Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

(Autonomous)

Academic Year 2023-2024

2022 Pattern

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

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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

Justification for the mapping

PO1 Disciplinary Knowledge

CO1: Developing models of physical systems aligns with disciplinary knowledge in control systems engineering, ensuring a solid foundation for the analysis and design of control systems.
CO2: Determining the stability of closed-loop control systems is a fundamental aspect of disciplinary knowledge in control systems engineering, contributing to a deeper understanding of system behavior.
CO3: Performing time domain analysis for stability analysis is a key component of disciplinary knowledge in control systems engineering, providing insights into the dynamic behavior of control systems.
CO4: Conducting frequency domain analysis for stability analysis is a part of disciplinary knowledge in control systems engineering, enhancing the understanding of system response in the frequency domain.

CO5: Applying root-locus and frequency plots techniques contributes to disciplinary knowledge in control systems engineering, offering valuable tools for system analysis and design.
CO6: Expressing and solving system equations for stability using different plots is integral to disciplinary knowledge in control systems engineering, demonstrating proficiency in analytical techniques.
CO7: Differentiating between various digital controllers and understanding their roles is a disciplinary knowledge aspect in control systems engineering, providing insights into the diverse range of control technologies.
CO8 and CO9: Understanding fuzzy logic principles and operations aligns with disciplinary knowledge, broadening the graduate's understanding of alternative control paradigms and expanding the toolkit for control system design.

PO2 Critical Thinking and Problem solving

CO1: Critical thinking is essential in determining and using models of physical systems, requiring analytical skills to choose appropriate models for effective control systems analysis and design.
CO2: Determining the stability of closed-loop control systems demands critical thinking in evaluating system behavior and applying stability criteria to solve complex problems in control systems engineering.
CO3: Performing time domain analysis involves critical thinking to analyze system dynamics and assess stability, contributing to effective problem-solving in control systems engineering.
CO4: Conducting frequency domain analysis requires critical thinking to interpret system responses in the frequency domain, demonstrating problem-solving skills in control systems engineering.
CO5: Applying root-locus and frequency plots techniques necessitates critical thinking to analyze and interpret system behavior, showcasing problem-solving abilities in control systems engineering.
CO6: Expressing and solving system equations for stability using different plots involves critical thinking and problem-solving skills to navigate complex mathematical relationships in control systems.
CO7: Differentiating between various digital controllers and understanding their roles requires critical thinking to make informed decisions in control systems engineering problem-solving.
CO8 and CO9: Understanding fuzzy logic principles involves critical thinking to grasp alternative control paradigms, showcasing problem-solving skills in incorporating fuzzy logic into control system design.

PO3 Social competence:

CO5: Applying root-locus and frequency plots techniques requires social competence to communicate analysis results and collaborate on control system assessments, contributing to positive interactions within the control systems engineering community.
CO6: Expressing and solving system equations for stability using different plots demands effective communication and collaborative problem-solving, showcasing social competence in control systems engineering.
CO7: Differentiating between various digital controllers and understanding their roles involves effective communication to convey technical information about controllers and collaborate on control system design, emphasizing social competence.

PO4 Research-related skills and Scientific Temper

CO1: Developing models of physical systems requires research skills to explore and understand various modeling approaches, aligning with the research-related skills needed in control systems engineering.
CO2: Determining the stability of closed-loop control systems involves scientific temper in critically analyzing and applying stability concepts, demonstrating research-related skills in control systems engineering.

CO3: Performing time domain analysis for stability analysis demands research skills to investigate and understand the dynamic behavior of control systems, contributing to scientific temper in control systems engineering.
CO4: Conducting frequency domain analysis requires research-related skills to explore and analyze control system behaviors in the frequency domain, aligning with the scientific temper in control systems engineering.
CO5: Applying root-locus and frequency plots techniques for analysis involves research skills to explore and apply advanced methods, showcasing scientific temper in control systems engineering research.
CO6: Expressing and solving system equations for stability using different plots demonstrates research-related skills in applying analytical techniques for control systems engineering, fostering a scientific temperament.
CO7: Differentiating between various digital controllers and understanding their roles involves research skills to stay updated on controller technologies, showcasing scientific temper in control systems engineering research.
CO8 and CO9: Understanding fuzzy logic principles involves research-related skills to explore and comprehend alternative control paradigms, demonstrating scientific temper in control systems engineering research.

PO5 Trans-disciplinary knowledge:

CO1: Integrating models of physical systems involves trans-disciplinary knowledge, incorporating insights from various scientific and engineering disciplines for effective control systems analysis and design.
CO2: Determining the stability of closed-loop control systems demands an integration of knowledge from different domains to comprehensively address the complexities of system behavior, showcasing trans-disciplinary skills in control systems engineering.
CO3: Performing time domain analysis requires a trans-disciplinary approach to leverage insights from different fields in control systems engineering for stability analysis.
CO4: Conducting frequency domain analysis necessitates a trans-disciplinary perspective to understand system responses in the frequency domain, contributing to trans-disciplinary knowledge in control systems engineering.
CO5: Applying root-locus and frequency plots techniques for analysis involves integrating knowledge from diverse sources to obtain a comprehensive understanding of control system behavior, aligning with trans-disciplinary knowledge.
CO6: Expressing and solving system equations for stability using different plots involves a trans-disciplinary approach to navigate complex mathematical relationships in control systems engineering.
CO7: Differentiating between various digital controllers and understanding their roles demands trans-disciplinary knowledge to comprehend the interplay of electronics, computer science, and control systems engineering in controller technologies.
CO8 and CO9: Understanding fuzzy logic principles requires a trans-disciplinary perspective, broadening the graduate's understanding of alternative control paradigms and expanding the toolkit for control system design.

PO6 Personal and professional competence

CO1: Developing models of physical systems and using them effectively requires personal and professional competence in translating theoretical concepts into practical control system design.
CO2: Determining the stability of closed-loop control systems involves personal and professional competence in applying mathematical and analytical skills to assess and improve system behavior.
CO3: Performing time domain analysis demands personal and professional competence in utilizing analysis techniques for effective control systems engineering practice.
CO4: Conducting frequency domain analysis requires personal and professional competence to

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interpret system responses in the frequency domain, contributing to effective control systems engineering practice.
CO5: Applying root-locus and frequency plots techniques involves personal and professional competence to use advanced methods for practical control system analysis.
CO6: Expressing and solving system equations for stability using different plots showcases personal and professional competence in applying analytical techniques for control systems engineering.
CO7: Differentiating between various digital controllers and understanding their roles requires personal and professional competence in making informed decisions for effective control systems engineering practice.
CO8 and CO9: Understanding fuzzy logic principles necessitates personal and professional competence to apply alternative control paradigms effectively, enhancing the graduate's toolkit for control system design.

PO7 Effective Citizenship and Ethics:

CO1: Determining and using models of physical systems involves ethical considerations to ensure accurate representations and responsible use of models for control systems analysis and design.
CO2: Assessing the stability of closed-loop control systems requires ethical decision-making to ensure the safety and reliability of engineered systems.
CO6: Expressing and solving system equations for stability using different plots demands ethical considerations in making accurate and responsible decisions in control systems engineering.

PO8 Environment and Sustainability:

CO1: Determining and using models of physical systems requires considering environmental factors and sustainability concerns to ensure that control systems are designed with minimal impact on the environment.
CO2: Assessing the stability of closed-loop control systems contributes to environmental sustainability by ensuring energy-efficient and reliable system operation.
CO3: Performing time domain analysis demands considering sustainability principles to ensure that control system designs align with environmental impact considerations.
CO4: Conducting frequency domain analysis requires awareness of environmental impact to ensure that control system designs contribute to sustainability.
CO5: Applying root-locus and frequency plots techniques involves considering the environmental impact of control system designs and optimizing for sustainability.
CO6: Expressing and solving system equations for stability using different plots requires considering sustainability principles to ensure responsible and efficient control system operation.

PO9 Self-directed and Life-long learning:

CO1: Being able to determine and use models of physical systems requires a commitment to continuous learning and staying updated with advancements in control systems modeling techniques.
CO2: Continuous learning is essential for staying abreast of evolving stability analysis methods and applying them to express and solve system equations using different plots in control systems engineering.
CO3: Self-directed and life-long learning is necessary for staying informed about the latest time and frequency domain analysis techniques for stability analysis in control systems.
CO4: Continuous learning is essential to stay updated on frequency domain analysis methods, ensuring effective control systems engineering practice.
CO5: Staying current with advancements in root-locus and frequency plots techniques through self-directed learning is crucial for effective analysis and design of control systems.
CO6: Expressing and solving system equations for stability using different plots involves self-directed learning to navigate complex mathematical relationships in control systems engineering.

CO7: Differentiating between various digital controllers and understanding their roles necessitates self-directed learning to stay informed about evolving controller technologies in control systems engineering.
CO8 and CO9: Understanding fuzzy logic principles involves self-directed learning to explore and comprehend alternative control paradigms, contributing to the graduate's ability to adapt and learn throughout their career in control systems engineering.

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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

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Justification for the mapping

PO1: Disciplinary Knowledge

The course outcomes (COs) contribute to the development of students' disciplinary knowledge in power electronics. For example, CO1, CO2, CO3, CO4 CO6 and CO7 require students for understanding of the principles and functioning of power electronic devices and their applications, operation of various phase power supplies and fundamental disciplinary knowledge in the field of electrical engineering.

PO2: Critical Thinking and Problem Solving

All of the COs contributes to the development of students' critical thinking and problem-solving skills. For example, CO2 to CO4 require students to think critically about various turn-on and turn-off methods, designing power converters and problem-solving skills to meet specific requirements. CO5 to CO7 required to designing power and protection circuits involves critical thinking and problem-solving to ensure the reliability and safety of devices and converters.

PO3: Social competence

CO3, CO4 and CO7: It is required for analyses power electronic circuit for a given application for social requirement.

.**PO4: Research-related skills and Scientific temper**

The entire COs contributes to the development of students' research-related skills and scientific temper. All COs require students for designing involves applying scientific principles and possibly engaging in research to improve or innovate power converter designs and understand the scientific principles behind the chosen design.

PO5: Trans-disciplinary knowledge

All the COs contribute to the development of students' trans-disciplinary knowledge. CO2, CO3, CO4 and CO7 require to identifying suitable converters for renewable resources. Require knowledge that spans different disciplines, such as understanding the characteristics of renewable sources and integrating them into the power system.

PO6: Personal and professional competence

CO3, CO4 and CO7 all contribute to the development of students' personal and professional competence. For example, learning advanced power electronics technology enhances personal and professional competence in keeping up with technological advancements in the field.

PO8: Environment and Sustainability

CO6, CO7: Trans-disciplinary knowledge is often essential when dealing with environmental and sustainability aspects, such as integrating renewable resources.

PO9: Self-directed and Life-long learning

CO3, CO4, CO6 and CO7 all contribute to the development of students' ability to engage in self-directed and life-long learning. For example, the entire COs is essential for staying updated in the rapidly evolving field power electronics.

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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	-	-	-	-	-	-	-

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Understanding the concept of AI contributes to disciplinary knowledge by providing a foundation in the field of artificial intelligence**.**

CO2: The concept of AI requires critical thinking to grasp complex ideas and problem-solving skills to apply AI techniques effectively.

CO5: Knowledge of AI enhances personal and professional competence by staying abreast of advancements in technology.

CO7:AI technique uses Disciplinary Knowledge.

P02: Critical Thinking and Problem solving

CO1: Understanding the concept of AI requires critical thinking to comprehend the complexities and possibilities of artificial intelligence.

CO2: Analyzing different logic involves critical thinking to evaluate and understand various logical systems.

CO3: Formulating an efficient problem space demands critical thinking to translate natural language problems into well-defined computational problems.

CO5: AI Planning involves critical thinking skills to strategize and solve complex problems.

CO7: Applying AI techniques to game playing requires critical thinking to develop strategies and algorithms for decision-making.

PO3 :Social competence

CO1: Understanding the concept of AI contributes to Social competence by providing a foundation in the field of artificial intelligence.

CO2: The concept of AI requires Social competence to grasp complex ideas and problem-solving skills to apply AI techniques effectively.

PO4: Research-related Skills and Scientific Temper
CO1 to CO6: All Include Research-related Skills and Scientific Temper

PO5: Trans-disciplinary knowledge

CO1: Understanding the concept of AI requires knowledge that spans multiple disciplines, including computer science, cognitive science, and mathematics.

CO2: Analyzing different logic involves understanding diverse logical systems, contributing to trans-disciplinary knowledge

CO6: Representing knowledge using appropriate techniques involves knowledge from various disciplines, including knowledge representation, ontology, and cognitive science.

P06: Personal and professional competence

CO1: Understanding the concept of AI requires Personal and professional competence spans multiple disciplines, including computer science, cognitive science, and mathematics.

CO6: Representing knowledge using appropriate techniques involves knowledge from Personal and professional competence, ontology, and cognitive science.

P07: Effective Citizenship and Ethics

CO1: Understanding the concept of AI requires considerations of ethical implications, responsible use of technology, and effective citizenship in shaping the societal impact of artificial intelligence.

CO2: Analyzing different logic involves understanding the ethical implications of logical systems and promoting responsible and ethical reasoning.

CO4: Selecting a search algorithm involves ethical considerations related to the impact of algorithmic choices on individuals and society.

PO8: Environment and Sustainability

CO1:Understanding the concept of AI contributes to Environment and Sustainability by providing a foundation in the field of artificial intelligence.

PO9: Self-directed and Life-long learning

CO1: Understanding the concept of AI contributes to Self-directed and Life-long learning by providing a foundation in the field of artificial intelligence

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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	2	-	-	1	-	-	1	1	1
CO2	2	1	1	1		-	-	-	-
CO3	2	1	1	-	-	-	-	-	-
CO4	1	1	1	1	1	-	-	1	1
CO5	1	2	-	1	1	-	-	1	-
CO6	1	1	-	-	-	-	-	-	-
CO7	2	-	-	2	-	-	-	2	1

Justification for the mapping

PO1: Disciplinary Knowledge

CO1: Knowledge about deploying Wireless Sensor Network directly contributes to demonstrating comprehensive disciplinary knowledge in the specific program, aligning with the postgraduate program's objectives.

CO2: Understanding various applications of WSN is strongly related to disciplinary knowledge, as it demonstrates a practical understanding of how the theoretical concepts can be applied in real-world scenarios.

CO3: Getting knowledge about node architecture is strongly related to disciplinary knowledge, as it contributes to a comprehensive understanding of the specific program related to Wireless Sensor Networks.

CO4: Understanding and explaining common wireless sensor node architectures is strongly related to disciplinary knowledge, providing a foundational understanding of the discipline within the postgraduate program.

CO5: Being able to carry out simple analysis and planning of WSNs is strongly related to disciplinary knowledge, showcasing the ability to apply theoretical knowledge in practical situations.

CO6: Demonstrating knowledge of MAC protocols developed for WSN is strongly related to disciplinary knowledge, indicating a strong theoretical understanding in the specific area of Wireless Sensor Networks.

CO7: Knowledge about wireless protocols is strongly related to disciplinary knowledge, as it forms a crucial aspect of the comprehensive understanding required in the specific postgraduate program.

PO2: Critical Thinking and Problem solving

CO2: Understanding various applications of WSN is moderately related to critical thinking and problem-solving, as it involves practical understanding but may not explicitly require the critical analysis of scientific texts.

CO3: Getting knowledge about node architecture is moderately related to critical thinking and problem-solving, as it involves technical understanding but may not explicitly require critical evaluation or placing scientific statements in contexts.

CO4: Understanding and explaining common wireless sensor node architectures is moderately related to critical thinking and problem-solving, providing technical knowledge but may not explicitly require critical evaluation of scientific texts.

CO5: Being able to carry out simple analysis and planning of WSNs is strongly related to critical thinking and problem-solving, as it requires applying analytical skills to design solutions and involves problem identification and planning.

CO6: Demonstrating knowledge of MAC protocols developed for WSN is strongly related to critical thinking and problem-solving, as it involves understanding and evaluating protocols in the context of problem-solving.

PO3: Social Competence

CO2: Understanding various applications of WSN is moderately related to social competence, as it may involve effective communication about the diverse applications of WSN in different contexts.

CO3: Getting knowledge about node architecture is moderately related to social competence, as it may involve effective communication of technical concepts related to node architecture.

CO4: Understanding and explaining common wireless sensor node architectures is moderately related to social competence, as it involves effective communication of technical information to others.

PO4: **Research-related skills and Scientific temper**

CO1: Knowledge about deploying Wireless Sensor Network is moderately related to research-related skills and scientific temper, as it involves technical knowledge but may not explicitly require extensive formulation and testing of hypotheses.

CO2: Understanding various applications of WSN is moderately related to research-related skills, as it involves practical understanding but may not explicitly require extensive analysis, interpretation, and hypothesis testing.

CO4: Understanding and explaining common wireless sensor node architectures is moderately related to research-related skills, as it involves technical explanation but may not explicitly involve extensive analysis and hypothesis testing.

CO5: Being able to carry out simple analysis and planning of WSNs is strongly related to research-related skills, as it requires analytical skills and planning, contributing to the formulation and testing of hypotheses.

CO7: Knowledge about wireless protocols is moderately related to research-related skills, as it provides technical knowledge but may not explicitly involve extensive analysis and hypothesis testing.

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PO5: **Trans-disciplinary knowledge**

CO4: Understanding and explaining common wireless sensor node architectures is moderately related to trans-disciplinary knowledge, as it provides technical knowledge within a specific discipline.
CO5: Being able to carry out simple analysis and planning of WSNs is strongly related to trans-disciplinary knowledge, as it involves applying analytical skills to address problems in a broader context.

PO7: Effective Citizenship and ethics
CO1: Knowledge about deploying Wireless Sensor Network is moderately related to effective citizenship and ethics, as it may contribute to technical knowledge but may not explicitly involve demonstrating empathetic social concern or an awareness of moral and ethical issues.

PO8: Environment and Sustainability

CO1: Knowledge about deploying Wireless Sensor Network is moderately related to environment and sustainability, as it may contribute to technical knowledge but may not explicitly involve understanding the impact of scientific solutions in societal and environmental contexts.
CO4: Understanding and explaining common wireless sensor node architectures is moderately related to environment and sustainability, as it provides technical knowledge but may not explicitly involve understanding the impact in societal and environmental contexts.
CO5: Being able to carry out simple analysis and planning of WSNs is strongly related to environment and sustainability, as it involves applying analytical skills to address problems in the context of societal and environmental impacts.
CO7: Knowledge about wireless protocols is moderately related to environment and sustainability, as it provides technical knowledge but may not explicitly involve understanding the impact in societal and environmental contexts.

PO9: Self-directed and Life-long learning

CO1: Knowledge about deploying Wireless Sensor Network is strongly related to self-directed and life-long learning, as it involves foundational knowledge that supports continuous learning and adaptation to technological changes.
CO4: Understanding and explaining common wireless sensor node architectures is strongly related to self-directed and life-long learning, as it involves foundational knowledge crucial for continuous learning.
CO7: Knowledge about wireless protocols is strongly related to self-directed and life-long learning, as it encompasses fundamental knowledge for adapting to changes in wireless communication technologies.

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PSEL245: Practical course VII – Project

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