



**TKR COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)**

(Sponsored by TKR Educational Society, Approved by AICTE, Affiliated by JNTUH,
Accredited by NBA & NAAC with 'A+' Grade)



ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. III Semester

L/T/P/C

1/0/2/2

**FUNDAMENTALS OF ROBOTICS AND APPLICATIONS IN
INDUSTRY 4.0 & INDUSTRY 5.0**

Pre-requisite: Fundamentals Of Robotics And Applications In Industry 4.0 & Industry 5.0.

Course Objectives:

- To provide a broad understanding of industrial revolutions and their transformation of society through robotics.
- To introduce various types of robots, their components, sensors, actuators, and programming methods.
- To explain manufacturing and fabrication techniques used in building robotic systems with an applications-first approach.
- To explore the role of robots in Industry 4.0 with focus on smart manufacturing and digital transformation.
- To examine emerging applications of robotics in Industry 5.0 including agriculture, healthcare, bionics, and collaborative robots.

Course Outcomes: After this course, the student will be able to

CO1: Understand the evolution of industrial revolutions and classify different types of robots based on architecture, mobility, and application.

CO2: Explain various sensors, actuators, and programming methods used in robotic systems.

CO3: Apply appropriate manufacturing and fabrication techniques for building robotic systems based on application requirements.

CO4: Analyze the role of robots in Industry 4.0 applications across different industrial sectors.

CO5: Evaluate emerging robotic applications in Industry 5.0 including collaborative robots, agriculture, healthcare, and bionics.

CO6: Demonstrate knowledge of robotic systems for practical and industrial applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	2	-	-	1	-	1	-
CO2	2	3	2	1	3	-	-	-	-	-	1	-
CO3	3	2	3	2	3	-	-	1	-	1	1	-
CO4	2	3	2	2	3	2	-	1	1	-	2	-
CO5	2	3	2	1	2	3	3	2	1	1	2	-
CO6	-	1	-	-	-	3	3	2	2	1	3	-

UNIT I: Industrial Revolutions and Classification of Robots

Need for Industrial Revolution and Society Transformation, Industry 1.0: Mechanization, Industry 2.0: Mass Production, Industry 3.0: Automation, Industry 4.0: Smart Manufacturing, Industry 5.0: HumanCentric Era, Looking Ahead: Society 5.0. Introduction to Robotics, Classification Based on Architecture: Articulated, SCARA, Delta, Cartesian, Cylindrical, Polar, Classification Based on Mobility: Fixed, Mobile (Wheeled, Tracked, Legged), Aerial, Underwater, Classification Based on Application: Industrial, Service, Medical, Agricultural, Military, Space, Classification Based on Interaction: Industrial, Collaborative, Teleoperated, Autonomous, Humanoid and Bio-inspired Robots.

UNIT – II: Sensors, Actuators, and Programming

Role of Sensors in Robotics, Position Sensors (Potentiometers, Encoders), Velocity and Acceleration Sensors (Tachometers, Accelerometers, Gyroscopes, IMUs), Proximity and Distance Sensors (Inductive, Capacitive, Ultrasonic, LiDAR, IR), Force and Tactile Sensors (Force Sensing Resistors, Strain Gauges, Tactile Arrays), Vision Sensors (Cameras, Depth Cameras, Thermal Cameras), Other Important Sensors. Introduction to Actuators, Electric Actuators (DC Motors, Servo Motors, Stepper Motors), Hydraulic Actuators, Pneumatic Actuators, Special Actuators (Piezoelectric, Shape Memory Alloys, SoÖ Actuators), Motor Drivers and Controllers. Introduction to Robot Programming Methods (Online vs Offline Programming, Teach Pendant, Lead through, Simulation-based), Overview of Programming Languages Used in Robotics (Python, C/C++, Block-based languages, Industrial robot languages), Simulation Software for Robotics (MATLAB, Gazebo, Coppelia Sim, Webots, RoboDK, Robot Studio), Sensor and Actuator Integration with Programming.

UNIT – III: Manufacturing and Fabrication of Robots

Robot Design and CAD Modeling, Simulation in Robotics Manufacturing, Types of Manufacturing Processes: An Overview.

Additive Manufacturing: Applications: Custom grippers, rapid prototyping, lightweight structures, patient-specific parts; Overview of Methods: FDM, SLA, SLS, SLM, MJF, PolyJet, DLP, Binder Jetng, **Subtractive Manufacturing:** Applications: Precision parts, gears, shaÖs, chassis, enclosures; Overview of Methods: CNC Milling, Turning, Routing, Laser Cutng, Waterjet, EDM, Wire EDM, Grinding),

Forming and Shaping: Applications: Robot covers, housings, structural frames, high-volume components; Overview of Methods: Sheet metal bending, stamping, forging, extrusion, injection molding, casting, deep drawing, **Joining Techniques:** Applications: Frame assembly, multi-material joining, electronics assembly; Overview of Methods: Welding MIG/TIG/Spot, brazing, soldering, adhesive bonding, mechanical fastening, press fit, snap fit, **Surface Finishing:** Applications: Corrosion protection, wear resistance, aesthetics, color coding; Overview of Methods: Anodizing, powder coating, plating, painting, polishing, sandblasting, heat treatment, **Composite Manufacturing:** Applications: Lightweight arms, drone frames, high-strength components; Overview: Hand lay-up, filament winding, resin transfer molding, pultrusion, compression molding,

Electronics Manufacturing: Applications: Controller boards, sensor interfaces, compact electronics; Overview of Methods: PCB fabrication, SMT, through-hole assembly, flex circuits, 3D printed electronics

Advanced Manufacturing: Applications : Micro-robots, medical robots, self-assembling structures; Overview of Methods: Micro manufacturing, LIGA, nano manufacturing, 4D printing, bio manufacturing, Actuator Mounting and Integration, Sensor Mounting and Wiring, Controller and Electronics Assembly, Final Assembly and Integration, Testing and Calibration.

UNIT – IV: Industry 4.0 - Smart Manufacturing and Robotic Applications

Industry 4.0 - Smart Manufacturing and Robotic Applications Industry 4.0 Definition and Core Principles, Cyber-Physical Systems (CPS), Industrial Internet of Things (IIoT), Cloud Computing and Big Data, Digital Twin, Artificial Intelligence in Industry 4.0, Automotive Manufacturing Applications, Electronics Industry Applications, Material Handling and Logistics, Machine Tending Applications, Quality Inspection and Testing, Food and Pharmaceutical Industry, Warehousing and Fulfillment.

UNIT – V: Industry 5.0 - Human-Centric Robotics and Emerging

Applications Industry 5.0: Definition and Core Values (Human-Centricity, Sustainability, Resilience), Human-Centric Manufacturing, Sustainable and Resilient Robotics, Collaborative Robots (Cobots), Human-Robot Collaboration Levels, Agriculture and Farming Robots (Harvesting, Seeding, Weeding, Monitoring), Bionics and Bio-inspired Robotics, Prosthetics and Assistive Devices, Healthcare and Medical Robotics (Surgical, Rehabilitation), Collaborative Manufacturing, Service and Hospitality Robots, Disaster Response and Rescue, Ethical and Social Considerations.

Text Books:

1. Niku, S.B. Introduction to Robotics: Analysis, Control, Applications, 3rd ed. (Indian Adaptation). Wiley India, 2024.
2. Groover, M.P. Automation, Production Systems, and Computer-Integrated Manufacturing, 5th ed. Pearson, 2022.
3. Ustundag, A. and Cevikcan, E. Industry 4.0: Managing The Digital Transformation, 1st ed. Springer, 2018.
4. Bartneck, C. et al. Human-Robot Interaction: An Introduction, 2nd ed. Cambridge University Press, 2024.

References Books:

1. Bajd, T. et al. Robotics (Intelligent Systems, Control and Automation Series), 1st ed. Springer, 2010.
2. Craig, J.J. Introduction to Robotics: Mechanics and Control, 4th ed. Pearson, 2018.
3. Sprague, N. Just Enough Robotics



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ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. IV Semester

L/T/P/C

3/0/0/3

LINUX AND SHELL PROGRAMMING

Pre-requisite: Fundamentals of Computer Programming and Operating Systems.

Course Objectives:

1. To introduce the concepts of Linux Operating System and its architecture.
2. To provide knowledge of Linux commands, file systems, and process management.
3. To develop skills in shell scripting for automation and system administration.
4. To understand advanced shell programming concepts and utilities.
5. To enable students to design and implement shell scripts for real-world applications.

Course Outcomes:

CO1: Understand Linux architecture, file systems, and basic command-line operations.

CO2: Apply Linux commands and utilities for file management, process control, and system administration.

CO3: Develop shell scripts using variables, operators, decision-making, and looping constructs.

CO4: Design and implement advanced shell programs using functions, arrays, command-line arguments, and file handling.

CO5: Analyze and develop Linux-based automation solutions using shell programming concepts.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	-	-	-	-
CO2	3	3	2	1	2	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-
CO4	3	3	3	3	2	1	-	-	-	-	-	-
CO5	3	3	3	2	3	1	-	-	-	-	-	-

UNIT I

Introduction to Linux Operating System: History and Features of Linux, Linux Architecture, Linux Distributions, Linux Installation Process, Linux Booting Procedure, Linux Kernel Overview, Login and Logout Process, Linux File System Structure, Directory Hierarchy, Absolute and Relative Paths.

Basic Linux Commands: Date and Calendar Commands, Displaying System Information, Working with Directories, File Handling Commands, Viewing File Contents, Copying, Moving and Removing Files, Wild Card Characters, Online Help Commands.

UNIT II

Linux File System and Process Management: File Permissions and Ownership, chmod, chown, umask Commands, Hard Links and Soft Links, File Compression and Archiving Utilities.

Process and System Management: Process Creation and States, Foreground and Background Processes, Process Monitoring Commands, Job Control Commands, Process Scheduling, System Administration Basics, User and Group Management, Disk Usage and Memory Monitoring.

UNIT III

Shell Programming Fundamentals: Introduction to Shells, Types of Shells, Shell Invocation, Shell Variables, Environment Variables, Read-only Variables, Command Substitution, Arithmetic Operations in Shell.

Decision Making and Looping: Conditional Statements – if, if-else, nested if, case Statement, Looping Constructs – for, while, until Loops, Break and Continue Statements, Menu Driven Programs.

UNIT IV

Advanced Shell Programming: Command Line Arguments, Positional Parameters, Special Parameters, Exit Status of Commands, Functions in Shell Scripts, Recursive Functions.

Arrays and String Processing: One-Dimensional Arrays, String Manipulation Functions, Pattern Matching, Regular Expressions, grep, egrep, sed Utilities, Text Processing using awk.

UNIT V

Shell Programming Applications: File Processing Scripts, Report Generation Scripts, Backup and Recovery Scripts, Log File Analysis, System Monitoring Scripts, Automation of Administrative Tasks.

Linux Networking and Automation: Basic Networking Commands, Remote Login Utilities, File Transfer Utilities, Cron and Crontab Scheduling, Shell Scripting for Network Administration, Introduction to Bash Automation and Real-Time Applications.

TEXT BOOKS

1. Linux Command Line and Shell Scripting Bible – Richard Blum & Christine Bresnahan.
2. Introduction to UNIX and Shell Programming – M.G. Venkateshmurthy.
3. UNIX Concepts and Applications – Sumitabha Das.

REFERENCE BOOKS

1. Beginning Linux Programming – Neil Matthew and Richard Stones.
2. UNIX and Shell Programming – Forouzan and Gilberg.
3. Bash Pocket Reference – Arnold Robbins.
4. Advanced Programming in the UNIX Environment – Stevens and Rago.



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ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. V Semester

L/T/P/C

0/0/2/1

AI/ML for ECE – Value Added Course Syllabus

Pre-requisite: Artificial Intelligence and Machine Learning for ECE

Course Objectives:

- Understand fundamentals of Artificial Intelligence and Machine Learning
- Learn Python programming for AI/ML applications
- Apply ML techniques to electronics and communication systems
- Analyze data and develop simple AI models
- Explore AI applications in IoT, signal processing, and embedded systems

Course Outcomes: After this course, the student will be able to

CO1: Understand AI and ML fundamentals

CO2: Apply Python programming for AI/ML.

CO3: Implement basic machine learning algorithms

CO4: Analyze AI applications in ECE.

CO5: Develop simple AI/ML-based mini projects

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	-	-	-	2
CO2	2	2	1	1	3	-	-	-	-	-	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	2
CO4	2	3	3	2	2	1	-	-	-	-	-	2
CO5	2	2	3	2	3	1	1	-	2	2	1	3

UNIT I : Introduction to AI and Machine Learning

- Introduction to Artificial Intelligence
- History and applications of AI
- AI vs ML vs Deep Learning
- Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning
- AI applications in ECE
- Introduction to datasets and data preprocessing

UNIT II : Python Programming for AI/ML

- Introduction to Python programming
- Data types, operators, loops, and functions
- NumPy fundamentals
- Pandas for data handling
- Data visualization using Matplotlib
- Introduction to Jupyter Notebook
- Python libraries for AI/ML

UNIT III : Machine Learning Algorithms

- Introduction to ML model development
- Training and testing datasets
- Linear Regression
- K-Nearest Neighbor (KNN)
- Decision Trees
- Support Vector Machine (SVM)
- K-Means clustering
- Model evaluation techniques

UNIT IV : AI Applications in ECE

- AI in communication systems
- AI for signal and image processing
- AI in wireless sensor networks
- AI-based fault detection systems
- Introduction to Computer Vision
- Speech and pattern recognition
- AI in embedded systems and IoT
- Edge AI concepts

UNIT V : Mini Project and Emerging Trends

- AI/ML project development methodology
- Dataset collection and preprocessing
- Mini Project Development
- Introduction to Deep Learning
- Neural Networks basics
- Future trends: Generative AI, AI chips, Autonomous systems, Industry 4.0

Text Books:

1. Artificial Intelligence, Authors: **Elaine Rich, Kevin Knight, Shivashankar B. Nair**,
Publisher: McGraw-Hill Education, Edition: **3rd Edition**

2. **Introduction to Machine Learning with Python**, Authors: **Andreas C. Müller, Sarah Guido**,
Publisher: O'Reilly Media

3. **Python for Data Analysis**, Author: **Wes McKinney**, Publisher: O'Reilly Media
Edition: 3rd Edition

References Books:

4. Artificial Intelligence: A Modern Approach
Authors: Stuart Russell and Peter Norvig
Publisher: Pearson
5. Machine Learning
Author: Tom M. Mitchell
Publisher: McGraw-Hill
6. Deep Learning
Authors: Ian Goodfellow, Yoshua Bengio, Aaron Courville
Publisher: MIT Press
7. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow
Author: Aurélien Géron
Publisher: O'Reilly Media
Taur, Yuan, and Tak H. Ning. Fundamentals of Modern VLSI Devices. Cambridge University Press, 2nd ed., 2009



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ELECTRONICS & COMMUNICATION ENGINEERING

B.Tech. VI Semester

L/T/P/C

1/0/0/0

IoT and Robotics

Course Objectives:

- Understand the fundamentals of IoT and Robotics
- Learn sensor interfacing and microcontroller programming
- Develop IoT-based smart systems using wireless communication
- Understand robotic control and automation concepts
- Design and implement simple IoT and robotic applications

Course Outcomes: After this course, the student will be able to

CO1: Understand IoT and Robotics fundamentals

CO2: Interface sensors and controllers for embedded applications

CO3: Develop IoT communication and cloud-based systems

CO4: Design simple robotic and automation systems

CO5: Implement mini projects using IoT and Robotics concepts

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	1					
CO2	3	3	2	2	1						
CO3	3	3	3	2	1						
CO4	3	3	3	2	2						
CO5	3	3	2	2	2	1					

UNIT I

Introduction to semiconductor physics: Formation of P-type and N-type semiconductors, principle and operation of Diode, Volt-Ampere characteristics, Current components in a p-n Diode, Diode equation, Temperature dependence, Static and dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Break down mechanisms in Diode,

Special Purpose Diodes: Zener Diode Volt-Ampere characteristics, Zener Diode as a Regulator. Principle of Operation of – SCR, Tunnel Diode, Varactor Diode, Photo Diode, Solar Cell, LED and Schottky Diode

UNIT II

Rectifiers and Filters: P-N junction diode as a Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π - section Filters (Qualitative treatment).

UNIT III

Bipolar Junction Transistor (BJT): Principle of Operation, Transistor current components, Transistor as an Amplifier, Common Emitter, Common Base and Common Collector configurations and their Characteristics.

UNIT IV

Transistor Biasing and Stabilization - Operating point, DC Load line, Biasing - Fixed Bias, Collector to Base Bias, Collector and Emitter Feedback Bias, Self bias, Bias stability, Stabilization against variations in V_{BE} , I_{co} , β , Bias Compensation using Diodes and Transistors.

UNIT V

Field Effect Transistor (FET): Construction, Principle of Operation, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): Different types of MOSFET's, Working operation and V-I Characteristics of different types of MOSFET's.

Text Books:

1. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits", PEI/PHI, 12th Ed, 2015.
2. J. Millman and C. C. Halkias, Satyabratajit, "Electronic Devices and Circuits", TMH, 4th Ed. 2015.
2. Sedra, Adel S., and Kenneth C. Smith. Microelectronic Circuits. Oxford University Press, 7th ed., 2014.

References Books:

1. "Electronic Devices and Circuits", S.Salivahanan and N.Suresh Kumar, TMH, 2015.
2. "Electronic Devices and Circuits", Sanjeev Gupta and Santosh Gupta, Dhanpat Rai Publications 5th Ed.2017
3. Razavi, Behzad. Fundamentals of Microelectronics. Wiley, 2nd ed 2013.

Taur, Yuan, and Tak H. Ning. Fundamentals of Modern VLSI Devices. Cambridge University Press, 2nd ed., 2009