules and signal flow graph, Mason's gain formula.

Unit-2: Stability and frequency response (18L)

Concept of stability, Routh stability criterion, Routh- Hurwitz criterion, Construction of Root locus, Bode plots- phase margin and gain margin, Lead, lag, lead-lag compensation using bode plot, Nyquist plots.

Unit-3: Analog and Digital Controllers (15L)

Classification of controllers, Controller terms Discontinuous controllers: On-OFF Controller, three position controller. Continuous controllers: Proportional, Integral and Derivative control. Composite control modes: PI, PD and PID controllers. Derivative overrun and integral windup in PID control mode

Unit-4: Introduction to Fuzzy Logic (12L)

Fuzzy set, fuzzy logic, fuzzy vs crisp set, fuzzy logic vs probability, membership functions, linguistic variables, fuzzy inference steps, use of fuzzy logic, operations on fuzzy set, applications, Fuzzy logic in control system, fuzzy controllers.

Text / Reference Books:

1. Process control: Principles and applications, Surekha Bhanot, Oxford University Press 2nd Edition.
2. Control Engineering Noel. M. Morris, 3rd Edition Mac Graw Hill.
3. Process control instrumentation technology, C. D Johanson, PHI.
4. Control system engineering, Nagrath and Gopal, New age international limited.
5. Control Systems, U.A. Bakshi and V. U. Bakshi, Technical Publications Pune.
6. Modern Control engineering, Ogata, Prentice Hall, EEE.
7. Introduction to Fuzzy sets Fuzzy logic and Fuzzy control systems, Guanrong Chen,Trung Tat Pham
8. Timothy J. Ross, Fuzzy logic with Engineering applications, 2ndedn, McGraw Hill.
9. Zimmerman H.J, Fuzzy set theory and its applications, 4thed, Springer, 2001.
10. Ganesh M, Introduction to fuzzy sets and Fuzzy logic, PHI, 2006

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	-	3	3	3	1	1	2
CO2	3	3	-	2	3	2	1	1	2
CO3	3	3	-	3	3	3	-	1	3
CO4	3	3	-	3	3	3	-	1	3
CO5	3	3	1	3	3	2	-	1	3
CO6	3	3	1	2	2	2	1	1	2
CO7	3	3	1	3	3	2	-	-	2
CO8	3	3	-	2	2	2	-	-	2
CO9	3	3	-	2	2	2	-	-	2

ELE242: Advanced Power Electronics and Control (Credit : 4)

Objectives:

1. To Study basic semiconductor properties of power devices and combine circuit mathematics and characteristics of linear and non-linear devices
2. To study the basic principles and applications of power electronics
3. To understand the solid-state devices required for power electronic circuits
4. To study and understand the power conversion and power transmission principles
5. To study the industrial and domestic applications
6. To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
7. To provide strong foundation for further study of power electronic circuits and systems.

Course Outcome

Upon successful completion of this course the students will be able to,

1. Compare the characteristics of switching devices and use them in practical systems.
2. Design and model different types of power converters.
3. Design controller and implement them in simulation.
4. Design power circuit and protection circuit of devices and converter
5. Distinguish between multilevel and modular power electronic converters and their conventional converters counterpart.
6. Identify suitable power electronic converter to enable integration of various renewable resources.
7. Design and analyse power electronic circuit for a given application.

Unit-1: Introduction to Power Devices (12)

Concept of load, Application areas, Construction, I-V characteristics, switching characteristics, types, Selection criteria and applications of Power diodes, Power BJT, MOSFET, IGBTs Thyristors: SCR Characteristics, two-transistor model, turn-on and turn-off methods of SCR

Unit-2: Power Circuits (18)

Rectifiers: single phase rectifiers performance parameters overview (half-wave and full wave) Controlled rectifiers: Single phase and three phase R and RL load – half-wave, semi-full wave and dual converters, Single phase series converters, Powerfactor improvement techniques.

AC voltage controllers: ON-OFF control, Concept of phase control, single phase Uni-directional and bidirectional controllers with resistive & inductive loads.

Cycloconverter: Introduction to cycloconverter, types of cycloconverter,Single Phase Cycloconverter, Mid point cycloconverter, Bridge type cycloconverter, step up cycloconverter. Reduction of output harmonics.

DC-DC converters: step-up and step-down converters, performance parameters, control strategies,

Unit-3: Applications of Power Electronics (16)

DC power supplies: switch mode DC power supplies, flyback, forward, push pull, half bridge, full bridge-converters, resonant DC power supplies, resonant power supplies, bi- directional power supplies AC Power supplies (UPS): switch mode AC Power supplies, resonant and bidirectional AC Power supplies DC drives: Basic characteristics of DC motors, Operating modes, single phase and 3 phase drives, DC –DC converter Drives, Closed loop control of DC drives AC drives: Induction

motors drives-squirrel cage and wound rotor motor, Performance characteristics, control methods Synchronous motor drives-cylindrical rotor, Reluctance, Permanent magnet, switched reluctance-motors, control methods, Brushless DC and AC Motors and Stepper Motor: types and Control

Unit-4: Practical Design Considerations (14)

Snubber circuits, Turn-on and turn-off and over voltage snubbers, isolation methods, Control Circuits: Current mode and voltage mode PWM Cooling and heat sinks, reverse recovery transients, supply and load side transients, Selenium diodes and MOVs for voltage protections, Current protection methods, EMI standards, sources and shielding methods, Induction and capacitive heating, modern electric welding

Text /Reference books:

1. Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, 3rd Edition, Pearson.
2. Industrial and Power Electronics, Deodatta Shingare, Electrotech Publication.
3. Power Electronics: Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, Wiley.
4. Power Electronics, P. C. Sen, Tata McGraw-Hill Education.
5. Power Electronics: A First Course, Ned Mohan, 2012.
6. Power Electronics Handbook, edited by Muhammad Rashid, Elsevier
7. Fundamentals of Power Electronics, Robert W. Erickson, Dragan Maksimovic, Springer
8. Power Electronics, Daniel Hart, Tata McGraw-Hill Education, 2011

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	-	-	1	-	-	-	-	-
CO2	2	3		2	1	1	-	-	-
CO3	3	2	2	1	2	2	-	-	2
CO4	3	2	1	2	1	2	-	-	2
CO5	-	2	-	1	-	-	-	-	-
CO6	3	2	-	2	-	-	-	2	1
CO7	3	3	2	2	2	2	-	1	3

ELE243: Fundamentals of Artificial Intelligence (Credit-4)

Course Objectives:-

1. To Study basic Concept of AI.
2. To study the distinction between optimal reasoning Vs. human like reasoning
3. To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
4. To understand Logic.
5. TO understand AI planning.
6. To get an idea on different knowledge representation techniques.
7. To understand the applications of AI, namely game playing, theorem proving

Course Outcomes:

By the end of the course students will be able to

CO1. Concept of AI
CO2. Analyze different Logic.
CO3. To formulate an efficient problem space for a problem expressed in natural language.
CO4. To select a search algorithm for a problem and estimate its time and space complexities.
CO5. AI Planninh
CO6. To possess the skill for representing knowledge using the appropriate technique for a given Problem.
CO7.To apply AI techniques to solve problems of game playing

UNIT 1: Introduction to AI (20L)

Basic Definitions and terminology, Foundation and History of AI, Overview of AI problems, Evolution of AI, Applications of AI, Classification/Types of AI. Artificial Intelligence vs Machine learning. Intelligent Agent: Types of AI Agent, Concept of Rationality, nature of environment, structure of agents. Turing Test in AI.

Problem Solving:- Search Algorithms in Artificial Intelligence: Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm, Best-first Search; Problem Reduction.

UNIT 2: Problem Solving (15L)

Problem Solving by Search-II and Propositional Logic, Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions. Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Propositional Logic: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

UNIT 3: Logic and Knowledge Representation (15L)

First-Order Logic: Representation, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution. Knowledge Representation: Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects,
Reasoning Systems for Categories, Reasoning with Default Information.

UNIT 4: AI Planning (10L)

Classical Planning: Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Planning and Acting in the Real World: Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

TEXT BOOKS

1. Artificial Intelligence A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCES:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3	3	3	2	1	2	1	3
CO2	2	1	1	1	1	-	1	-	-
CO3	-	3	-	2	-	1	-	-	-
CO4	-	-	-	2	-	-	2	-	-
CO5	1	1	-	3	-	-	-	-	-
CO6	-	-	-	1	2	-	-	-	-
CO7	2	1	-	-	-	-	-	-	-

PSEL244- Wireless sensor Network

Objectives:

1. To familiarize with wireless sensor network.
2. To provide a background of single-node architecture and wireless networking protocols.
3. To study currently available sensor platforms and tools.
4. To understand the basic WSN technology and supporting protocols.
5. To understand the medium access control protocols.
6. To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
7. Knowledge about the security of wireless sensor network.

Course Outcomes:

1. Knowledge about deploying Wireless Sensor Network.
2. Understand various application of WSN.
3. Get knowledge about node architecture.
4. Understand and explain common wireless sensor node architectures.
5. Be able to carry out simple analysis and planning of WSNs.
6. Demonstrate knowledge of MAC protocols developed for WSN.
7. Knowledge about the wireless protocols.

Unit-1: Overview of Wireless Sensor Networks (15)

Introduction, background of sensor network technology, challenges and hurdles Examples of WSN applications: home control, industrial automation, medical and agricultural applications. ISM band, Specifications of WSN devices, Comparison with ad hoc network.

Unit-2: Architecture Considerations and Networking Sensors (15)

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts Physical Layer and Transceiver Design considerations.

Unit-3: Introduction to Protocols (15)

Overview of Communication Protocols for Sensor Networks, wireless networking protocols (IEEE 802.11, 802.15, 802.16, GPRS, MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, IEEE 802.15.4.

Unit 4.Sensor Network Platforms, Sensor Network Security (15)

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming. Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack, Secure Routing – SPINS, reliability requirements in sensor networks.

Text / Recommended Books:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks Technology
2. Protocols and Applications”, John Wiley & Sons, 2007.
3. Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong, “Wireless Sensor Networks- Signal Processing and Communications Perspectives” John Wiley & Sons,2009
4. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, ELSEVIER publications, 2005.
5. Kaveh Pahlavan and Prashant Krishnamurthy, “Principle of Wireless network- A unified approach”, Prentice Hall, 2006.
6. “Theoretical and algorithmic aspects of sensor, Ad Hoc Wireless and Peer to Peer Networks”, Edited by Jie Wu, Auerbach Publications.
7. Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems, CRC
8. PRESS Publication, Edited by Mohammad Ilyas and Imad Maugoub.

Course Outcome	Program Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2	1	1	-	3	-	-	1
CO2	1	1	-	1	-	-	-	-	1
CO3	1	1	1	-	-	-	-	-	1
CO4	1	1	-	2	-	-	-	-	2
CO5	1	1	-	1	-	-	-	-	1
CO6	2	2	-	-	1	-	-	-	1
CO7	2	2	-	-	2	-	-	-	2

PSEL245: Practical course VII – Project