Cummins College of Engineering for Women

(An autonomous institute affiliated to Savitribai Phule pune university)

Karve Nagar, Pune - 411 052.

Vision

To be globally renowned engineering institute for imparting holistic education and developing professional women leaders in engineering and technology

Syllabus Structure and Syllabus

of

T. Y. B.Tech.
(Electronics and Telecommunication Engineering)

2023 Pattern [R0]

List of Abbreviations

Abbreviation	Title
PCC	Programme Core Course
BSC	Basic Science Course
ESC	Engineering Science Course
PE	Programme Elective Course
OE	Open Elective
VSEC	Vocational and Skill Enhancement Course
CC	Co-curricular Courses / Liberal Learning Course
IKS	Indian Knowledge System
VEC	Value Education Course
RM	Research Methodology
INTR	Internship
PROJ	Project
CEP	Community Engagement Project
RM	Research Methodology
Mm	Multidisciplinary Minor
AEC	Ability Enhancement course

Curriculum for UG Degree Course in B. Tech. Electronics and Telecommunication Engineering
(Academic Year: 2025-26 Onwards)

Semester-VI

Course Code	Course Title	Teaching Scheme Hours / Week			Cr	Examination Scheme			Total Marks
		L	T	P		ISE	ESE	Pr/Or	
23PCEC601	Broadband Communication Systems	3	0	0	**3**	50	50	0	**100**
23PCEC602	Embedded Processors	3	0	0	**3**	50	50	0	**100**
23PCEC603	Artificial Intelligence	3	0	0	**3**	50	50	0	**100**
23PCEC604	Computer Networks	3	0	0	**3**	50	50	0	**100**
23PEEC601	Programme Elective-II	3	0	0	**3**	50	50	0	**100**
23MmEC601	Deep Learning in Healthcare	2	0	0	**2**	25	25	0	**50**
23PCEC602L	Embedded Processors Lab	0	0	2	**1**	25	0	25	**50**
23PCEC603L	Artificial Intelligence Lab	0	0	2	**1**	25	0	25	**50**
23PEEC601L	Programme Elective-II Lab	0	0	2	**1**	25	0	25	**50**
23VSECEC601L	Java Programming Lab	0	0	4	**2**	25	0	25	**50**
	Total =	**17**	**00**	**10**	**22**	**375**	**275**	**100**	**750**

L=Lecture, T=Tutorial, P= Practical, Cr= Credits, ISE =In Semester Evaluation, ESE =End Semester Examination, Pr/Or = Practical/Oral

Programme Elective-II		**Programme Elective-II Lab**	
PECEC601A	Control and Automation	PECEC601LA	Control and Automation Lab
PECEC601B	Electromagnetic Waves and Radiating Systems	PECEC601LB	Electromagnetic Waves and Radiating Systems Lab
PECEC601C	Robotics	PECEC601LC	Robotics Lab
PECEC601D	Power Electronics	PECEC601LD	Power Electronics Lab

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MKSSS CUMMINS COLLEGE OF ENGG. FOR WOMEN KARVENAGAR PUNE-52.

23PCEC601 BROADBAND COMMUNICATION SYSTEMS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1 To establish a strong foundation in optical fibre communication systems and their advanced extensions.
2 To develop competence in modern optical network technologies, including DWDM, coherent systems, and advanced components.
3 To understand satellite communication principles, orbital mechanics, and link engineering.
4 To familiarize students with contemporary satellite technologies, including LEO constellations, DVB-S2X, NTN/5G, and optical inter-satellite links.

Course Outcomes:

After completion of the course, students will be able to

CO1 Discuss the components of the optical fibre system and its propagation characteristics.
CO2 Illustrate broadband satellite system architectures
CO3 Apply Dense Wavelength Division Multiplexing using coherent communication techniques in broadband optical systems.
CO4 Apply the propagation effects to satellite orbits for communication link design.
CO5 Analyze the impact of channel impairments and modulation schemes on Optical Wireless Communication link design.

Unit I: Optical Fiber Communication Fundamentals

Fiber optic communication system elements, optical spectrum and transmission windows, Optical fibers: types, refractive index profiles, Multicore fiber, attenuation, chromatic dispersion, PMD and compensation techniques, Optical sources: LEDs, DFB lasers, Detectors: PIN, APD, performance parameters, Bandwidth, rise-time budget and link budget

Unit II: Dense Wavelength Division Multiplexing Systems and Coherent Optical Detection

Multi-carrier Modulation (OFDM) for Optical Wireless Communication, Colour Shift Keying, NOMA. WDM/DWDM system design: channel spacing, ITU-T grids, dispersion management, Optical amplifiers EDFA, Coherent detection fundamentals: QPSK/QAM, LO requirements, OSNR role in coherent systems, Nonlinear impairments: Self-Phase Modulation Cross-Phase Modulation, Four Wave Modulation

Unit III: Optical Wireless Communication and Channel Modelling

Indoor and outdoor OWC system fundamentals, Ambient light interference and multipath effects, Channel modelling for indoor OWC and FSO links, Atmospheric turbulence effects, induced penalties, and mitigation techniques, Introduction to Photonic Integrated Circuits (PICs) and applications, Use-cases: Indoor OWC links, O-OFDM, CSK modulation, WiFi/LiFi coexistence, V2V communications

Unit IV: Satellite Fundamentals & Orbital Mechanics

Satellite communication overview; evolution and applications, Orbital types: GEO, MEO, LEO, HEO; Keplerian elements and orbital parameters, Look-angles, Satellite communication standards: DVB-S, DVB-S2, DVB-S2X, Uplink and downlink design principles, Link budget calculations, EIRP, G/T ratio, system noise temperature, Carrier-to-noise ratios, rain attenuation, availability, Earth station parameters, small Earth stations, VSAT fundamentals

Unit V: Modern Satellite Systems

Modern satellite architectures: LEO constellations & mega constellations, Handover strategies in LEO systems, NTN/5G integration, IoT connectivity via satellites, Software-defined payloads, Optical inter-satellite links (OISL), Regulatory aspects: spectrum allocation, orbital sustainability

Text Books:

1. Gerd Keiser**, "Optical Fiber Communications"**, Tata McGraw Hill, (5th Edition), (2013).
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt **"Satellite Communications",** John Wiley &Sons, (3rd Edition), (2002).
3. Dr. Ivan B. Djordjevic, **"Advanced Optical and Wireless Communications Systems",** Springer, (1st Edition), (2020).

Reference Books:

1. John M. Senior, **"Optical Fiber Communications: Principles and Practice"**, PHI, (3rd Edition), (2008).
2. Dennis Roddy, **"Satellite Communications"**, *McGraw Hill*, (4th Edition), (2017).
3. Alessandro Vanelli-Coralli, Nicolas Chuberre, Gino Masini, Alessandro Guidotti, Mohamed El Jaafari, **"5G Non-Terrestrial Networks: Technologies, Standards, and System Design"**, *Wiley-IEEE Press*, 1st Edition (2024).
4. Jun Yang, **"The Inter-Satellite Link: Theory and Technology"**, *Springer Singapore*, 1st Edition (2025).

Online Resources:

1. NPTEL Course "Fiber Optic Communication Technology" https://nptel.ac.in/courses/108/106/108106167
2. NPTEL Course "Satellite Communication Systems" https://nptel.ac.in/courses/117/105/117105131
3. NPTEL Course "Optical Wireless Communications For Beyond 5G Networks And IOT" nptel.ac.in/courses/108106190

23PCEC602 EMBEDDED PROCESSORS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1 To introduce the architecture and features of embedded processor
2 To explain the applications of embedded processor-based architecture
3 To interface I/O devices to embedded processor for real world applications
4 To explain hardware and software development tools

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain architecture of core-based processor
CO2 Develop an algorithm for on-chip and off chip peripherals
CO3 Analyse hardware circuit and software of embedded systems
CO4 Design embedded system for real time applications

Unit I: Introduction to processor cores

Processor cores and RISC design philosophy, Multi-core concepts, ARM core data-flow model, Overview of Cortex processor architecture, Features, classification of cortex series, Bus interfaces (AMBA, AHB, APB), AHB microcell, Introduction to STM32 series processors, Architecture block diagram, Pin configuration and description, GPIO pin-connect block, register-level programming, and interfacing with LED.

Unit II: System Architecture and Control

Modes of operation and execution, System Address Map and Bit Banding, Processor core registers and exceptions, System control, memory map, Memory Protection Unit (MPU), NVIC, Floating Point Unit, Watchdog Timer, Serial communication programming for transmission and reception from computer, Programming for UART/USART, Ethernet.

Unit III: On Chip Peripherals

Power controller, reset and clock controller, System configuration controller, ADC, sensor interface and calibration, DAC controllers and registers, Timers, RTC, and register configurations.

Unit IV: External Peripheral Interface

Interfacing of Global System for Mobile, Global Positioning System, Graphical LCD, Bluetooth module, Wi-Fi module. Debugging, Debug Port (JTAG/SWD), Embedded Trace Macrocell (ETM), Trace port

Unit V: Embedded system Design using processor

Firmware development using CMSIS Standard, Case studies: Societal, health, agricultural, Industry Innovation, Sustainable Cities and Communities, safety.

Textbooks:

4. Andrew N. Sloss, Dominic Symes, Chris Wright, **"ARM System Developer's Guide-Designing and Optimizing Software"**, *Elsevier Publication*, (1st Edition), (2004).
5. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", (3rd edition) 2024.
6. Alexander G. Dean, **"Embedded Systems Fundamentals with ARM Cortex-M Based Microcontrollers"**, – 2nd Edition (2022)

Reference Books:

1. Tammy Noergaard, **"Embedded Systems Architecture"**, *Elsevier Publications*, (2nd Edition), (2004).
2. Dr. K. V. K. K. Prasad, **"Programming for embedded systems"**, *Wiley – Dreamtech India Pvt. Ltd*., (1st Edition), (2008).

Online Resources:

1. ARM Cortex M4 Technical Reference manual
2. https://www.st.com/content/st_com/en/support/learning/stm32-education/stm32-moocs.html
3. NPTEL course on, "Embedded System Design with ARM", https://onlinecourses.nptel.ac.in/noc20_cs15/preview
4. NPTEL course on, "ARM based development", https://nptel.ac.in/courses/117/106/117106111/
5. https://www.st.com/content/st_com/en/support/learning/stm32-education.html

23PCEC603 ARTIFICIAL INTELLIGENCE

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1 To introduce the fundamental concepts of Artificial Intelligence
2 To develop an understanding of knowledge representation, reasoning, and learning methods to building intelligent systems
3 To enable students to design simple expert systems and apply essential data mining techniques
4 To introduce students to modern AI paradigms namely, agentic AI, generative AI, explainable AI, and the ethical issues associated with AI systems

Course Outcomes:

After completion of the course, students will be able to

CO1 Analyse intelligent agents, classical problem-solving techniques, and search strategies to select optimal AI solutions
CO2 Compare knowledge representation techniques, reasoning and learning to solve structured problems
CO3 Analyse the functionality and working of expert systems and ethical implications of AI systems
CO4 Examine the real-world applications using modern AI paradigms

Unit I: Basics of AI and Problem Solving

Categories of AI, applications of AI, Intelligent agents, agents and environments, nature of environments, structure of agents,-Searching for solutions

Unit II: Search Algorithms

Search Algorithms: uninformed search, Informed search, Local search algorithms and optimization problems, Optimal decisions in games, Adversarial search algorithm: MINIMAX algorithm, Alpha-Beta pruning, Constraint satisfaction problems (CSP)

Unit III: Knowledge representation, Reasoning and Learning

Logic: Propositional logic, First order logic, Knowledge engineering in first order logic, Inference in first order logic, forward chaining, backward chaining, resolution.
Types of Reasoning: Inductive and deductive, non-monotonic and monotonic reasoning
Reasoning with fuzzy logic, inference methods, Truth Maintenance Systems

Learning from observations: forms of learning, Inductive and deductive learning, Ensemble learning, Logical formulation of learning, Hidden Markov Models, Association Learning: Apriori Algorithm, Case study.

Unit IV: Expert systems and Ethics of AI

Introduction to Expert System, Architecture and functionality, Examples of Expert system. Template Matching, Prototype Matching, Pattern Mining.

Ethics of AI: Privacy and Surveillance, Manipulation of Behaviour, Opacity of AI Systems, Bias in Decision Systems, Human-Robot Interaction, Automation and Employment, Autonomous Systems, Machine Ethics, Artificial Moral Agents Privacy, Case study.

Unit V: Modern AI paradigms

Basics of Gen AI, Models, Prompt engineering, multimodal GenAI, tools, evaluation.

Agentic AI, need, difference between classical agents vs. modern autonomous agents, Components: planning, memory, tool use, Applications: workflow automation, autonomous assistants.

Explainable AI (XAI), Black-box vs. transparent models, Feature importance, Rule-based explanations, Local example–based explanations, Algorithms, Case study**.**

Textbooks:

1 Stuart Russell, Peter Norvig, **'Artificial Intelligence - A Modern Approach'**, *Pearson Education/Prentice Hall of India,* (3rd Edition), (2010)

2 Sam Bhagwat, "**Principles of Building AI Agents**", *Independently Published*, (1st edition), (2025).

3 Alger Fraley, "**Artificial Intelligence and Generative AI Bible**", *Algo Ray Publishing*, (1st edition) , (2023).

4 Paula Boddington**, "Towards a Code of Ethics for Artificial Intelligence", ***Springer International Publishing***,** (1st Edition), (2017).

Reference Books:

1. Nils J. Nilsson, **"Artificial Intelligence: A new Synthesis"**, *Morgan Kaufmann Publishers,* (1st Edition), (1998).
2. George F. Luger, **"Artificial Intelligence: Structures and Strategies for Complex Problem Solving ",** *Pearson Education***,** (6th Edition), (2008) .
3 Elaine Rich, Kevin Knight and Shivshankar Nair, "**Artificial Intelligence"**, *Tata McGraw Hill,* (3rd Edition), (2009).

Online Resources:

1. NPTEL Lectures on AI : http://nptel.ac.in/courses/106105077/
2. NPTEL Lectures on Gen AI : https://onlinecourses.nptel.ac.in/noc25_cs137/preview
3. https://plato.stanford.edu/entries/ethics-ai/
4. https://intelligence.org/files/EthicsofAI.pdf

23PCEC604 COMPUTER NETWORKS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE 50 Marks
Credits: 3

Course Objectives:
1. To introduce functions of each layer of computer network models
2. To introduce networking protocols, architectures and applications
3. To describe computer network applications
4. To introduce cloud computing fundamentals
5. To describe data & network security mechanisms

Course Outcomes:
After completion of the course, students will be able to
CO1 Explain network models & functions of physical layer
CO2 Analyze protocols, MAC techniques in data link layer
CO3 Apply IP addressing mechanisms, routing strategies for IP-based networks.
CO4 Explain concepts of cloud computing and advanced networking
CO5 Apply cryptographic algorithms for data security

Unit I: Basics of Computer Networks
Basics of Computer Network, Network Models, Physical layer functions, Data Link Control, Media Access Control, LAN technologies: Ethernet, Fast Ethernet, Connecting devices, Virtual LAN.

Unit II: Network Layer
Network layer Services, IPv4 & IPv6 Addresses, Network-Layer Protocols IP, ICMP, Unicast routing algorithms: Distance Vector, Link State Routing, Routing protocols: RIP, OSPF.

Unit III: Transport Layer & Application Layer
Transport layer services, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Application Layer Services, Client-server paradigm, Application layer protocols (HTTP, FTP, E-mail, DNS), Quality of Service.

Unit IV: Cloud Networking and Emerging Network Technologies
Introduction to cloud computing, Cloud Computing Architecture, Virtualization, Cloud Services & Platforms, Software Defined Networking (SDN), Case Study: Data Centre.

Unit V: Cryptography & Network Security
Security Goals & Attacks, Confidentiality techniques using ciphers, Network layer security, Transport layer security, Application layer security, Firewalls, Cyber Attacks.

Text Books:
1. Behrouz A. Forouzan, "**Data Communication and Networking**", Tata McGraw-Hill, (5th Edition), (2017).
2. Andrew S. Tannenbaum, "**Computer Networks**", Pearson Education, (6th Edition), (2022).

3. Shailendra Singh, **"Cloud Computing", Oxford** University Press; (1st Edition), (2018).

Reference Books:

1. William Stallings, **"Cryptography and Network Security: Principles and Practice",** (6th Edition), Pearson Education
2. Kurose, Rose**, "Computer Networking a Top Down Approach featuring the Internet",** Pearson, **(**8th Edition), (2021).
3. Wayne Tomasi, **"Introduction to Data Communication and Networking",** Pearson Education, (1st Edition), (2007).
4. Pachgare V.K**., "Cryptography and Information Security",** PHI, (3rd Edition),(2019)

Online Resources:

1. NPTEL Course "Computer Networks and Internet Protocol" https://onlinecourses.nptel.ac.in/noc26_cs35/preview

23PEEC601A CONTROL AND AUTOMATION

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Prerequisite: Basic Mathematics, Basic Electrical and Electronics Engineering

Course Objectives:

1 To establish understanding of the architecture, and operational principles of industrial automation systems, and Programmable Logic Controller.
2 To analyze system response and stability in time and frequency domain.
3 To test observability, controllability of a system
4 To enable students to examine the performance characteristics of standard controllers (P, I, D, PI, PD, PID)

Course Outcomes:

After completion of the course, students will be able to

CO1 Elaborate the components of Industrial Automation
CO2 Apply the conditions to check observability, and controllability of a system
CO3 Examine the system stability in time domain and frequency domain
CO4 Analyze the performance of a system for the given conditions

Unit I: Basics of Control System

Definition of Laplace and Inverse Laplace transform, Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modelling of Electric systems and Mechanical systems, Time and frequency domain behaviour of 1^{st} and 2^{nd} order LTI systems.

Unit II: Stability Analysis

Concept of Stability, Bode Plots, Stability analysis from plots**,** Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique.

Unit III: State Variable Analysis

State space advantages and representation, Transfer function from State space, Controllable canonical form, Observable canonical form, Solution of homogeneous state equations, State transition matrix and its properties, Computation of state transition matrix, Concepts of Controllability and Observability.

Unit IV: Introduction to Controllers

Classification of controllers, Introduction to Proportional (P), Proportional-Integral (P-I), Proportional-Derivative (P-D) and Proportional-Integral-Derivative (P-I-D) Controller, Effect of controlling action on various system parameters, Process control principles, Servomechanisms.

Unit V: Digital Control System

Introduction, Advantages over analog control system, Sampled Data Control System, Transfer Function of Digital Control System, Step Response (First & Second Order Systems only), Introduction to Digital PID Controller, Concept of Offset P, PI, PD and PID Characteristics Introduction to PLC: Block schematic, PLC addressing, any one application of PLC using Ladder diagram.

Unit VI: Industrial Automation

Types of Automation, Architecture of Industrial Automation Systems, Advantages and Limitations of Automation for Supervisory Control & Data Acquisition (S.C.A.D.A.), Introduction to Distributed Control System (D.C.S.), Case study

Text Books:

1. I. J. Nagrath, M. Gopal, **"Control Systems Engineering",** *New Age International Publishers*, New Delhi, (5thEdition), (2007).
2. Katsuhiko Ogata, **"Modern Control Engineering"**, *PHI Learning Private Limited, New Delhi*, (5th Edition), (2010).
3. S. Sen, S. Mukhopadhyay, A.K. Deb**," Industrial Instrumentation Control and Automation"**, *Jaico Publishing House*, (1st Edition), (2013).

Reference Books:

1. Katsuhiko Ogata, **"Discrete Time Control Systems"**, Second Edition, PHI Learning New Delhi, 2006.
2. C. D. Johnson, **"Process Control Instrumentation Technology"**, *Pearson Pub*, (6thEdition), (2006).
3. Stuart A. Boyer, **"SCADA: Supervisory Control and Data Acquisition"**, *ISA Publication*, (4th Edition), (2009).

Online Resources:

1. NPTEL Course "Control Engineering"
   http://nptel.ac.in/courses/108101037/1
2. NPTEL Course "Industrial Automation and Control"
   https://nptel.ac.in/courses/108105063

23PEE601B ELECTROMAGNETIC WAVES AND RADIATING SYSTEMS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1. To understand the fundamentals of Electrostatics and Magnetostatics
2. To study Maxwell's equations and analyze wave propagation in different media
3. To learn basics of transmission line and apply the Smith chart for problem-solving
4. To learn antenna fundamentals and analyze different types of antennas and arrays

Course Outcomes:

After completion of the course, students will be able to

CO1. Apply electrostatic, magnetostatic, and time-varying field principles to formulate and solve electromagnetic field problems
CO2. Analyze uniform plane wave propagation, and power flow in various media
Co3. Compute key transmission-line parameters using analytical methods and the Smith chart
CO4. Analyze antenna performance using key antenna parameters such as radiation pattern, gain, directivity, and efficiency
CO5. Compare types of antennas used in communication applications

Unit I: Fundamentals of Electrostatics and Magnetostatics Fields

Coulombs law and Electric field intensity, Electric flux density, Types of charge distributions, Gauss's law, Biot Savart and Ampere Circuital law, Magnetic field intensity and flux density, Boundary conditions.

Unit II: Time Varying Fields and Uniform plane waves

Faradays law, Maxwell Equations in point form and integral form, Wave Equation, Uniform Plane wave in free space, and conducting medium, Polarization: Linear, circular & Elliptical polarization, Electromagnetic power and Poynting vector.

Unit III: Transmission Lines

Types of transmission lines, Infinite line, Dissipation less line, Voltage and current on a transmission line, Input impedance, Open and Short-circuited transmission line, Impedance mismatch, standing waves, Distortion less line, Smith chart and applications, EMI, EMC.

Unit IV: Antenna Basics and Antenna Array

Antenna fundamentals, Types of antennas, Near and far field, Radiation mechanism, Antenna parameters, Infinitesimal dipole, half wavelength dipole, Loop antenna, Antenna arrays, Two element array, Array factor, Pattern multiplication, N-element linear array, Uniform amplitude and spacing, Broad side and end-fire array, Non-uniform amplitude, Binomial and Dolph Chebyshev array.

Unit V: Antenna Types and Their Applications

Medium frequency antennas, HF antennas, Yagi Uda, Helical, Horn, Parabolic reflector, microstrip antennas, Planer Inverted F antenna (PIFA), Metamaterial Antenna, Wearable and Flexible antennas, Graphene based antennas.

Text Books:

1. Mathew N. O. Sadiku, **"*Principles of Electromagnetics*"**, 4th Edition, Oxford University Press, 2009.
2. C. A. Balanis, **"*Antenna Theory: Analysis and Design*"**, 4th Edition, John Wiley & Sons, 2016

Reference Books:

1. John D. Kraus, Ronald J. Marhefka, Ahmad S. Khan**, "*Antennas for All Applications*"**, 3rd Edition, McGraw Hill, **2006**.
2. K. D. Prasad**, "*Antenna and Wave Propagation*"**, Satya Prakashan**,** 2014**.**
3. John D. Kraus**, "*Antenna & Wave Propagation*"**, 4th Edition**,** McGraw Hill**,** 2010**.**

Online Recourses:

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://onlinecourses.nptel.ac.in/noc20_ee20/preview

23PEEC601C ROBOTICS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1. To explain fundamentals of robotic system
2. To introduce kinematics, dynamics and control for robotics systems
3. To introduce localization, mapping and path planning for mobile robots
4. To describe application of robots in automation

Course Outcomes:
After completion of the course, students will be able to

CO1	Explain the functionality of sensors, actuators, mechanical components, and algorithms used in the development of robotic systems
CO2	Identify the sensors, actuators, and mechanical components used in the development of robotic systems
CO3	Apply formulations to obtain kinematics, dynamics and navigations of robots
CO4	Analyze the kinematic and dynamic models of robots to evaluate their motion behaviour and performance
CO5	Analyze various path planning, navigation, and obstacle avoidance algorithms to assess their effectiveness in different operating conditions
CO6	Apply appropriate tools and techniques to build a robotic system that performs a specified task

Unit I: Introduction to Robotics
Definition of robotics, Robots laws, Types of robots, Components of Robot system, Classification of robots, work space, degree of freedom, manoeuvrability, Robot sensors for position, Acceleration, Velocity and Torque measurement, Tactile sensor, Camera and robot vision, end effectors.

Unit II: Manipulators
Classification and configuration of manipulators, joints and links used in manipulators, Position and orientation description, introduction to forward and inverse kinematic models, introduction dynamics and Inverse dynamics of manipulators, DC Motor used its Specification and controls, Application of robotic arm, Collaborative Robots (Cobots) and Digital twins.

Unit III: Mobile Robots
Definition and characteristics of mobile robots, Types of mobile robots, Robot locomotion, types of wheels, wheel mobile robot (WMR) configurations, holonomic and nonholonomic constraints, simple wheel vehicle kinematics and dynamic models of wheel mobile robots, DC Motor used its Specification and controls, Applications of wheel mobile robots.

Unit IV: Localization and Mapping

Sensors used for mobile robots' perception and localization, mapping techniques, position estimation, Belief representation, Probabilistic mapping, Markov localization, Kalman based Simultaneous Localization and Mapping (SLAM) algorithm.

Unit V: Path Planning and Navigations

Global planning using A*, Dijkstra, Probabilistic Road Maps (PRM), Local Planning using Potential field, Trajectory generation and smoothing, Obstacle avoidance methods, Navigation in static and dynamic environments, case studies for Autonomous Robots.

Text Books:

1. S.K. Saha, **"Introduction to Robotics",** *Tata McGraw Hill*, (3rd Edition), (2024).
2. R. Siegwart, I. R. Nourbakhsh, **"Introduction to Autonomous Mobile Robots"**, *The MIT Press*, (2nd Edition), (2011).
3. Gregor Klancar , Andrej desar , Saso Blazic , Igor Skrjanc, "**Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems"** 1st Edition, B&H Elesever, 2017.

Reference Books:

1. K. S.Fu, R. C. Gonzalez, C. S. G. Lee, "**Robotics Control, Sensing, Vision and Intelligence" ,** *Tata McGraw Hill* **,** (2nd Edition), (2008).
2. S. R. Deb**, "Robotics Technology and Flexible Automation",** S. Deb, Tata McGraw Hill, (1st Edition), (2010).
3. Francis X. Govers, **"Artificial Intelligence for Robotics",** *Packt Publishing Ltd., United Kingdom,* (1st Edition), (2018).

Online Resources:

1. **NPTEL Course "Mechanics and Control of Robot Manipulator",** https://onlinecourses.nptel.ac.in/noc21_me108/
2. NPTEL Course **" Wheeled Mobile Robot",** https://nptel.ac.in/courses/112/106/112106298/

23PEEC601D POWER ELECTRONICS

Teaching Scheme
Lectures: 3 Hours / Week

Examination Scheme
ISE: 50 Marks
ESE: 50 Marks
Credits: 3

Course Objectives:

1.To explain the need of power devices, their structure and characteristics.
2.To analyze the power converters.
3.To explain power converter applications.
4.To explain dc and ac drives.

Course Outcomes:

After completion of the course, students will be able to
CO1 Explain the need of power switching devices
CO2 Analyse the power converter output voltage, current and power for different types of loads
CO3 To select suitable power converter for the specified application
CO4 Select a suitable drive for motor speed control in the given application

Unit 1: Power Devices

Introduction to Power Electronics and its applications., SCR, Power MOSFET, IGBT, triac Construction, turn on mechanism, Static and Dynamic characteristics, gate drive circuits, Isolation Techniques, SCR Specifications and ratings, Gate-cathode characteristic, protection of power devices
Overview of Silicon, Silicon Carbide & GaN based MOSFET/ IGBT, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC)

Unit 2: Phase Controlled Rectifiers and AC to AC converters

Concept of Line and Forced Commutation, Single phase Semi converters and Full Converters for R and R-L, R-L-E load, Effect of Freewheeling Diode, Performance parameters. AC to AC converter for R load, Case study.

Unit 3: Choppers

Circuit Diagram, waveforms and operation of Step-Down chopper for R and R-L load, Different Control Strategies for the output voltage control, Step up chopper, 2-Quadrant and 4-Quadrant Choppers, busk and boost converters, Block diagram and working of SMPS.

Unit 4: Inverters

Working principle of Single-phase Full Bridge inverter for R and R-L load, Analysis

performance parameters, Quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters, Working of ON Line and Off Line UPS.

Unit 5: Drives for Electric Vehicles

Separately excited DC motor drive, Brushed DC motor drives, induction motor (IM) drives, Permanent Magnet (PM), brushless DC (BLDC) motor drives, and Switched Reluctance Motor (SRM) drives. Comparisons between four types of electric motor drives.

Text Books:

1. M. H. Rashid, **"Power Electronics Circuit, Device and Application"**, Prentice Hall (PHI), (3rd Edition),(2009).
2. M D Singh and K B Khanchandani, **"Power Electronics",** TMH, (2nd edition),(2006).
3. Ned Mohan,T. M.Undeland, and W.P. Robbins**, "Power Electronics Converter Application and Design",** John Wiley and Sons ,(3rd Edition),(2004).

Reference Books:

1. Bimal K. Bose, **"Power Electronics and AC Drives",** Pearson India,(1st Edition),2015.
2. P. C. Sen, **"Thyristor DC Drives"**, John Wiley and Sons, (1st Edition),1981

Online Resources:

1. NPTEL Course "Power Electronics"
https://nptel.ac.in/courses/108105066

2. NPTEL Course "Fundamentals of Electric Drives"
https://onlinecourses.nptel.ac.in/noc19_ee65

23MmEC601 DEEP LEARNING IN HEALTHCARE

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 2

Course Objectives:

1. To introduce deep learning fundamentals and key healthcare data types.
2. To apply CNN, sequence, and NLP models for analyzing healthcare data.
3. To implement deep learning solutions with ethical awareness.

Course Outcomes:

After completion of the course, students will be able to

CO1	Explain deep learning fundamentals, healthcare data types, and key ethical and regulatory considerations
CO2	Analyze the performance of ANN and CNN models for medical imaging problems
CO3	Apply sequential and NLP deep learning models for analysis of healthcare data
CO4	Develop a solution based on deep learning models for healthcare applications

Unit I: Basics of Deep Learning

Overview of Healthcare data and Patient records, Healthcare data formats, Need for Deep Learning (DL) in Healthcare, Artificial neural networks (ANN), Activation functions, Loss functions, Training of neural networks, Backpropagation, Gradient descent, Deep learning workflow, and Python libraries.

Unit II: Convolutional Neural Networks

Building blocks of Convolutional Neural Network (CNN), Convolution operation, Pooling, Feature maps, Basic medical image preprocessing, Transfer learning and pretrained models, CNN autoencoder, Model performance metrics.

Unit III: Sequence Models and NLP

Basics of sequential and time-series data, Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Backpropagation through time (BPTT), Introduction to Natural Language Processing (NLP), and Transformer architecture.

Unit IV: DL Applications in Healthcare

Applications of CNN – Medical image classification and segmentation, Applications of sequence models – ECG arrhythmia detection, EEG seizure detection, and Wearable sensor data, Applications of NLP – Text classification/ Sentiment analysis, Case study on EHR, Ethics and regulatory concerns.

Text Books:

1. Francois Chollet, **"Deep Learning with Python"**, *Manning Publications,* (1st Edition), (2018).
2. Michael Nielsen, **"Neural networks and deep learning",** *Determination Press*, (2016).

3. Rowel Atienza, "**Advanced Deep Learning with TensorFlow 2 and Keras**", *Packt Publishing*, (2nd Edition), (2020).

Reference Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, **"Deep Learning"**, *MIT Press*, (1st Edition), (2016).
2. Josh Patterson and Adam Gibson, **"Deep Learning- A Practitioner's Approach"**, *O'Reilly Media*, (1st Edition), (2017).
3. Phil Kim, **"MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence"**, *Apress*, (1st Edition), (2017).

Online Resources:

1. NPTEL Course **"Deep Learning"** https://onlinecourses.nptel.ac.in/noc19_cs54/preview
2. NPTEL Course **"Deep Learning"** https://onlinecourses.nptel.ac.in/noc21_cs76/preview

23PCEC602L EMBEDDED PROCESSORS LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objective

1. To develop hardware interfacing skill
2. To develop software skill in embedded domain
3. To develop skill of designing embedded system using sensors
4. To explore cortex-based card size hardware system
5. To explore multicore programming

Course Outcomes:

After completion of the course, students will be able to

CO1	Apply software development tools for embedded processor-based applications
CO2	Implement an algorithm for on-chip peripherals
CO3	Implement an algorithm for externally interfaced peripheral devices
CO4	Design embedded applications using simulation tools

List of Experiments:

1	Introduction to ARM development board and IDE development tools.
2	Develop a program to receive and transmit data on serial communication.
3	Interface GSM with ARM processor for sending and receiving messages, call connection.
4	Interface GPS to ARM processor and extract Latitude and Longitude from the string.
5	Generate the waveform using DAC.
6	Interface GLCD module to GPIO of ARM processor and develop a program to display images.
7	Interface sensor to ADC and write a program to display calibrated data on serial port.
8	Interface Wi-Fi module to ARM processor and show connectivity with mobile.
9	Hackathon based on Societal, health, agricultural, Industry Innovation, Sustainable Cities and Communities, and safety concept.

23PCEC603L ARTIFICIAL INTELLIGENCE LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE :25 Marks
ESE :25 Marks
Credits: 1

Course Objective

1. To introduce students to fundamental AI problem-solving strategies
2. To enable students to work with modern Generative AI technologies
3. To develop understanding and hands-on skills related to Agentic AI systems
4. To provide exposure to Explainable AI (XAI) methods that enhance transparency of AI systems

Course Outcomes:

After completion of the course, students will be able to

CO1	Implementation of Classical problem-solving techniques, and search algorithms
CO2	Implementation of reasoning and learning techniques
CO3	Implementation of Generative AI Models and Agentic AI techniques
CO4	Model Interpretation using Explainable AI (XAI) Techniques

List of Experiments:

1. To implement Calculator using python language as:
    - Simple reflux agent
    - Model based reflux agent
    - Goal based agent
    - Utility based agent
2. Implementation of Breadth First Search and Depth First Search algorithms for the Water Jug problem and Maze problem respectively using python.
3. Implementation of Greed Best first search and A* algorithm for Map based problem using python.
4. Implementation of Tic Tac Toe game using minimax algorithm using python.
5. Implementation of fuzzy logic and fuzzy reasoning using Matlab.
6. Implementation of Constraint Satisfaction Problem, Cryptarithmetic using python.
7. Implementation of agentic AI using python.
8. Open Ended Assignment using Agentic AI / Gen AI.
9. Implementation of Prompt engineering to develop an application

23PECEC601AL CONTROL AND AUTOMATION LAB

Teaching Scheme
Practical: 2 Hours / Week

Examination Scheme
ISE :25 Marks
ESE :25 Marks
Credits: 1

Course Objective

1. To find the time domain specifications and steady-state performance of control systems.
2. To test the stability of a system in time and frequency domain
3. To assess system controllability and observability
4. To analyze the performance of Proportional (P), Proportional-Integral (P-I), Proportional-Derivative (P-D) and Proportional-Integral-Derivative (P-I-D) Controller

Course Outcomes:

After completion of the course, students will be able to

CO1	Interpret time domain parameters of a given control system
CO2	Analyze system stability in time and frequency domain
CO3	Examine the system controllability and observability
CO4	Analyze the performance of Proportional-Integral-Derivative (P-I-D) Controller

List of Experiments:

1. System formation in S-domain and stability analysis of a system from pole-zero plot.
2. Find time domain parameters of a system and analyze the effect of ξ
3. Analyze system stability using Routh's Array
4. Construct Bode Plot of a system, find Gain Margin, Phase Margin, crossover frequencies and stability analysis from these parameters
5. Form state transition matrix of a system and analyze observability and controllability of a system
6. Examine the system response with and without PID controller and observe the effect of parameter variation
7. Find Step Response of First order and Second order digital control system
8. Case study-Use of PLC for improved efficiency, reliability, safety, and productivity

23PEEC601LB ELECTROMAGNETIC WAVES AND RADIATING SYSTEMS LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 1

Course Objectives:
1. To compare various antenna parameters for the different types of antennas.
2. To analyze the nature of standing waves for different terminations.
3. To design and simulate different antenna arrays.
4. To compare various antenna parameters for the different types of antennas.

Course Outcomes:
After completion of the course, students will be able to
1. Measure and analyze antenna parameters.
2. Explain the importance of impedance matching from the perspective of antenna design.
3. Simulate and analyze the performance of antenna arrays through MatLab
4. Design, and analyze antenna arrays using antenna design software.

List of Experiments:
1. To measure various parameters of Dipole Antenna
2. To measure various parameters of Folded Dipole Antenna
3. To measure various parameters of 3 element Yagi Antenna
4. To measure parameters of Parabolic Reflector Antenna.
5. To measure various parameters of Horn Antenna.
6. Plot standing wave pattern for open, short and matched termination.
7. Dipole Antenna design using 4nec2x software.
8. Broadside Array Antenna design using 4nec2x software.
9. Yagi Antenna design using 4nec2x software.
10. Matlab simulation for varying length Dipole Antenna.
11. Matlab simulation for Broadside Linear Array & End Fire Linear Array.
12. Matlab simulation for Binomial Array.
13. Matlab simulation for Dolph Tschebyscheff Array.

23PEEC601LC ROBOTIC LAB

Teaching Scheme:
2 Hours/Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credit: 1

Course Objectives:

1. To demonstrate robot working and degree of freedom using physical components
2. To demonstrate robot functioning using simulation software
3. To design a microcontroller-based robotic system for specific tasks

Course Outcomes:

After completion of the course, students will be able to

CO1 Explain the mechanical configuration of robot manipulation
CO2 Select sensors and actuators used in robot manipulation
CO3 Apply formulation to simulate to obtain kinematics, Dynamic, Localization, and Navigation of robots
CO4 Develop a robot for a specified task

List of Experiments:

1. Plot of workspace of a 2-link planer arm using simulation software.
2. Simulation of Forward Kinematics and Inverse Kinematic of manipulators.
3. Simulation of Trajectory and Path Planning of Manipulators.
4. Simulation of Pick and Place manipulators.
5. Simulation of Dynamics of planer 2 -link robot
6. Simulation of Kinematics of Mobile Robots
7. Simulation of Localization and Mapping using SLAM algorithms.
8. Open Ended: Design Mobile Robot for given application.

23PEEC601DL POWER ELECTRONICS LAB

Teaching Scheme
Lectures: 2 Hours / Week

Examination Scheme
ISE**:** 25 Marks
ESE**:** 25 Marks
Credits: 1

Course Objectives:

1. To study Torque Speed characteristics of motors
2. To analyze the power converters
3. To apply power converters for speed control of motors
4. To Simulate power converter

Course Outcomes:
After completion of the course, students will be able to
CO1 Examine the speed-torque characteristics of dc and ac motors
CO2 Analyse the performance of power converters for R, R-L loads
CO3 Simulate power converters
CO4 Use power converters for speed control of motors

List of Experiments:

1) Study and verify the Torque-Speed characteristics of DC motor and Induction motor
2) Examine the output of single phase fully controlled bridge rectifier for R , R-L load and R-L with fly wheel diode
3) To simulate full bridge inverter using MOSFET
4) To test the gate drive circuit and analyse the output of Step-down chopper
5) To observe the waveforms of the triggering circuit, output of power circuit and measure the output voltage of AC Voltage controller
6) To perform converter-based DC drive for PMDC motor
7) To perform Induction motor speed control using ac to ac converter
8) Simulate Half controlled bridge rectifier

23VSECEC601L JAVA PROGRAMMING LAB

Teaching Scheme
Practical: 4 Hours / Week

Examination Scheme
ISE: 25 Marks
ESE: 25 Marks
Credits: 2

Course Objectives:

1 To recall the concepts and techniques of OOP paradigm
2 To utilize the commonly used classes and Object as superclass
3 To make use of generics and various classes in Java Collections Framework
4 To understand the importance of Lambda expressions and streams

Course Outcomes:

After completion of the course, students will be able to

CO1 Apply the concepts of basic Java constructs and data structures
CO2 Develop programs utilizing the concepts of classes, objects and interfaces
CO3 Apply appropriate Java collections for various use cases
CO4 Implement functional programming paradigms using Lambda expressions and the Stream API

List of Assignments:

1. Program to explore Object class methods (toString, equals, hashCode)
   Create an Employee class with fields first name and last name.
   Create and print Employee class objects.
   Create multiple Employee class objects and compare whether they are equal or not.
2. Declare an interface and create an anonymous class that implements it.
3. Program to implement in-built interfaces in Java
4. Program to create a Person class with fields; first name and last name and getter setters. Modify it to make it immutable. In the Person class, add a field of type Address, which has fields as city and pin code with getters and setters. Prove that the Person class is now mutable. Modify the classes such that Person becomes immutable again.
5. Create a list of names of your friends. Check if a name of a friend is present in the list. Remove a name from the list and add another. Print the list to see where the added name is appearing in list
6. Create a set of movies (Movie class having name and imdb rating). Print the list of movies in the ascending order of their names. Now print the movies in descending order of imdb rating, using a comparator interface.
7. Create a map of device ids and subscribers associated with it. Create a list of all device ids associated with a subscriber.
8. Given a stream of amplitude values of a sampled signal (as a List), filter out the samples having amplitudes above and below the threshold values (upper threshold: 4.5V and lower threshold: 0.5V). These filtered samples are to be passed through the multiplier system (multiplication factor = 2). Create a list of signal values at the output of the multiplier system. Find min and max amplitudes in the result.
9. Application based program on trees / graphs.
10. Open Ended Assignment