JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech., ROBOTICS AND ARTIFICIAL INTELLIGENCE
EFFECTIVE FROM ACADEMIC YEAR 2025-26 ADMITTED BATCH
R25 COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Core – I	Robotic Systems	3	0	0	3
Professional Core –II	Artificial Intelligence	3	0	0	3
Professional Elective – I	1. Robot Sensing and Vision 2. Intelligent Systems and Interfaces 3. Knowledge Engineering and Expert System	3	0	0	3
Professional Elective – II	1. Machine Learning 2. Smart Manufacturing Systems 3. Digital Electronics and Microprocessors	3	0	0	3
	Research Methodology and IPR	2	0	0	2
Lab– I	Robotics Simulation Laboratory	0	0	4	2
Lab – II	Python Programming Laboratory	0	0	4	2
Audit–I	Audit Course-I	2	0	0	0
	Total	**16**	**0**	**8**	**18**

I Year II Semester

Course Code	Course Title	L	T	P	Credits
Professional Core– III	Kinematics and Dynamics of Robotic Systems	3	0	0	3
Professional Core – IV	Big Data Management	3	0	0	3
Professional Elective – III	1. Internet of Things 2. Autonomous Vehicles 3. Robotic Simulation and localization Mapping	3	0	0	3
Professional Elective–IV	1. Advanced Robotics Manufacturing 2. Intelligent Sensors and Actuators 3. Cyber security	3	0	0	3
	Mini Project with Seminar	0	0	4	2
Lab –III	Robotic Systems Laboratory	0	0	4	2
Lab –IV	Artificial Intelligence Programming Laboratory	0	0	4	2
Audit–II	Audit Course-II	2	0	0	0
	Total	**14**	**0**	**12**	**18**

II Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Elective–V	1. Deep Learning 2. Computer Integrated Manufacturing 3. Additive Manufacturing Technology	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review-II	0	0	18	6
	Total	**6**	**0**	**18**	**12**

II YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review- III	0	0	18	6
Dissertation	Dissertation Viva-Voce	0	0	42	14
	Total	**0**	**0**	**60**	**20**

***For Dissertation Work Review - I, Please refer R25 Academic Regulations.**

Audit Course I:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education

Audit Course II:

1. Constitution of India
2. Pedagogy Studies
3. Stress Management by Yoga
4. Personality Development through Life Enlightenment Skills

Open Electives:

1. Business Analytics
2. Waste to Energy
3. Principles of Automation
4. Composite Materials

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
ROBOTIC SYSTEMS
(Professional Core-I)

L	T	P	C
3	0	0	3

Prerequisites: Fundamentals of Robotics, Analysis and Control

Course Objectives: The course aims to:

1. To introduce the fundamental concepts and components of robotic systems.
2. To understand spatial descriptions and transformations for robotic motion.
3. To study forward and inverse kinematics for manipulators and mobile robots.
4. To analyze the dynamics and trajectory planning of robotic systems.
5. To explore applications of robotic systems in real-world environments.

Course Outcomes: Upon successful completion of this course,

1. Explain the essential elements, structure, and types of robotic systems.
2. Apply spatial transformations and homogeneous coordinates in robot motion analysis.
3. Perform forward and inverse kinematic analysis of manipulators and mobile robots.
4. Analyze robot dynamics and plan trajectories based on motion requirements.
5. Evaluate the performance and design of robotic systems for practical applications.

UNIT - I: Robotic Systems and Coordinate Frames

Robot Anatomy Definition, Law of Robotics, History and Terminology of Robotics, Accuracy and Repeatability of Robotics, Simple Problems, Specifications of Robot-Speed of Robot-Robot Joints And Links-Robot Classifications, Architecture of Robotic Systems, Robot Drive Systems, Hydraulic, Pneumatic and Electric System.

UNIT - II: End Effectors and Controls

Mechanical Grippers, Slider crank mechanism, Screw type, Rotary actuators, cam Type-Magnetic grippers, Vacuum grippers, Air operated Grippers, Gripper force Analysis, Gripper design, Simple problems, Robot controls, Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control.

UNIT - III: Transformations and Sensors

Robot Kinematics, Types, 2D and 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple Transformation. Simple problems. Sensors in robot: Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision Sensor, Force sensor, Light sensors, Pressure sensors.

UNIT - IV: Robot Dynamics and Trajectory Planning

Robot Cell Design and Micro/Nano Robotics System: Robot work cell design and Control, Sequence control, Operator interface, Safety monitoring devices in Robot, Mobile robot working principle, actuation using MATLAB, NXT Software Introductions, Robot applications, Material

handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Micro/Nanorobotics system Overview, Scaling effect, Top down and bottom up approach, Actuators of Micro/Nano robotics system, Nanorobot communication Techniques, Fabrication of micro/nano Grippers, Wall climbing micro robot working Principles, Biomimetic Robot, Swarm Robot, Nano robot in targeted drug delivery system.

UNIT - V: Robot Programming and Languages

Robot Programming, Introduction, Types, Flex Pendant, Lead Through Programming, Coordinate Systems of Robot, Robot Controller, Major Components, Functions, Wrist Mechanism, Interpolation, Interlock Commands, Operating Mode of Robot, Jogging, Types, Robot Specifications, Motion Commands, End Effectors and Sensors Commands.

Robot Languages, Classifications, Structures, VAL Language Commands, Motion Control, Hand Control, Program Control, Pick and Place Applications, Palletizing Applications Using VAL, Robot Welding Application Using VAL Program, Wait, Signal and Delay Command for Communications Using Simple Applications. RAPID Language Basic Commands, Motion Instructions, Pick and Place Operation Using Industrial Robot, Manual Mode, Automatic Mode, Subroutine Command-Based Programming. Move Master Command Language, Introduction, Syntax, Simple Problems. VAL-II Programming, Basic Commands, Applications, Simple Problem Using Conditional Statements, Simple Pick and Place Applications.

TEXT BOOKS:

1. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, McGraw-Hill, 2nd Edition, 2013
2. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson, 4th Edition, 2018

REFERENCE BOOKS:

1. Robotic Engineering: An Integrated Approach, Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, Prentice Hall (Englewood Cliffs, NJ), 1st Edition, 1989.
2. Robotics Technology and Flexible Automation, S. R. Deb and Sankha Deb, Tata McGraw-Hill Education, 1st Edition, 2009.
3. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Peter Corke, Springer, 2nd Edition, 2022.
4. Robot Modeling and Control, Mark W. Spong and Seth Hutchinson and M. Vidyasagar, Wiley, 2nd Edition, 2023.
5. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms, Nikolaus Correll and Bradley Hayes and David Coleman, CreateSpace, 2nd Edition, 2022.
6. Mobile Robotics: Mathematics, Models and Methods, Alonzo Kelly, Cambridge University Press, 2nd Edition, 2023.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
ARTIFICIAL INTELLIGENCE
(Professional Core-I)

L	T	P	C
3	0	0	3

Prerequisites: Artificial Intelligence and Machine Learning

Course Objectives:

1. Introduce the fundamentals and scope of artificial intelligence and its role in intelligent systems.
2. Explore problem-solving techniques such as search strategies and knowledge representation.
3. Familiarize students with machine learning methods including supervised and unsupervised learning.
4. Develop the ability to model reasoning under uncertainty using probabilistic approaches.
5. Examine applications of AI in natural language processing, robotics, and expert systems.

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

1. Understand the foundational concepts, structure, and scope of artificial intelligence.
2. Apply heuristic search and optimization algorithms to solve AI-related problems.
3. Represent knowledge using logic and ontologies for building intelligent agents.
4. Analyze machine-learning algorithms and implement basic classifiers and clustering models.
5. Demonstrate the use of AI in practical domains such as robotics, speech recognition, and intelligent decision-making systems.

UNIT - I: Concepts of Artificial Intelligence

Introduction, History, Definition of AI, Emulation of Human Cognitive Process, Intelligent Agents, The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT - II: Search Methods and Strategies

Search Methods, Problem-Solving Agents, Problem Definitions, Formulating Problems, Searching for Solutions, Measuring Problem-Solving Performance with Examples. Search Strategies, Uninformed Search Strategies, Breadth-First Search, Uniform-Cost Search, Depth-First Search, Depth-Limited Search, Iterative Deepening Depth-First Search, Bidirectional Search, Comparing Uninformed Search Strategies. Informed Search Strategies, Heuristic Information, Hill Climbing Methods, Best-First Search, Branch-and-Bound Search, Optimal Search and A*, and Iterative Deepening A*.

UNIT III: Machine Learning Concepts

Concepts of Machine Learning I, Supervised Learning, Unsupervised and Reinforcement Learning, Linear, Logistic, and Hierarchical Cluster Analysis, Decision Tree, Procedure and Technique of Decision Tree, Support Vector Machine, Mathematical Approach.

UNIT IV: Advanced Machine Learning Techniques

Concepts of Machine Learning - II, Clustering and Classification Analysis, Boosting and Bagging, Data Visualization, Random Forest Algorithm, K-Nearest Neighbour Algorithm, Naïve Bayes Algorithm, Solving Numerical Methods.

UNIT V: Logical Methods in Artificial Intelligence

Programming and Logics in Artificial Intelligence, LISP and Other Programming Languages, Introduction to LISP, Syntax and Numerical Function, LISP and PROLOG Distinction, Input, Output and Local Variables, Interaction and Recursion, Property List and Arrays, Alternative Languages, Formalized Symbolic Logics, Properties of WERS, Non-Deductive Inference Methods.

TEXT BOOKS:

1. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, Prentice Hall, 3rd Edition, 2009
2. Machine Learning, Tom M. Mitchell, McGraw-Hill, 1st Edition, 1997

REFERENCE BOOKS:

1. Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, Prentice-Hall (PHI in India), 1st Edition, 1990.
2. A Guide to Expert Systems, Donald A. Waterman, Addison-Wesley, 1st Edition, 1986.
3. Introduction to Artificial Intelligence, Wolfgang Ertel, Springer, 2nd Edition, 2017.
4. Artificial Intelligence, Patrick Henry Winston, Pearson Education, 3rd Edition, 1992.
5. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 1st Edition, 2016.
6. Machine Learning, Tom M. Mitchell, McGraw Hill Education, 1st Edition, 1997.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
ROBOT SENSING AND VISION
(Professional Elective-I)

L	T	P	C
3	0	0	3

Prerequisites: Introduction to Autonomous Robots Mechanisms, Sensors, Actuators, and Algorithms

Course Objectives:

1. To introduce the principles and applications of sensors in robotic systems.
2. To study vision systems and image processing techniques for robots.
3. To integrate sensor data for perception, navigation, and control.
4. To explore 2D and 3D vision systems for object detection and recognition.
5. To develop algorithms for visual serving and robot guidance.

Course Outcomes: After completing this course, students will be able to:

1. Identify and select appropriate sensors for robotic applications.
2. Implement image acquisition, enhancement, and feature extraction techniques.
3. Integrate vision systems with robot control for real-time operation.
4. Develop algorithms for object detection, tracking, and scene interpretation.
5. Apply sensing and vision techniques for industrial inspection, assembly, and navigation tas

UNIT – I: Robotic Vision

Robotic Vision Sensors and their Interfacing, Fundamentals of Computer Vision, Image Accusation and Representation, Image Transformation, Filtering, Restoration, Morphing, Camera Models, Calibration, Single View Geometry, Multiple View Geometry, Epipolar Geometry, RANSAC.

UNIT – II: Robotic Machine Vision Systems

Robotic Machine Vision, Imaging Devices, Lighting Techniques, Image Processing and Analysis, Analog to Digital Signal Conversion, Object Recognition, Training the Vision System.

UNIT – III: Position and Orientation Estimation

Position and Orientation: Feature Based Alignment, Pose Estimation, Time Varying Pose and Trajectories, Structure from Motion, Dense Motion Estimation, Visual Odometry (Semi-direct VO, Direct Sparse Odometry), Bundle Assignment.

UNIT – IV: Localization and Mapping

Localization and Mapping, Initialization, Tracking, Mapping, Geometric SLAM Formulations (Indirect vs. Direct Error Formulation, Geometry Parameterization, Sparse vs. Dense Model, Optimization Approach), Relocalization and Map Optimization, Visual SLAM. Examples: Indirect (Feature Based) Methods (MonoSLAM, PTAM, ORB-SLAM), Direct Methods (DTAM, LSD-SLAM), Sensor Combinations (IMU, Mono vs. Stereo, RGB-Depth), Analysis and Parameter Studies.

UNIT –V: Recognition and Interpretation in Robotic Vision

Recognition and Interpretations, Concepts of Machine Learning and Deep Learning, Sequence Modeling, Learning for Robotic Vision: Active Learning, Incremental and Class Incremental Learning Identify Unknowns, Uncertainty Estimation and Embodiment for Robotic Vision, Active Vision, Spatial and Temporal Embodiment, Reasoning for Object, Scene and Scene Semantics.

TEXT BOOKS:

1. Sensors for Mobile Robots: Theory and Application, H. R. Everett, A K Peters / CRC Press, 2nd Edition, published July 15, 1995.
2. Robotic Tactile Sensing: Technologies and System, Ravinder S. Dahiya and Maurizio Valle, Springer, 1st Edition, 2013.

REFERENCE BOOKS:

1. Simulation Modeling and Analysis, Averill M. Law and W. David Kelton, McGraw-Hill, 2nd Edition, 1991
2. Discrete Event System Simulation, Jerry Banks and John J. S. Carson II, Prentice-Hall, 1st Edition, 1984.
3. Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms, Nikolaus Correll, Bradley Hayes, Patrick Beeson, and Amit Talwalkar, MIT Press, 2nd Edition, 2022.
4. Robotics, Vision and Control: Fundamental Algorithms In MATLAB, Peter Corke, Springer, 2nd Edition, 2017.
5. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2nd Edition, 2022.
6. Introduction to Autonomous Mobile Robots, Roland Siegwart, Illah R. Nourbakhsh and Davide Scaramuzza, MIT Press, 2nd Edition, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
INTELLIGENT SYSTEMS AND INTERFACES
(Professional Elective-I)

L	T	P	C
3	0	0	3

Prerequisites: Artificial Intelligence and Neural Networks and Fuzzy Logic

Course Objectives: The course aims to:

1. Introduce the principles and architectures of intelligent systems and human-computer interfaces.
2. Explain the integration of artificial intelligence techniques into real-time and embedded systems.
3. Explore natural user interfaces including voice, gesture, and touch-based interactions.
4. Develop understanding of adaptive systems that learn user behavior and provide context-aware responses.
5. Expose students to design, implementation, and evaluation of intelligent interactive systems.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the design and architecture of intelligent systems with user-centered interfaces.
2. Apply AI and machine learning techniques in building adaptive and interactive systems.
3. Design multimodal interfaces using speech, gesture, and visual inputs for enhanced interaction.
4. Develop context-aware applications capable of sensing, interpreting, and responding to user environments.
5. Evaluate the performance and usability of intelligent systems and recommend improvements based on user feedback and data analytics.

UNIT – I: Language Processing and Parsing

Language Processing, Computational Phonology, Issues, Phonological Rules, Mapping Text to Phones, Prosody in TTS, Probabilistic Models of Pronunciation and Spelling, N-Grams.
Syntax: Word Classes and POS Tagging, CFG for English, Lexicalized and Probabilistic Parsing.

UNIT – II: Semantics, Pragmatics, and Machine Learning

Semantic Representation, Semantic and Lexical Analysis and Word Sense Disambiguation, IR, Pragmatics, Discourse, Dialogue Agents, Natural Language Generation and Machine Translation. Machine Learning: Data Mining, Association Rules, Clustering, Decision Trees and Text Mining.

UNIT – III: Synergetic and Neural Network Techniques

Synergetic Techniques, Synergetic Learning Systems, Concept, Architecture and Algorithm, Basics of Genetic Algorithms, Artificial Neural Network Techniques for Machine Learning.

UNIT – IV: Bioinformatics and Intelligent Interfaces

Application to Bio Informatics, Intelligent Interfaces, Incorporating Intelligence, Requirements, Design Issues, Applications, Development of Intelligent Interfaces for Systems, Stand Alone Systems like OS, Databases, Physical Machines Including Robots.

UNIT – V: Web Applications and Intelligent Systems

Web Based Application, Intelligent Tutoring Systems, Design and Developmental Methods, Methods of Web Mining, E Shopping, E-Commerce Chat Box, Augmented Reality.

TEXT BOOKS:

1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, Pearson Education, 1st Edition, 2000.
2. Building Natural Language Generation Systems, Ehud Reiter and Robert Dale, Cambridge University Press, 1st Edition, 2000.

REFERENCE BOOKS:

1. Machine Learning, Tom M. Mitchell, McGraw-Hill (MGH), 1st Edition, 1997.
2. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufmann Publishers, 1st Edition, 2000.
3. Intelligent Systems: Architecture, Design and Control, P. S. Grover and Manisha Grover, Oxford University Press, 1st Edition, 2016.
4. Human-Computer Interaction, Alan Dix, Janet Finlay, Gregory D. Abowd and Russell Beale, Pearson, 3rd Edition, 2004.
5. Designing User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, Pearson, 6th Edition, 2017.
6. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 1st Edition, 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
KNOWLEDGE ENGINEERING AND EXPERT SYSTEM
(Professional Elective-I)

L	T	P	C
3	0	0	3

Prerequisites: Artificial Intelligence Fundamentals and Knowledge-Based Systems

Course Objectives: The course aims to:

1. Introduce the foundational concepts of knowledge-based systems and their role in intelligent decision-making.
2. Explain the methods of knowledge acquisition, representation, and reasoning.
3. Familiarize students with expert system architectures and inference mechanisms.
4. Explore rule-based systems, semantic networks, frames, and ontologies.
5. Develop skills for designing and implementing simple expert systems using appropriate tools and languages.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the structure, components of knowledge-based, and expert systems.
2. Apply various knowledge representation techniques such as production rules, frames, and semantic networks.
3. Analyze and implement reasoning mechanisms such as forsward and backward chaining.
4. Acquire, organize, and validate domain-specific knowledge for expert system development.
5. Design and develop small-scale expert systems using tools like CLIPS, Prolog, or Python-based shells.

UNIT – I: Introduction to Knowledge Engineering

The History of Knowledge Based Expert Systems, Types of Knowledge Based Systems, Characteristics of Current Expert Systems, Basic Concepts for Building Expert Systems.

UNIT – II: Knowledge Representation and Reasoning

Logic, Rules and Representation, Developing Rules Based System and Semantic Networks, Knowledge Acquisition, Knowledge Representation Schemes.

UNIT – III: Expert System Architecture and Development

Building the Expert System, Architecture of Expert Systems, Constructing an Expert System, Methods of Inference, Expert Systems Shells, Development of Environments, Use of AI Language.

UNIT – IV: Plausible Reasoning and Expert System Tools

Conceptual Data Analysis, Plausible Reasoning Techniques, Tools for Building Expert Systems, Reasoning under Uncertainty, Introduction to Clips, Pattern Matching, Modular Design and Execution Control.

UNIT – V: Production Rule Programming and Case Studies

Production Rule Programming, Issues and Case Studies, Comparing Different Approaches, Language and Tools for Knowledge Engineering, Expert System Design Examples, Case Study in Knowledge Engineering.

TEXT BOOKS:

1. Expert Systems – Principles and Programming, Joseph C. Giarratano and Gary D. Riley, Course Technology (PWS Publishing), 3rd Edition, 1998.
2. An Introduction to Knowledge Engineering, Simon L. Kendal and Malcolm Creen, Springer, 1st Edition, published October 4, 2006.

REFERENCE BOOKS:

1. Building Expert Systems with Production Rules: The Mycin Experiments, B.B. Buchanan and E.H. Shortliffe, Addison-Wesley Publishing Company, 1st Edition, 1984.
2. Knowledge-Based Systems in Artificial Intelligence, Randall Davis and Douglas B. Lenat, McGraw-Hill International Book Company, 1st Edition, 1982.
3. Building Expert Systems, Frederick Hayes-Roth, Donald A. Waterman, and Douglas B. Lenat (Eds.), Addison-Wesley Publishing Company, 1st Edition, 1983.
4. Expert Systems: State of the Art, I.S. Torsun, Addison-Wesley Publishing Company, 1st Edition, 1995.
5. Knowledge Engineering: Principles and Techniques, Peter Jackson, Wiley, 2nd Edition, 1998.
6. Principles of Expert Systems, Peter Jackson, Addison-Wesley, 1st Edition, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
MACHINE LEARNING
(Professional Elective-II)

L	T	P	C
3	0	0	3

Prerequisites: Programming Skills and Introduction to Machine Learning

Course Objectives: The course aims to:

1. To introduce the fundamental concepts and algorithms of machine learning.
2. To study supervised, unsupervised, and reinforcement learning techniques.
3. To explore feature selection, dimensionality reduction, and model evaluation methods.
4. To apply machine learning for pattern recognition, prediction, and classification tasks.
5. To develop skills in implementing machine learning algorithms using programming tools.

Course Outcomes: After completing this course, students will be able to,

1. Explain the basic principles and types of machine learning approaches.
2. Select and apply suitable algorithms for classification, regression, and clustering.
3. Evaluate and improve machine-learning models using performance metrics.
4. Implement ML algorithms using tools such as Python, Tensor Flow, or Scikit-learn.
5. Apply machine-learning solutions to real-world engineering and industrial problems.

UNIT – I: Concepts of Machine Learning

Types of Machine Learning, Supervised, Unsupervised and Reinforcement Learning, Various Packages used for Machine Learning, Data Visualization, Splitting the Data into Training and Validation.

UNIT – II: Supervised Learning - I

Linear Regression Technique, Logistic Regression Technique and Hierarchical Cluster Analysis, Significance of using Decision Tree, Types of Decision Trees, Theory on Hyperplane and Kernels, Strategies to Implement Transformations such as Translation, Scaling, Rotation, Mirror Reflection, Shearing for Simple Geometries.

UNIT – III: Supervised Learning - II

Bayesian Classification, Perceptrons, Multi-Layer Perceptron, RBF Networks, Regression Model, Support Vector Machines, Convolutional Neural Networks, Recurrent Neural Networks, Random Forest, Mathematical Concepts, Native Bayes Theorem, Limitation of Naïve Bayes Theorem, K Nearest Neighbors Algorithm.

UNIT – IV: Unsupervised Learning

K-Means Clustering, DBSCAN, Non-Parametric Estimation, Mean Shift Clustering, Classification Performance Analysis, Ensemble Methods, Boosting and Bagging.

UNIT –V: Reinforcement and Deep Learning

Reinforcement Learning, Learning Task, Q Learning, Temporal Difference Learning, Relationship to Dynamic Programming, Generalizing from Examples. Introduction To Deep Learning, Applications: Structure Mapping, Case Studies In Robotics.

TEXT BOOKS:

1. Machine Learning, Tom Mitchell, McGraw Hill Publishers, 1st Edition, 1997.
2. Introduction to Machine Learning, Alpaydin, Prentice Hall, 3rd Edition, 2015.

REFERENCE BOOKS:

1. Neural Networks and Learning Machines, S. O. Haykin, Pearson Education (India), 3rd Edition, 2016.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press,1st Edition, 2017.
3. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 1st Edition, 2006.
4. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 2nd Edition, 2019.
5. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2nd Edition, 2009.
6. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 1st Edition, 2016.
7. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 1st Edition, 2012.
8. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz and Shai Ben-David, Cambridge University Press, 1st Edition, 2014.
9. Bayesian Reasoning and Machine Learning, David Barber, Cambridge University Press, 1st Edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
SMART MANUFACTURING SYSTEMS
(Professional Elective-II)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes and Systems and Industrial Automation

Course Objectives:

1. Introduce the concept and evolution of smart manufacturing within Industry 4.0 frameworks.
2. Explain the integration of cyber-physical systems, IoT, cloud computing, and big data in manufacturing.
3. Develop understanding of intelligent automation, robotics, and adaptive control in smart factories.
4. Explore data-driven decision-making, predictive maintenance, and real-time monitoring systems.
5. Familiarize students with digital twins, smart sensors, and standards for interoperable systems.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the principles and architecture of smart manufacturing systems.
2. Analyze the role of IoT, sensors, and cloud platforms in enabling intelligent production.
3. Apply digital technologies for automation, real-time monitoring, and process optimization.
4. Evaluate data analytics and AI techniques for quality control, fault detection, and maintenance.
5. Design and propose smart manufacturing solutions incorporating cyber-physical integration, digital twins, and industry standards**.**

UNIT - I: CIM Systems and Communication

Computer Integrated Manufacturing Systems Structure and Functional Areas of CIM System, CAD, CAPP, CAM, CAQC, ASRS, Advantages of CIM, Manufacturing Communication Systems, MAP / TOP, OSI Model, Data Redundancy, Top-Down and Bottom-Up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation.

UNIT - II: Knowledge Based Systems

Components of Knowledge Based Systems, Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT - III: Machine Learning in Manufacturing

Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks, Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications In Manufacturing.

UNIT - IV: Automated Process Planning

Automated Process Planning, Variant Approach and Generative Approach, Expert Systems for Process Planning, Feature Recognition and Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES), Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT - V: Group Technology and KBGT

Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation, Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology, Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBST), Data Base, Knowledge Base, Clustering Algorithm.

TEXT BOOKS:

1. Intelligent Manufacturing Systems, Andrew Kusiak, Prentice Hall, 1st Edition, 1990.
2. Artificial Neural Networks, B. Yegnanarayana, Prentice-Hall of India (PHI), 1st Edition, 2006.

REFERENCE BOOKS:

1. Automation, Production Systems and CIM, M.P. Groover, Prentice-Hall of India (PHI), 3rd Edition, 2007.
2. Neural Networks: A Comprehensive Foundation, Simon Haykin, Prentice-Hall of India (PHI), 2nd Edition, 2005.
3. Neural Networks in Computer Intelligence, Li Min Fu, Tata McGraw-Hill (TMH), 1st Edition, 2003.
4. Smart Manufacturing: The Lean Six Sigma Way, Anthony Tarantino, Wiley, 1st Edition, 2022.
5. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, Apress, 1st Edition, 2016.
6. Cyber-Physical Systems for Industry 4.0, Dinesh C. Verma, Springer, 1st Edition, 2021.
7. Smart Manufacturing: A Guide for Digital Transformation, Michael McClellan, CRC Press, 1st Edition, 2017.
8. Digital Manufacturing and Design for Industry 4.0, Michael Schilling, Springer, 1st Edition, 2021.
9. Manufacturing Intelligence for Industrial Engineering: Methods for System Self-Organization, Zude Zhou, Shane Shengquan Xie and Dejun Chen, IGI Global, 1st Edition, 2010.
10. Smart Sensors, Measurement and Instrumentation, Subhas Chandra Mukhopadhyay, Springer, 1st Edition, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
DIGITAL ELECTRONICS AND MICROPROCESSORS
(Professional Elective-II)

L	T	P	C
3	0	0	3

Prerequisites: Fundamentals of Digital Circuits and Digital Design

Course Objectives:

1. Introduce the fundamental concepts of digital logic circuits and systems.
2. Explain combinational and sequential circuit design using logic gates and flip-flops.
3. Provide detailed knowledge of microprocessor architecture, instruction sets, and programming.
4. Familiarize students with interfacing techniques for memory, I/O devices, and peripherals.
5. Develop skills to design and troubleshoot digital systems and simple microprocessor-based applications.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the fundamentals of number systems, Boolean algebra, and logic gates.
2. Design and analyze combinational and sequential digital circuits like multiplexers, counters, and registers.
3. Describe the architecture and operation of 8-bit/16-bit microprocessors (e.g., 8085, 8086).
4. Write assembly language programs for arithmetic, logical, and control operations.
5. Interface microprocessors with memory and I/O devices and implement basic applications.

UNIT – I: Number Systems and Boolean Logic

Number Systems and Code Conversion, Boolean Algebra and Logic Gates, Truth Tables, Universal Gates and Simplification of Boolean Functions, SOP and POS Methods, Simplification of Boolean Functions using K-Maps, Signed and Unsigned Binary Numbers.

UNIT – II: Combinational and Sequential Circuits

Combinational Logic Circuits, Adders and Subtractors, Multiplexers, Demultiplexers, Encoders, Decoders, Programmable Logic Devices. Sequential Logic Circuits: RS, Clocked RS, D, JK, Master Slave JK, T Flip-Flops, Shift Registers, Types of Shift Registers, Counters, Ripple Counter, Synchronous Counters, Asynchronous Counters, Up-Down Counter.

UNIT – III: 8086 Microprocessor Basics

Microprocessors -I - 8085 Microprocessor Review (Brief Details Only), 8086 Microprocessor, Functional Diagram, Register Organization 8086, Flag Register of 8086 and its Functions, Addressing Modes of 8086, Pin Diagram of 8086, Minimum Mode and Maximum Mode Operation of 8086, Interrupts in 8086.

UNIT – IV: 8086 Programming and 8051 Microcontroller

Microprocessors -II -Instruction Set of 8086, Assembler Directives, Procedures and Macros, Simple Programs Involving Arithmetic, Logical, Branch Instructions, Ascending, Descending and Block Move Programs, String Manipulation Instructions, Overview of 8051 Microcontroller, Architecture, I / O Ports and Memory Organization, Addressing Modes and Instruction Set of 8051(Brief Details only), Simple Programs.

UNIT – V: Peripheral Interfacing and Applications

Interfaces, Peripheral Interfacing Parallel versus Serial Transmission, Synchronous and Asynchronous Serial Data Transmission, Interfacing or Hexadecimal Keyboard and Display UNIT, Interfacing of Cassette Recorders and Parallel, Serial Interface Standards, Study of Peripheral Devices 8255, 8253, 8257, 8251, 8259. Module V: Microprocessor Applications to Power Engineering Protective Relaying over-Current, Impedance, MHO, Reactance, Bi-Directional Relays.

TEXT BOOKS:

1. Digital Design, M. Morris Mano and Michael D. Ciletti, Pearson Education, 5th Edition, 2013.
2. Digital Electronics: Principles, Devices and Applications, Anil K. Maini, John Wiley and Sons, Ltd., 1st Edition, 2007.

REFERENCE BOOKS:

1. Digital Fundamentals – A Systems Approach, Thomas L. Floyd, Pearson Education, 1st Edition, 2013.
2. Fundamentals of Logic Design, Charles H. Roth, Cengage Learning, 5th Edition, 2004.
3. Microprocessors and Interfacing, D. V. Hall, TMGH (Tata McGraw-Hill), 2nd Edition, 2006.
4. The 8051 Microcontroller, Kenneth J. Ayala, Cengage Learning, 3rd Edition, 2010.
5. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh S. Gaonkar, Penram International, 6th Edition, 2013.
6. Digital Fundamentals, Thomas L. Floyd, Pearson, 11th Edition, 2015.
7. Modern Digital Electronics, R.P. Jain, McGraw Hill, 4th Edition, 2010.
8. Microprocessors and Interfacing: Programming and Hardware, Douglas V. Hall, McGraw Hill, 3rd Edition, 2012.
9. Digital Design, M. Morris Mano and Michael D. Ciletti, Pearson, 5th Edition, 2013.
10. Fundamentals of Microprocessors and Microcontrollers, B. Ram, Dhanpat Rai Publications, 1st Edition, 2000.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
RESEARCH METHODOLOGY AND IPR

L	T	P	C
2	0	0	2

Prerequisite: Fundamentals of Statistics, Technical Writing Skills

Course Objectives:

1. To understand research fundamentals, methodologies, and the significance of research ethics.
2. To enable students to formulate research problems and conduct literature surveys effectively.
3. To introduce the principles of data collection, analysis, and interpretation in research.
4. To explain intellectual property rights, patents, copyrights, and trademarks.
5. To highlight the importance of IPR in protecting innovative ideas and research outcomes.

Course Outcomes: At the end of this course, students will be able to

1. Understand the research process, methodologies, and ethics involved in scholarly work.
2. Formulate and define research problems with appropriate objectives.
3. Apply suitable data collection and analysis techniques for research projects.
4. Understand the various forms of intellectual property rights and legal aspects related to patents and copyrights.
5. Apply the knowledge of IPR to safeguard their innovations and research findings.

UNIT-I: Research Problem and Investigation Approaches

Meaning of Research Problem, Sources of Research Problem and Criteria Characteristics of a Good Research Problem, Errors in Selecting a Research Problem, Scope and Objectives of Research Problem. Approaches of Investigation of Solutions for Research Problem, Data Collection, Analysis, Interpretation, Necessary Instrumentations.

UNIT-II: Literature Review and Ethics

Effective Literature Studies Approaches, Analysis, Plagiarism, Research Ethics.

UNIT-III: Technical Writing and Proposals.

Effective Technical Writing, How to Write Report, Paper Developing a Research Proposal, Format of Research Proposal, a Presentation and Assessment by A Review Committee.

UNIT-IV: Intellectual Property and Patenting

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process Of Patenting and Development: Technological Research, Innovation, Patenting, Development. International Scenario: International Cooperation on Intellectual Property. Procedure for Grants of Patents, Patenting Under PCT.

UNIT-V: Patent Rights and Emerging IPR

Patent Rights: Scope of Patent Rights, Licensing and Transfer of Technology, Patent Information and Databases, Geographical Indications. New Developments in IPR: Administration of Patent System. IPR of Biological Systems, Computer Software Etc., Traditional Knowledge Case Studies, IPR and IITs.

TEXTBOOKS:

1. Research methodology: an introduction for science and engineering students, Stuart Melville and Wayne Goddard, Juta and Co. Ltd, 1ST Edition, 1996.
2. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, SAGE, 2nd Edition, 2010.

REFERENCE BOOKS:

1. Resisting Intellectual Property, Debora J. Halbert, Routledge, Taylor and Francis, 1st Edition, 2005.
2. Industrial Design, W. H. (William Henry) Mayall, Iliffe Books (London), also McGraw-Hill editions, 1st Edition, 1974.
3. Intellectual Property in the New Technological Age, Robert P. Merges, Peter S. Menell and Mark A. Lemley, Aspen Casebook Series, Latest Edition, 2016.
4. Intellectual Property Rights under WTO, T. Ramappa, Wheeler Publishing, 1st Edition, 2000.
5. Research Methodology and IPR, P. N. Ganesan, Scitech Publications, 1st Edition, 2019.
6. Intellectual Property Rights: Unleashing the Knowledge Economy, Prabuddha Ganguli, Tata McGraw-Hill, 1st Edition, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
ROBOTICS SIMULATION LABORATORY

L	T	P	C
0	0	4	2

Prerequisites: Robot Operating System

Course Objectives: The course aims to:

1. Provide hands-on experience in modeling, simulating, and controlling robotic systems using simulation tools.
2. Enable students to understand and implement forward and inverse kinematics, path planning, and trajectory generation.
3. Familiarize students with robot programming environments and visualization platforms.
4. Integrate sensing, actuation, and control in a simulated environment.
5. Prepare students for real-world robotic applications through virtual testing and debugging.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Model and simulate robotic manipulators using kinematic and dynamic principles.
2. Implement forward and inverse kinematics algorithms using simulation tools like MATLAB, ROS, or Gazebo.
3. Design motion planning and trajectory generation routines for various robotic applications.
4. Integrate sensors and actuators virtually to simulate closed-loop control systems.
5. Develop and test robotic algorithms in a simulated environment and analyze their performance.

List of Experiments:

1. Dynamic model development and simulation of simple mechanical systems using Matlab and Mathematica.
2. Numerical simulation of simple mechanical systems.
3. Stability analysis of simple mechanical systems using linear system theory namely root locus and Bodeplot.
4. State space model development and dynamic simulation using Simulink.
5. Model a single degree of freedom spring–mass–damper system using MATLAB Simscape Multibody to analyze natural frequency, damping, and parameter effects.
6. Simulate a crankshaft–rod–piston assembly using MATLAB Simscape Multibody to study kinematics, angular velocity distribution, and bearing reaction forces.
7. Create and validate hydraulic components using MATLAB Simscape Multibody and integrate them with multibody mechanics for performance analysis.
8. Build and control a complete hydraulic actuation system with load using MATLAB Simscape Multibody to analyze dynamic performance and stability.
9. Model and control a multi–degree of freedom robot manipulator using MATLAB Simscape Multibody to validate kinematics, dynamics, and trajectory tracking.Mobile robot control using Matlab/Simulink.

10. Acquiring Data from Sensors and Instruments Using MATLAB.
11. Developing Kinematics (Forward and Inverse of popular configurations using using simulations.

Lab Manuals:

1. Dynamic Model Development and Simulation of Mechanical Systems Using MATLAB and Mathematica, Peter W. Christensen, Springer, 1st Edition, 2022.
2. Numerical Simulation of Mechanical Systems with MATLAB, William B. J. Zimmerman, Elsevier, 2nd Edition, 2020.
3. Linear System Theory and Stability Analysis with MATLAB, Chi-Tsong Chen, Oxford University Press, 4th Edition, 2019.
4. State-Space Modeling and Simulation Using Simulink, Brian D. Hahn, Elsevier, 3rd Edition, 2021.
5. Simscape Multibody Simulation with MATLAB and Simulink, Michael Tan, MathWorks Press, 1st Edition, 2022.
6. Mobile Robot Control with MATLAB and Simulink, Bruno Siciliano, Springer, 2nd Edition, 2021.
7. Data Acquisition Using MATLAB, Gary W. Johnson, CRC Press, 2nd Edition, 2020.
8. Robot Kinematics and Dynamics with MATLAB Simulation, John J. Craig, Pearson, 4th Edition, 2021.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, I Semester

PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

Prerequisites: Python Programming

Course Objectives:

1. Introduce the syntax, semantics, and basic constructs of Python programming.
2. Develop problem-solving skills using Python's control structures, functions, and modules.
3. Enable hands-on experience with file operations, exception handling, and object-oriented programming.
4. Familiarize students with Python libraries for data handling, numerical computation, and simple visualizations.
5. Encourage the development of real-world applications using Python.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Write Python programs using variables, data types, conditional statements, loops, and functions.
2. Implement programs involving strings, lists, tuples, dictionaries, and sets.
3. Perform file handling, exception management, and utilize built-in as well as user-defined modules.
4. Apply object-oriented programming principles in Python for class and object design.
5. Use libraries such as NumPy, Matplotlib, or Pandas to develop simple data-centric applications.

List of Experiments

1. Write a program to create, concatenate and print a string and accessing sub-string from given string
2. Write a program to perform basic arithmetic operations using function evaluation, root of equations and nonlinear solution methods.
3. Write a program to find the solutions of various numerical methods.
4. Write a python program that defines a matrix and perform matrix operations like addition, multiplication etc.
5. Use a python program to solve a Systems of Linear Algebraic Equations
6. Write a python program to define a module to find Fibonacci numbers and import the module to another program
7. Write a program to implement transformations such as Translation, Scaling, Rotation, Mirror Reflection and Shearing for simple geometries like line, triangle, rectangle and other
8. Write a program to implement curve generation using python for cubic spline, B-spline and Bezier curves.
9. Write a python program to compute Central Tendency Measures and Measure of Dispersion: Variance, Standard Deviation
10. Write a Python program to implement Simple Linear Regression
11. Use of Scikit-learn tools for classification, regression, clustering and dimensionality reduction.

12. Use of SciKit-learn tools to implement Naïve bayes, Random Forest Algorithm.
13. Use of SciKit Learn tools to implement Decision Tree, Logistic Regression, KNN Algorithms.

Lab Manuals:

1. Python Programming Laboratory Manual, E. Balagurusamy, McGraw Hill Education, 1st Edition, 2017.
2. Python Programming Lab Manual, Reema Thareja, Oxford University Press, 2nd Edition, 2019.
3. Practical Python Lab Manual, Mark Lutz, O'Reilly Media, 5th Edition, 2013.
4. Python Programming Using Anaconda Lab Manual, Yashavant Kanetkar, BPB Publications, 1st Edition, 2020.
5. Python Programming Experiments, Eric Matthes, No Starch Press, 2nd Edition, 2019.
6. Core Python Laboratory Manual, Wesley J. Chun, Pearson Education, 2nd Edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
KINEMATICS AND DYNAMICS OF ROBOTIC SYSTEMS
(Professional Core-III)

L	T	P	C
3	0	0	3

Prerequisites: Robotics and Robot Dynamics and Control

Course Objectives:

1. To understand the principles of kinematics and dynamics as applied to robotic systems.
2. To study forward and inverse kinematics for various robot configurations.
3. To analyze robot motion using velocity and acceleration equations.
4. To apply dynamic modeling for manipulator motion and control.
5. To develop mathematical models for trajectory planning and performance analysis.

Course Outcomes: After completing this course, students will be able to:

1. Derive and solve forward and inverse kinematics for robotic manipulators.
2. Analyze velocity and acceleration in robotic joints and links.
3. Develop dynamic equations of motion using Lagrangian and Newton–Euler methods.
4. Perform trajectory planning considering motion constraints.
5. Apply kinematics and dynamics principles for robotic control and simulation.

UNIT – I: Object Position and Transformations

Introduction to Position and Orientation of Objects, Objects Coordinate Frame Rotation Matrix, Euler Angles Roll, Pitch and Yaw Angles Coordinate Transformations, Joint Variables and Position of End Effector, Dot and Cross Products, Coordinate Frames, Rotations, Homogeneous Coordinates.

UNIT - II: Direct Kinematics and D-H Representation

Link Coordinates D-H Representation, The Arm Equation, Direct Kinematic Analysis for Four Axis, SCARA Robot and Three, Five and Six Axis Articulated Robots.

UNIT - III: Inverse Kinematics

The Inverse Kinematics Problem, General Properties of Solutions. Tool Configuration, Inverse Kinematics of Four Axis SCARA Robot and Three and Five Axis, Articulated Robot.

UNIT - IV: Workspace and Trajectory Planning

Workspace Analysis and Trajectory Planning: Workspace Analysis, Work Envelope of a Four Axis SCARA Robot and Five Axis Articulated Robot Workspace Fixtures, The Pick and Place Operations, Joint Space Technique - Continuous Path Motion, Interpolated Motion, Straight Line Motion and Cartesian Space Technique in Trajectory Planning.

UNIT - V: Manipulator Dynamics and Modeling

Manipulator Dynamics: Introduction, Lagrange's Equation Kinetic and Potential Energy. Link Inertia Tensor, Link Jacobian Manipulator Inertia Tensor. Gravity, Generalized Forces, Lagrange-Euler Dynamic Model, Dynamic Model of a Two-Axis Planar Robot, Newton Euler Formulation, Lagrange - Euler Formulation, Problems.

TEXT BOOKS:

1. Fundamentals of Robotics Engineering, Harry H. Poole, Cengage Learning, 1st Edition, 2012.
2. Robotics and Control, R. K. Mittal and Nagrath, Tata McGraw-Hill Education Private Limited, 3rd Edition, 2009

REFERENCE BOOKS:

1. Fundamentals of Robotics: Analysis and Control, Robert J. Schilling, PHI Learning, 1st Edition, 2009.
2. Robotics Engineering**:** An Integrated Approach, Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, PHI Learning, 1st Edition, 2009.
3. Robotics and Image Processing: An Introduction, Janaki Raman P.A., Tata McGraw-Hill Publishing Company Ltd., 1st Edition, 1995.
4. Industrial Robotics, Bernard Hodges, Jaico Publishing House, 2nd Edition, 1993.
5. Foundations of Robotics: Analysis and Control, Tsuneo Yoshikawa, MIT Press, 1st Edition, 2003.
6. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson Education, 3rd Edition, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
BIG DATA MANAGEMENT
(Professional Core-IV)

L	T	P	C
3	0	0	3

Prerequisites: Database Systems and Big Data Fundamentals, Concepts, Drivers and Techniques

Course Outcomes:

1. To introduce the concepts, challenges, and technologies for managing big data.
2. To study big data storage, processing, and retrieval techniques.
3. To explore distributed computing frameworks such as Hadoop and Spark.
4. To develop skills for handling structured, semi-structured, and unstructured data.
5. To apply big data analytics for decision-making in engineering and business applications.

Course Outcomes: After completing this course, students will be able to:

1. Explain the characteristics and challenges of big data management.
2. Implement big data storage solutions using distributed file systems.
3. Apply parallel and distributed processing techniques for large datasets.
4. Use tools like Hadoop, Spark, and NoSQL databases for big data applications.
5. Design and manage big data solutions for real-world problems across various domains.

UNIT – I: Database Concepts and Modeling

Databases and Database Users, Database System Concepts and Architecture, Data Modeling Using Entity Relationship (ER) Model, Enhanced ER Model, Relational Model, The Relational Data Model and Relational Database Constraints, The Relational Algebra and Relational Calculus.

UNIT - II: Database Design and Normalization

Overview of the Hierarchical Data Model, Overview of the Network Data Model, Relational Database Design, Mapping ER Model to Relational Model, Commercial Query Languages, QBE, Functional Dependency, Normalization.

UNIT - III: SQL and Query Processing

SQL Queries, Embedded SQL. MySQL: Basics, Queries in MySQL and Algorithms for Query Processing and Optimization, Introduction to Transaction Processing Concepts and Theory, Concurrency Control Techniques.

UNIT - IV: Recovery and Security

Database Recovery Techniques, Database Security, Debate on the Distributed Databases and Client, Server Architecture with Reference to Indian Railway Reservation System.

UNIT - V: Object DB and Emerging Technologies

Object Database and Current Trends, Concepts for Object Database, Emerging Database Technologies and Application, Introduction to Data Warehousing and Data Mining, Applications of Data Mining.

TEXT BOOKS:

1. Database Management Systems, Raghurama Krishnan and Johannes Gehrke, Tata McGraw-Hill, 3rd Edition, 2004
2. Database System Concepts, Silberschatz and Korth, McGraw-Hill, 6th Edition, 2010

REFERENCE BOOKS:

1. Database Systems: Design, Implementation, and Management, Peter Rob and Carlos Coronel, Cengage Learning, 14th Edition, 2016.
2. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, Pearson Education, 7th Edition, 2016.
3. Database System Concepts, Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, McGraw-Hill, 7th Edition, 2019.
4. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Elsevier, 3rd Edition, 2011.
5. Object-Oriented Database Design, Jan L. Harrington, Elsevier, 2nd Edition, 2005.
6. Data Management in Cloud, Liang Zhao & Xiaohua Jia, Springer, 1st Edition, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
INTERNET OF THINGS
(Professional Elective – III)

L	T	P	C
3	0	0	3

Prerequisites: IoT Fundamentals, Networking Technologies, Protocols, and Use Cases

Course Objectives:

1. To introduce the fundamental concepts, evolution, and enabling technologies of IoT.
2. To understand the relationship between IoT and Machine-to-Machine (M2M) communication.
3. To develop practical skills in IoT device programming using Arduino and Raspberry Pi.
4. To study various IoT architectures and data management techniques.
5. To analyze the challenges and applications of IoT across different domains like agriculture, healthcare, and smart cities.

Course Outcomes: After completing this course, students will be able to:

1. Explain the basic concepts, architecture, and characteristics of IoT.
2. Differentiate between IoT and M2M and understand their value chains.
3. Program and interface sensors and actuators using Arduino and Raspberry Pi for IoT applications.
4. Describe IoT architectures and manage IoT data effectively.
5. Design IoT systems for real-world applications in various sectors, addressing challenges and emerging technologies.

UNIT – I: Technologies of IoT

Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, Enabling technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

UNIT - II: IoT and M2M Communication

M2M to IoT, A Basic Perspective, Introduction, Differences and similarities betweenM2M and IoT, SDN and NFV for IoT.M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

UNIT - III: IoT Practical Implementation

IoT Hands-on: Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi.

UNIT - IV: IoT Architecture and Data Management

IoT Architecture components, Comparing IoT architectures, A simplified IoT architecture, The core IoT functional stack, IoT Data Management and Compute Stack.

UNIT - V: IoT System Design and Applications

IoT System design: Challenges associated with IoT, Emerging pillars of IoT, Agricultural IoT, Vehicular IoT, Healthcare IoT, Smart cities, Transportation and Logistics.

TEXT BOOKS:

1. Introduction to IoT, Sudip Misra, Anandarup Mukherjee and Arijit Roy, Cambridge University Press, 1st Edition, 2019
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for IoT, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2nd Edition, 2020.

REFERENCE BOOKS:

1. Getting Started with the Internet of Things, Cuno Pfister, O'Reilly Media, 1st Edition, 2011.
2. Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, Francis daCosta, A press Publications, 1st Edition, 2013.
3. Internet of Things: A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 1st Edition, 2015.
4. Internet of Things: A Hands-On Approach, Arshdeep Bahga & Vijay Madisetti, Universities Press, 1st Edition, 2014.
5. Building Internet of Things with the Arduino, Charalampos Doukas, Apress, 1st Edition, 2012.
6. Internet of Things: Architecture and Applications, Rajkumar Buyya, Sherali Zeadally & Schahram Dustdar, Wiley, 1st Edition, 2020.
7. Designing the Internet of Things, Adrian McEwen & Hakim Cassimally, Wiley, 1st Edition, 2013.
8. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton & Jerome Henry, Cisco Press, 1st Edition, 2017.
9. The Internet of Things: Key Applications and Protocols, Olivier Hersent, David Boswarthick & Omar Elloumi, Wiley, 2nd Edition, 2012.
10. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Ovidiu Vermesan & Peter Friess, River Publishers, 1st Edition, 2014.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
AUTONOMOUS VEHICLES
(Professional Elective – III)

L	T	P	C
3	0	0	3

Prerequisites: Self-Driving Vehicles and Enabling Technologies

Course Objectives:

1. To introduce the concepts and technologies behind autonomous vehicles.
2. To understand the sensors, perception, and decision-making systems used in autonomous driving.
3. To study control strategies and algorithms for vehicle navigation and path planning.
4. To analyze safety, security, and regulatory aspects of autonomous vehicles.
5. To explore real-world applications and challenges in autonomous vehicle development.

Course Outcomes: After completing this course, students will be able to:

1. Explain the fundamentals of autonomous vehicle systems and their components.
2. Analyze sensor technologies and data fusion techniques used for perception.
3. Develop algorithms for vehicle localization, path planning, and control.
4. Evaluate safety and ethical issues related to autonomous driving.
5. Design basic autonomous vehicle models addressing real-world driving scenarios.

UNIT – I: Mobile Robots

Introduction to Mobile Robots and Mobile Manipulators. Principle of Locomotion and Types of Locomotion. Types of Mobile Robots: Ground Robots (Wheeled and Legged Robots), Aerial Robots, Underwater Robots and Water Surface Robots.

UNIT - II: Kinematics and Dynamics

Kinematics Of Wheeled Mobile Robot, Degree Of Freedom And Manoeuvrability, Generalized Wheel Model, Different Wheel Configurations, Holonomic And Non-Holonomic Robots. Dynamics Of Mobile Robot: Lagrange-Euler And Newton-Euler Methods. Computer Based Dynamic (Numerical) Simulation of Different Wheeled Mobile Robots.

UNIT - III: Sensors and Navigation

Sensors for Mobile Robot Navigation: Magnetic and Optical Position Sensor, Gyroscope, Accelerometer, Magnetic Compass, Inclinometer, Tactile and Proximity Sensors, Ultrasound Rangefinder, Laser Scanner, Infrared Rangefinder, Visual and Motion Sensing Systems. Robot Navigation: Localization, Error Propagation Model, Probabilistic Map Based Localisation, Autonomous Map Building, Simultaneous Localization and Mapping (SLAM).

UNIT - IV: Path Planning and Control

Motion and Path Planning: Collision Free Path Planning and Sensor-Based Obstacle Avoidance. Motion Control of Mobile Robots: Motion Controlling Methods, Kinematic Control, Dynamic Control and Cascaded Control.

UNIT - V: Advanced Mobile Robots

Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Manipulators, Autonomous Mobile Robots.

TEXT BOOKS:

1. Material Handling Equipment, Michael G. Kay, Pearson Education, 2nd Edition, 2015
2. Mobile Robots: Navigation, Control and Sensing, Surface Robots and AUVs, Gerald Cook and Feitian Zhang, Wiley Publishers, 1st Edition, 2007

REFERENCE BOOKS:

1. Wheeled Mobile Robots, Kevin M. Lynch and Franck C. Park, Cambridge University Press, 1st Edition, 2011.
2. Introduction to Autonomous Mobile Robots, Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza, The MIT Press, 2nd Edition, 2011.
3. Autonomous Driving: Technical, Legal and Social Aspects, Markus Maurer, J. Christian Gerdes, Barbara Lenz, Hermann Winner, Springer, 1st Edition, 2016.
4. Self-Driving Cars: The Road to Autonomy, Steven E. Shladover, Springer, 1st Edition, 2020.
5. Introduction to Autonomous Robots, Nikolaus Correll, Bradley Hayes, Patrick Beeson, and Amit Talwalkar, MIT Press, 1st Edition, 2018.
6. Vehicle Dynamics and Control, Rajesh Rajamani, Springer, 2nd Edition, 2011.
7. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, Lentin Joseph, Apress, 2nd Edition, 2019.
8. Mobile Robotics: Mathematics, Models, and Methods, Alonzo Kelly, Cambridge University Press, 1st Edition, 2013.
9. Artificial Intelligence for Autonomous Vehicles, Amit Kumar Tyagi, Wiley, 1st Edition, 2020.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, II Semester

ROBOTIC SIMULATION AND LOCALIZATION MAPPING

(Professional Elective – III)

L	T	P	C
3	0	0	3

Prerequisites: Robot Kinematics and Dynamics

Course Objectives:

1. To introduce the fundamentals of robotic systems and their simulation techniques.
2. To understand robotic movements, commands, and programming for effective simulation.
3. To study localization, mapping, and motion planning methods used in robotics.
4. To learn about various robotics simulation tools and software architecture.
5. To analyze robotic motion, design linkages, and control strategies for practical applications.

Course Outcomes: After completing this course, students will be able to:

1. Explain the basics of robotics systems and types of simulation.
2. Apply robotic commands and principles to develop simulations.
3. Analyze localization and mapping techniques for robot navigation.
4. Utilize robotics simulation software and control motion effectively.
5. Design robotic linkages and evaluate motion parameters for specific applications.

UNIT – I: Robotics and Simulation Basics

Introduction to Robotics Systems, Robot Movements, Quality of Simulation, Types of Simulation, Robot Applications, Robotics Simulation Displays. Simulation Notation, Auto Lisp Functions, Features, Command Syntax, Writing Design Functions.

UNIT - II: Robotic Principles and Commands

Robotic Principles: Straight Lines, Angles and Optimal Moves Circular Interpolation, Robotic Functions Geometrical Commands, Edit Commands. Selecting Robot Views, Standard Robot Part, Using the Parts in a Simulation.

UNIT - III: Localization, Mapping and Motion Planning

Localization and Mappings: Introduction, Robotic Perception, Localization, Mappings Planning to Move, Configuration Space, Cell Decomposition Methods, Skeletonization Methods, Planning Uncertain Movements, Robust Methods. Moring, Dynamics and Control, Potential Field Control, Reactive Control, Robotics Software Architecture, Applications.

UNIT - IV: Robotics Simulation Techniques and Control

Robotics Simulation: Simulation Packages, Loading the Simulation, Simulation Editors, Delay, Resume Commands. Slide Commands, Program Flow Control. Robot Motion Control, Analysis of Robot Elements, Robotic Linkages.

UNIT - V: Robotic Motion Analysis and Design

Robotic Motion: Solids Construction, Solid Animation. Types of Motion, Velocity and Acceleration, Types of Simulation Motion: Harmonic Motion, Parabolic Motion, Uniform Motion Velocity and Acceleration Analysis for Robots. Robot Design: Linkages, Types, Transmission Elements Flexible Connectors, Pulley and Belt Drives, Variable Speed Transmission. Design of Robot for Particular Applications – A Case Study.

TEXT BOOKS:

1. Simultaneous Localization and Mapping: Exactly Sparse Information Filters, Gamini Dissanayake, Shoudong Huang and Zhan Wang, World Scientific Publishers, 1st Edition, 2011
2. Robotics: Designing the Mechanisms for Automated Machinery, Ben-Zion Sandler, Academic Press, 2nd Edition, 2003

REFERENCE BOOK:

1. Hello, Robot: Design Between Human and Machine, Mateo Kries, Vitra Design Museum Publisher, 1st Edition, 2017
1. Introduction to Autonomous Mobile Robots, Roland Siegwart, Illah R. Nourbakhsh and Davide Scaramuzza, The MIT Press, 2nd Edition, 2011.
2. Probabilistic Robotics, Sebastian Thrun, Wolfram Burgard and Dieter Fox, MIT Press, 1st Edition, 2005.
3. Robot Modeling and Control, Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Wiley, 1st Edition, 2005.
4. Mobile Robotics: Mathematics, Models, and Methods, Alonzo Kelly, Cambridge University Press, 1st Edition, 2013.
5. Simultaneous Localization and Mapping: Exactly Sparse Information Filters, Timothy D. Barfoot, Cambridge University Press, 1st Edition, 2017.
6. Planning Algorithms, Steven M. LaValle, Cambridge University Press, 1st Edition, 2006.
7. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, Lentin Joseph, Apress, 2nd Edition, 2019

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
ADVANCED ROBOTICS MANUFACTURING
(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Robotics and Automation and Control Systems

Course Objectives:

1. To understand the fundamentals of manufacturing systems and automation principles.
2. To analyse different manufacturing systems including automated production lines and assembly systems.
3. To explore material handling equipment, storage systems, and identification technologies.
4. To introduce digital twin technology and its role in modern manufacturing.
5. To study the implementation of virtual twin experience and its impact on innovation and manufacturing efficiency.

Course Outcomes: After completing this course, students will be able to:

1. After completing this course, the student will be able to explain the concepts of automation and manufacturing systems in industrial environments.
2. Evaluate various automated production lines and assembly systems for effective manufacturing.
3. Assess material handling and identification technologies to improve manufacturing processes.
4. Understand the challenges and advantages of digital twin technology in manufacturing.
5. Demonstrate knowledge of virtual twin experiences and apply them to real-world manufacturing scenarios.

UNIT – I: Manufacturing and Automation
Production Systems, Automation in Production Systems, Automation Principles and Strategies, Manufacturing Operations, Production Facilities, Basic Elements of an Automated System, Levels of Automation, Hardware Components for Automation and Process Control, Programmable Logic Controllers and Personal Computers.

UNIT – II: Manufacturing and Automated Production Lines
Components of a Manufacturing System, Single Station Manufacturing Cells, Manual Assembly Lines, Line Balancing Algorithms, Mixed Model Assembly Lines, Alternative Assembly Systems, Automated Production Lines: Applications and Analysis of Transfer Lines, Automated Assembly Systems: Fundamentals and Analysis, Cellular Manufacturing, Part Families, Coding, Production Flow Analysis, Group Technology and Flexible Manufacturing Systems, Quantitative Analysis.

UNIT – III: Material Handling and Technologies
Material Handling Equipment and Analysis, Storage Systems: Performance and Location Strategies, Automated Storage Systems, AS/RS Types, Automatic Identification Methods: Barcode Technology, RFID, Quality Control and Support Systems, Quality in Design and Manufacturing, Inspection Principles and Strategies, Automated Inspection: Contact vs Non-Contact Inspection, Coordinate Measuring Machines (CMM).

UNIT – IV: Digital Twin in Manufacturing
Overview of Digital Twin Technology, Key Challenges in Manufacturing, Key Trends in Manufacturing and Operations, Advantages of Twin Experience in Manufacturing.

UNIT – V: Virtual Twin Experience

Virtual Twin Experience, Innovation Time Frozen, Major Improvements through the Virtual Twin Experience, Realization of Virtual Twin Experience in Manufacturing, Case Study of Digital Twin in Agriculture Sector.

TEXT BOOKS:

1. Automation, Production Systems and CIM, M. P. Groover, PHI, 3rd Edition, 2007
2. Computer Aided Manufacturing, T. C. Chang, R. A. Wysk and H.-P. Wang, Pearson, 1st Edition, 2002
3. Digital Twin Technology: Fundamentals and Applications, Manisha Vohra, Scrivener Publishing, 1st Edition, 2020

REFERENCE BOOKS:

1. System Approach to Computer Integrated Design and Manufacturing, Singh, John Wiley, 1st Edition, 1991
2. Manufacturing and Automation Technology, R. T. Wright and M. Berkeihiser, Goodheart-Willcox Publishers, 2nd Edition, 2013
3. Automation, Production Systems and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson, 4th Edition, 2015.
4. Robotics and Automation Handbook, Thomas R. Kurfess, CRC Press, 2nd Edition, 2013.
5. Flexible Manufacturing Systems: Strategies and Simulations, S. Kant Vajpayee, Wiley, 2001.
6. Material Handling Handbook, Raymond A. Kulwiec, McGraw Hill, 2nd Edition, 2005.
7. Digital Twin Technologies and Smart Manufacturing, Fei Tao, Elsevier, 1st Edition, 2019.
8. Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design, Yusuf Altintas, Cambridge University Press, 1st Edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
INTELLIGENT SENSORS AND ACTUATORS
(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Sensors and Actuators in Mechatronics

Course Objectives:

1. To introduce the concepts and types of intelligent sensors and actuators.
2. To study sensing principles, signal conditioning, and data acquisition.
3. To explore integration of sensors and actuators in intelligent systems.
4. To understand communication protocols and networking for smart devices.
5. To apply intelligent sensing and actuation in automation, robotics, and IoT applications.

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

1. Explain the working principles and characteristics of various intelligent sensors and actuators.
2. Select and integrate appropriate sensors and actuators for specific applications.
3. Design signal conditioning and data acquisition systems for smart devices.
4. Implement communication protocols for intelligent sensing networks.
5. Apply intelligent sensor–actuator systems in industrial automation and smart manufacturing.

UNIT – I: Anatomy of Robotic System

Types of Sensors: Pressure/contact, Resistive Position, Infrared, Light, Position Sensors, Optical Encoders, Proximity Sensors, Range Sensors, Ultrasonic Sensors, Touch and Slip Sensors, Sensors for Motion and Position, Force, Torque and Tactile Sensors, Flow Sensors, Temperature Sensing Devices.

UNIT – II: Vision Sensors

Vision System Devices, Image Acquisition, Masking, Sampling and Quantization, Image Processing Techniques, Noise Reduction Methods, Edge Detection, Segmentation. Advanced Sensor Technology: Smart Sensors, MEMS Based Sensors, Innovations in Sensor Technology.

UNIT – III: Actuators and Its Selection While Designing a Robot System

Types of Transmission Systems, Electric Actuators: Direct Current Motor, Permanent Magnet Stepper Motor, Servo Control DC Motors, Linear and Latching Linear Actuators, Rotatory Actuators, Piezoelectric Actuators, Actuator Parameters and Characteristics, Stepper Motors, Specifications and Characteristics of Stepper Motors, Servomotors.

UNIT – IV: Pneumatic and Hydraulic Actuators

Hydraulic and Pneumatic Power Actuation Devices, Hydraulic Actuators, Selection of Linear Actuating Cylinders, Hydraulic Motors, Pneumatic Actuators, Design Considerations and Selection, Pneumatic Cylinders, Pneumatic Drive System, Linear and Rotary Actuators.

UNIT – V: Advanced Actuators

Piezoelectric Actuators, Elastomer Actuators, Soft Actuators, Shape Memory Alloy Based Actuators, under actuated Robotic Hand.

TEXT BOOKS:

1. Sensor Technology Handbook, Jon S. Wilson, Elsevier, 1st Edition, 2005
2. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover, Nicholas Godfrey, Mitchel Weiss, Roger N. Nagel, and Ashish Dutta, McGraw-Hill Publishers, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, T. Braünl, Springer, 3rd Edition, 2008
2. Robot Sensors and Transducers, S.R. Ruocco, Springer, 1st Edition, 2013.
3. Smart Sensor Systems, Gerard C. M. Meijer, Wiley, 1st Edition, 2008.
4. Introduction to Robotics: Mechanics and Control, John J. Craig, Pearson, 4th Edition, 2019.
5. Sensors and Actuators: Engineering System Instrumentation, Clarence W. de Silva, CRC Press, 2nd Edition, 2007.
6. Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzalez, C. S. G. Lee, McGraw Hill, 1987.
7. Mechatronics: Principles and Applications, Godfrey C. Onwubolu, Elsevier, 1st Edition, 2005.
8. Microelectromechanical Systems (MEMS) and Their Applications, Chang Liu, CRC Press, 2011.
9. Smart Sensors and MEMS: Intelligent Devices and Microsystems for Industrial Applications, Sabrie Soloman, CRC Press, 2013.
10. Sensors and Actuators in Mechatronics, Andrzej M. Pawlak, Taylor and Francis Group, 1st Edition, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
CYBER SECURITY
(Professional Elective – IV)

L	T	P	C
3	0	0	3

Prerequisites: Computer Networks and Cybersecurity

Course Objectives:

1. Understand the fundamental concepts and layers of cyber security, types of attacks, and defense mechanisms.
2. Explain cyberspace law, cyber forensics, and related regulations including national and international perspectives.
3. Analyze security challenges posed by mobile and wireless devices and organizational security measures.
4. Examine the organizational implications of cyber security including cybercrime, intellectual property rights, and social media risks.
5. Understand privacy issues, data privacy concepts, and review cybercrime examples and mini-cases.

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

1. Describe basic cyber security concepts, threat models, attack types, and risk management approaches.
2. Discuss cyber laws, cyber forensics principles, and the role of legal frameworks in cyberspace.
3. Identify security issues related to mobile and wireless devices and formulate organizational policies.
4. Evaluate cyber security challenges for organizations and ethical issues related to cybercrime and terrorism.
5. Explain privacy concerns, data protection strategies, and analyze real-world cybercrime cases.

UNIT – I: Concepts of Cyber Security

Basic Cyber Security Concepts, Layers of Security, Vulnerability, Threat, Harmful Acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, Motive of Attackers, Active Attacks, Passive Attacks, Software Attacks, Hardware Attacks, Spectrum of Attacks, Taxonomy of Various Attacks, IP Spoofing, Methods of Defense, Security Models, Risk Management, Cyber Threats - Cyber Warfare, Cyber Crime, Cyber Terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT – II: Cyber Security and Forensics

Introduction, Cyber Security Regulations, Roles of International Law, The Indian Cyberspace, National Cyber Security Policy. Introduction, Historical Background of Cyber Forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT – III: Mobile and Wireless Devices

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones. Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT – IV: Cybercrime and Organizational Security

Introduction, Cost of Cybercrimes and IPR Issues, Web Threats for Organizations, Security and Privacy Implications, Social Media Marketing: Security Risks and Perils for Organizations, Social Computing and the Associated Challenges for Organizations. Cybercrime and Cyber Terrorism: Introduction, Intellectual Property in the Cyberspace, The Ethical Dimension of Cybercrimes, The Psychology, Mindset and Skills of Hackers and Other Cyber Criminals.

UNIT – V: Data Privacy and Cybercrime Cases

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data Linking and Profiling, Privacy Policies and Their Specifications, Privacy Policy Languages, Privacy Indifferent Domains - Medical, Financial, etc. Cybercrime: Examples and Mini-Cases - Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, E-mail Spoofing Instances. Mini-Cases: The Indian Case of Online Gambling, an Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

TEXT BOOKS:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunit Belpure, Willey, 1st Edition, 2011
2. Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, B. B. Gupta, D. P. Agrawal and Haoxiang Wang, CRC Press, 1st Edition, 2018.

REFERENCE BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press, 2nd Edition, 2020
2. Introduction to Cyber Security, Chwan-Hwa (John) Wu and J. David Irwin, CRC Press T and F Group, 1st Edition, 2018.
3. Cyber Security and Cyber Laws, P. K. Sinha, BPB Publications, 3rd Edition, 2018.
4. Cybersecurity: Principles and Practice, Mark Stanislav, Pearson, 1st Edition, 2020.
5. Computer Security: Principles and Practice, William Stallings, Pearson, 4th Edition, 2018.
6. Digital Forensics and Cyber Crime, Pavel Gladyshev, Springer, 1st Edition, 2015.
7. Cybercrime and Digital Forensics: An Introduction, Thomas J. Holt, Routledge, 1st Edition, 2017.
8. Information Security: Principles and Practice, Mark Stamp, Wiley, 2nd Edition, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, II Semester

ROBOTIC SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

Prerequisites: Robot Modeling and Control

Course Objectives:

1. Provide hands-on experience in programming and controlling various robotic systems.
2. Familiarize students with kinematic modeling, sensor integration, and path planning in physical robots.
3. Enable students to use robotic simulation and programming platforms effectively.
4. Develop the ability to implement basic robotic tasks such as pick-and-place, obstacle avoidance, and line following.

Course Outcomes: The students will be able to

1. Design a gripper for different applications using design considerations
2. Learn working of touch sensors and their interfacing and feedback
3. Perform kinematic analysis
4. Perform trajectory planning
5. Detect the object and path tracing using vision sensor

List of Experiments:

1. Study of Robot Gripper design using a manipulator.
2. Demonstrating Touch Sensors interfacing and feedback system.
3. Performing Manipulator kinematics analysis using R-R-R Robot manipulator.
4. Performing object detection and Image processing using Vision sensors in Robot System.
5. Performing Trajectory planning and analysis using simulation software.
6. Demonstrating Pick and place tracking using robot.
7. Demonstrating path tracking using robot
8. Designing collision avoidance robots incorporating sensors.
9. Virtual lab experiments on Robot kinematics for Move PUMA 560 and KGP 50.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
ARTIFICIAL INTELLIGENCE PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

Prerequisites: Knowledge of programming in Python, Artificial Intelligence (AI)

Course Objectives:

1. Provide practical exposure to implementing AI concepts and algorithms.
2. Enable students to solve problems using uninformed and informed search strategies.
3. Teach the design of knowledge representation systems using logic and rules.
4. Develop reasoning and inference engines using forward and backward chaining.
5. Introduce AI-based applications in areas such as games, planning, and intelligent agents.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Implement classical search algorithms such as BFS, DFS, A*, and Greedy search.
2. Design knowledge bases using propositional and predicate logic.
3. Implement reasoning systems using rule-based logic programming.
4. Develop intelligent agents for applications such as path planning, decision-making, and game strategies.
5. Utilize AI libraries and tools in Python or Prolog to develop and test simple AI systems.

List of Experiments:

1. Installing Python interpreter and working on simple programs to understand programming concepts in python.
2. Write the program to explore strings, tuples, lists, dictionaries, set and dictionary comprehensions.
3. Installing and setup the Anaconda, Spyder, Jupyter notebook environments.
4. Installing basic modules related to machine learning like numpy, pandas, json, scikit- learn, Scipy, open CV.
5. Working with machine learning programs: Linear Regression, Logistic Regression, SVM, Decision trees, KNN, Naive Bayes
6. Basic Electronics using Raspberry PI - Raspbian Installation, Connecting via SSH, Simple LED lightning programs, Motor speed control with PWM and working with basic sensors like ultrasonic, infrared and buzzers,
7. Working with camera module Open CV and Mediapipe - Basic image operations, Contours, gray scale conversion, Drawing and writing on Image, Working with video stream, Face detection, Object detection using Haar Cascade.
8. AI Based programming tools like classical AI – LISP, Prolog, Tensor Flow.
9. Exploring H20 in AI, Cortana and IBM WATSON.
10. Develop and analyze ANN models using the ANN Virtual Lab.
11. Perform pattern recognition tasks using the ANN Virtual Lab.
12. Apply ANN techniques for optimization problems using the ANN Virtual Lab.
13. Implement ANN applications in image processing using the ANN Virtual Lab.

Note: Perform any 10 out of 13 Exercises

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., II Year, I Semester
DEEP LEARNING
(Professional Elective-V)

L	T	P	C
3	0	0	3

Prerequisites: Linear Algebra, Machine Learning
Course Objectives: The course aims to:

1. Introduce the foundations and mathematical principles of deep learning.
2. Explore architectures of neural networks including CNNs, RNNs, and autoencoders.
3. Explain techniques for training deep neural networks including backpropagation and regularization.
4. Familiarize students with deep learning frameworks such as TensorFlow and PyTorch.
5. Apply deep learning to tasks in image processing, natural language processing, and time-series analysis.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the theoretical concepts and structure of deep neural networks.
2. Design and implement deep learning models using industry-standard tools.
3. Apply various deep learning architectures to solve classification and prediction problems.
4. Analyze the performance of deep learning models and apply optimization techniques.
5. Develop solutions to real-world problems using deep learning in domains such as vision and language.

UNIT – I: Concepts of Deep Learning
Introduction to Deep Learning, Historical Trends in Deep Learning, Deep Feed-forward Networks, Gradient-Based Learning, Hidden Units, Architecture Design, Back-propagation and Other Differentiation Algorithms.

UNIT – II: Regularization for Deep Learning
Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness.

UNIT – III: Advanced Learning Methods
Semi-supervised Learning, Multi-task Learning, Early Stopping, Parameter Typing and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold, Tangent Classifier.

UNIT – IV: Optimization for Training Deep Models
Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-order Methods, Optimization Strategies and Meta-algorithms.

UNIT – V: Deep Learning and AI Applications
Large-scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.

TEXT BOOK:

1. Deep Learning, Ian Good fellow, Yoshua Bengio and Aaron Courville, MIT Press Book, 1st Edition, 2016.
2. Deep Learning with Python, Francois Chollet, Manning Publications, 2nd Edition, 2021.

REFERENCE BOOK:

1. Deep Learning with R for Beginners, Mark Hodnett and Joshua F. Wiley, Packt Publishing, 2019.
2. Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer, 1st Edition, 2018.
3. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 1st Edition, 2016.
4. Neural Networks and Deep Learning: A Textbook, Charu C. Aggarwal, Springer, 1st Edition, 2018.
5. Deep Learning with Python, François Chollet, Manning Publications, 1st Edition, 2017.
6. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 2nd Edition, 2019.
7. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 1st Edition, 2006.
8. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 1st Edition, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., II Year, I Semester

COMPUTER INTEGRATED MANUFACTURING

(Professional Elective-V)

L	T	P	C
3	0	0	3

Prerequisites: Manufacturing Processes, Production Technology and CAD/CAM

Course Objectives: To make the students

1. To understand the role of computers in manufacturing.
2. To provide an in-depth understanding of manufacturing and database systems.
3. To provide an understanding of the needs of the market and design the product.
4. To design and develop material handling, storage and retrieval systems for specific cases of manufacturing.
5. To develop CIM systems for current manufacturing scenario by using computer and networking tools.

Course Outcomes: At the end of the course, students will be able to

1. Select the necessary computing tools for the development of products.
2. Use appropriate database systems for manufacturing a product and store the same for future use.
3. Apply the latest technology of manufacturing systems and software for the development of a product.
4. Use modern manufacturing techniques and tools including principles of networking.
5. Apply the concepts of lean manufacturing and agile manufacturing.

UNIT – I: Concepts of CIM

The meaning of Manufacturing, Types of Manufacturing; CIM Definition, Elements of CIM, CIM wheel, Concept or Technology, Evolution of CIM, Benefits of CIM, Needs of CIM, Hardware and software, Fundamentals of Communication, Communications Matrix, Product Development Cycle. Concurrent Engineering: Definition, Sequential Engineering versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of Concurrent Engineering, Framework for Integration of Life Cycle Phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life Cycle Management (PLM), Collaborative Product Development.

UNIT – II: Database Systems and PDM

Introduction to Manufacturing Data, Types, Sources, Database Terminology, Database Requirements, Database Models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL), Basic structure, Data Definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (Store, Retrieve, Update, Delete).

Illustration of Creating and Manipulating a Manufacturing Database, SQL as a Knowledge Base Query Language, Features of Commercial DBMS, Oracle, MySQL, SQL Access, Sybase, DB2, Product Data Management (PDM), Advantages of PDM.

UNIT – III: Product and Manufacturing Systems

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly.

Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II).

Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine Component Group Analysis, Similarity Coefficients- Based Approaches, Evaluation of Cell Design.

Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS, Types of Flexibility. Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout, Operational Problems of FMS. FMS benefits.

UNIT – IV: Networking and CIM Models

Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN. Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods. Network Architectures and Protocols: OSI Model, MAP and TOP, TCP, IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise, wide Integration.

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT – V: Lean Manufacturing:

Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems.

TEXT BOOKS:

1. Principles of Computer Integrated Manufacturing, S.Kant Vajpayee, Prentice Hall India, 1st Edition, 1998.
2. Systems Approach to Computer Integrated Design and Manufacturing, Nanua Singh, John Wiley and Sons, Inc, 1st edition, 1995.

REFERENCE BOOKS:

1. CAD, CAM, CIM, P. Radhakrishnan, S. Subramanyam and V. Raju, New Age International Pvt Ltd, 4th Edition, 2016.
2. Computer Integrated Manufacturing, A. Alavudeen and N. Venkateshwaran, Prentice Hall India Learning Pvt Ltd, 1st Edition, 2010.
3. Manufacturing Planning and Control for Supply Chain Management, F. Robert Jacobs and William Lee Berry, McGraw-Hill Education, 7th Edition, 2023.
4. Automation, Production Systems, and Computer-Integrated Manufacturing, Mikell P. Groover, Pearson Education, 5th Edition, 2023.
5. Manufacturing Systems Engineering, Stanley B. Gershwin, Prentice Hall, 2nd Edition, 2022.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., II Year, I Semester

ADDITIVE MANUFACTURING TECHNOLOGY

(Professional Elective-V)

L	T	P	C
3	0	0	3

Prerequisites: Linear algebra, calculus and probability**,** Neural Networks and optimization Algorithms

Course Objectives:

1. Introduce the foundations of deep learning and neural network architectures.
2. Provide insights into training techniques, backpropagation, and regularization methods.
3. Explore convolutional neural networks (CNNs), recurrent neural networks (RNNs), and deep generative models.
4. Develop proficiency in using deep learning frameworks such as TensorFlow or PyTorch.
5. Apply deep learning techniques to real-world problems in vision, language, and sequence modeling.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the theoretical foundations of deep learning and neural computation.
2. Design and train feedforward, convolutional, and recurrent neural networks.
3. Implement deep learning models using modern frameworks such as TensorFlow or PyTorch.
4. Apply deep learning to solve classification, regression, and sequence prediction problems.
5. Evaluate deep learning models using appropriate metrics and optimize them for performance and generalization.

UNIT – I: Concepts of Additive Manufacturing

Prototyping Fundamentals: Need for Time Compression in Product Development, Need for Additive Manufacturing, Historical Development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly Used Terms, Classification of AM Process, Fundamental Automated Processes: Distinction between AM and CNC, Other Related Technologies.

UNIT – II: Liquid and Solid Based AM Systems

Liquid-Based AM Systems, Stereo lithography Apparatus (SLA) and Solid Ground Curing (SGC), Models and Specifications, Process, Working Principle, Photopolymers, Photo Polymerization, Case Studies. Solid-Based AM Systems: Laminated Object Manufacturing (LOM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Fused Deposition Modeling (FDM) and Multi-Jet Modelling (MJM): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies.

UNIT – III: Powder Based AM and Rapid Tooling

Powder Based AM Systems: Selective Laser Sintering (SLS) and Three-Dimensional Printing (3DP): Models and Specifications, Process, Working Principle, Applications, Advantages and Disadvantages, Case Studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool Process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling Using 3DP.

UNIT – IV: AM Data and Software Tools

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL File Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Subdivision Techniques. AM Software's: Need for AM Software, Features of Various AM Software's Like Magics, Mimics, Solid View, View Expert, 3D View, Velocity 2, Rhino, STL View, 3 Data Expert and 3D Doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

UNIT – V: Applications of Additive Manufacturing

AM Applications: Application–Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewellery Industry, Coin Industry, GIS Application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and Simulation of Complex Surgery, Customized Implants and Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems.

TEXT BOOKS:

1. Rapid Prototyping: Principles and Applications, Chua C. K., Leong K. F. and Lim C. S., World Scientific Publications, 3rd Edition, 2010.
2. Fundamentals of Additive Manufacturing Technologies, Gokce Aydin and Mohsen Attaran, CRC Press, 1st Edition, 2020.

REFERENCE BOOKS:

1. Rapid Manufacturing, D. T. Pham and S. S. Dimov, Springer, 1st Edition, 2001.
2. Wohlers Report 2000, Terry Wohlers, Wohlers Associates, 1st Edition, 2000.
3. Rapid Prototyping and Engineering Applications, Frank W. Liou, CRC Press, Taylor and Francis Group, 1st Edition, 2011.
4. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David Rosen, Brent Stucker, Springer, 2nd Edition, 2015.
5. Rapid Prototyping: Principles and Applications, Chee Kai Chua, Kah Fai Leong, Springer, 3rd Edition, 2014.
6. Additive Manufacturing: Materials, Processes, Quantifications and Applications, Kun Zhou, Woodhead Publishing, 1st Edition, 2020.
7. Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, Frank W. Liou, CRC Press, 1st Edition, 2011.
8. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, David W. Rosen, Springer, 1st Edition, 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic English Grammar and Composition, Fundamentals of Technical Writing

Course objectives: Students will be able to:

1. To improve the quality and clarity of academic writing specifically for research papers.
2. To provide students with the structure, style, and conventions of scholarly communication.
3. To help students understand how to write titles, abstracts, introductions, literature reviews, methods, results, and conclusions effectively.
4. To guide students in avoiding common grammatical, structural, and ethical mistakes in writing.
5. To build competence in reviewing and editing research manuscripts for publication.

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

1. Write grammatically correct, well-structured, and coherent research papers.
2. Use appropriate academic language and tone for different parts of a research article.
3. Construct effective titles, abstracts, and concise conclusions.
4. Apply standard referencing styles and avoid plagiarism.
5. Critically revise and refine research drafts for clarity and publication readiness.

UNIT-I: Effective Writing and Sentence Structuring
Planning And Preparation, Word Order, Breaking up Long Sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II: Academic Writing and Research Ethics
Clarifying Who Did What, Highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction

UNIT-III: Research Paper Structure and Finalization
Review of the Literature, Methods, Results, Discussion, Conclusions and Final Check.

UNIT-IV: Essential Academic Writing Skills for Research Papers
Key Skills are needed when Writing a Title, Key Skills are needed when Writing an Abstract, Key Skills are needed when Writing an Introduction, Skills needed when writing a Review of the Literature.

UNIT-V: Advanced Research Writing Skills
Skills are needed when Writing the Methods, Skills needed when writing the Results, Skills are needed when writing the Discussion, and Skills are needed when writing the Conclusions.

UNIT-VI: Perfecting Your Research Paper

Useful Phrases, How to ensure Paper is as Good as it could possibly be the First Time Submission.

TEXT BOOKS:

1. Writing for Science, Robert Goldbort, Yale University Press, 1st Edition, 2006.
2. How to Write and Publish a Scientific Paper, Robert A. Day & Barbara Gastel, 6th Edition (Cambridge University Press), 2006.

REFERENCE BOOKS

1. Handbook of Writing for the Mathematical Sciences, Nicholas J. Higham, SIAM, 2nd Edition, 1998.
2. English for Writing Research Papers, Adrian Wallwork, Springer, 1st Edition, 2011.
3. How to Write and Publish a Scientific Paper, Barbara Gastel, Robert A. Day, Cambridge University Press, 8th Edition, 2016
4. The Elements of Style, William Strunk Jr., E.B. White, Pearson Education, 4th Edition, 2000
5. Scientific Writing and Communication: Papers, Proposals, and Presentations, Angelika H. Hofmann, Oxford University Press, 3rd Edition, 2016
6. Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded, Joshua Schimel, Oxford University Press, 1st Edition, 2012

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
DISASTER MANAGEMENT
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Environmental Science, Basic Geography or Earth Science
Course Objectives: Students will be able to

1. To introduce the concepts, phases, and classifications of disasters and disaster management.
2. To develop an understanding of disaster risk reduction and mitigation strategies.
3. To impart knowledge on institutional frameworks, legal aspects, and community-based approaches.
4. To build the ability to assess risks and prepare emergency management plans.
5. To create awareness about post-disaster recovery, rehabilitation, and resilience planning.

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

1. Identify different types of natural and man-made disasters and their causes.
2. Analyze risk factors and develop suitable mitigation and preparedness strategies.
3. Understand the role of government agencies, NGOs, and international bodies in disaster management.
4. Apply principles of emergency response planning and coordination.
5. Contribute to post-disaster rehabilitation and sustainable development planning.

UNIT-I: Disaster

Definition, Factors and Significance, Difference between Hazard and Disaster, Natural and Manmade Disasters, Difference between Nature Types and Magnitude.

UNIT-II: Repercussions of Disasters and Hazards

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches. Man made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-III: Disaster Prone Areas in India

Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches, Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami, Post Disaster Diseases and Epidemics

UNIT-IV: Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard, Evaluation of Risk, Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V: Risk Assessment Disaster Risk

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation, Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

UNIT-VI: Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

TEXT BOOKS:

1. Disaster Management in India: Perspectives, Issues and Strategies, R. Nishith & A. K. Singh, New Royal Book Company, 1st Edition, 2007
2. Disaster Mitigation: Experiences and Reflections, Pardeep Sahni et al. (Eds.), Prentice Hall India, 1st Edition, 2001

REFERENCE BOOKS:

1. Disaster Administration and Management: Text and Case Studies, S. L. Goel, Deep & Deep Publications, 1st Edition, 2007.
2. Introduction to International Disaster Management, Damon P. Coppola, Butterworth-Heinemann, 3rd Edition, 2015.
3. Disaster Management and Preparedness, Thomas D. Schneid, Larry Collins, CRC Press, 1st Edition, 2001.
4. Disaster Science and Management, Tushar Bhattacharya, McGraw Hill Education, 1st Edition, 2013.
5. Natural Disasters, Patrick L. Abbott, McGraw Hill Education, 9th Edition, 2016.
6. Environmental Hazards: Assessing Risk and Reducing Disaster, Keith Smith, Routledge, 6th Edition, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, I Semester
SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic understanding of Indian heritage and classical languages

Course Objectives:

1. To expose students to Sanskrit as a classical language of knowledge and science.
2. To introduce technical terms and concepts embedded in ancient Sanskrit texts.
3. To enable understanding of foundational texts related to mathematics, engineering, and philosophy.
4. To build linguistic skills for reading and interpreting original Sanskrit sources.
5. To appreciate the relevance of Sanskrit in the context of modern scientific discourse.

Course Outcomes: Students will be able to

1. Understand the structure and grammar of Sanskrit relevant to technical usage.
2. Recognize and interpret key technical terms and concepts from ancient Sanskrit literature.
3. Translate and explain Sanskrit verses that relate to scientific and engineering disciplines.
4. Develop an interdisciplinary perspective connecting ancient wisdom with contemporary science.
5. Appreciate the contribution of Sanskrit to Indian scientific, philosophical, and cultural heritage.

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past / Present / Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of Roots,

UNIT-IV:
Technical Information about Sanskrit Literature

UNIT-V:
Technical Concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS:

1. Abhyaspustakam, Dr. H. R. Vishwasa, Samskrita Bharati Publication, New Delhi, 1st Edition, 2012.
2. Teach Yourself Sanskrit: Prathama Diksha, edited by Vempati Kutumbashastri, Rashtriya Sanskrit Sansthanam, New Delhi, 1st Edition, 2002.

REFERENCE BOOKS:

1. Technical Literature in Sanskrit, S. Balachandra Rao, Rashtriya Sanskrit Vidyapeetha, 1st Edition, 2005.
2. Sanskrit and Science, Prabhakar Apte, Central Institute of Indian Languages, 1st Edition, 2003.
3. Scientific Heritage of India in Sanskrit, R. Ganapathi, Bharatiya Vidya Bhavan, 1st Edition, 1990.
4. Sanskrit and Artificial Intelligence, Rick Briggs, AI Magazine (Journal Paper), 1st Edition, 1985.
5. Essentials of Sanskrit Language for Engineering Students, M. Sampath Kumar, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, 1st Edition, 2010.
6. Vyavaharika Samskritam (Functional Sanskrit), R.S. Vadhyar, R.S. Vadhyar & Sons, 3rd Edition, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, I Semester

VALUE EDUCATION

(Audit Course - I)

L	T	P	C
2	0	0	0

Prerequisite: Basic Understanding of Ethics and Social Responsibility

Course Objectives: Students will be able to

1. To help students understand the importance of values in personal and professional life.
2. To promote ethical behavior and decision-making based on human values.
3. To develop a sense of responsibility, empathy, and integrity.
4. To cultivate respect for diversity, equality, and sustainable living.
5. To encourage self-reflection and a commitment to lifelong value-based learning.

Course Outcomes: Students will be able to

1. Recognize and apply core human values such as honesty, compassion, and respect.
2. Analyze ethical dilemmas and make morally sound decisions.
3. Demonstrate socially responsible behavior in both personal and professional contexts.
4. Promote harmony in relationships, society, and the environment.
5. Engage in continuous personal development guided by ethical principles.

UNIT-I: Values and Ethics

Values and Self-Development, Social Values and Individual Attitudes, Work Ethics, Indian Vision of Humanism, Moral and Non- Moral Valuation, Standards and Principles, Value Judgements.

UNIT-II: Core Personal Values

Importance of Cultivation of Values, Sense of Duty, Devotion, Self-Reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of Faith, National Unity, Patriotism, Love for Nature, Discipline.

UNIT-III: Personality Traits

Personality and Behavior Development, Soul and Scientific Attitude, Positive Thinking, Integrity and Discipline, Punctuality, Love and Kindness.

UNIT-IV: Virtuous Living

Avoid Fault Thinking, Free from Anger, Dignity of Labour, Universal Brotherhood and Religious Tolerance, True Friendship, Happiness vs Suffering, Love for Truth, Aware of Self-Destructive Habits, Association and Cooperation, Doing Best for Saving Nature.

UNIT-V: Character and Wisdom

Character and Competence, Holy Books vs Blind Faith, Self-Management and Good Health, Science of Reincarnation, Equality, Nonviolence, Humility, Role of Women, All Religions and Same Message, Mind Your Mind, Self-Control, Honesty, Studying Effectively.

TEXT BOOKS:

1. Values and Ethics for Organizations: Theory and Practice, S. K. Chakraborty, Oxford University Press, 1st Edition, 1998 (paperback reprint 1999.
2. Value Education and Professional Ethics, R.R. Gaur, R. Sangal, G.P. Bagaria, Excel Books, 1st Edition, 2010.

REFERENCE BOOKS:

1. Education in Values: A Source Book, UNESCO, NCERT Publication, 1st Edition, 2002.
2. Value Education: Principles and Practice, S. Ignacimuthu, Don Bosco Publications, 1st Edition, 2009.
3. Value Education: Theory and Practice, G. Rajagopalan, Bharatiya Vidya Bhavan, 1st Edition, 2011.
4. Education for Values in Schools – A Framework, NCERT, NCERT Publication, 1st Edition, 2012.
5. Education in Human Values, A.C. Bhaktivedanta Swami Prabhupada, Bhaktivedanta Book Trust, 1st Edition, 2001.
6. Teaching of Values: Some Reflections, M. M. Goel, Shipra Publications, 1st Edition, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, II Semester

CONSTITUTION OF INDIA

(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic knowledge of Indian history and Governance

Course Objectives: Students will be able to:

1. To provide a comprehensive understanding of the Indian Constitution, its structure, and significance.
2. To familiarize students with the fundamental rights, duties, and directive principles.
3. To introduce the key organs of government and their roles in a democratic system.
4. To promote awareness of constitutional values, governance mechanisms, and public responsibility.
5. To understand the relationship between the Constitution and the legal-administrative framework of India.

Course Outcomes: Students will be able to:

1. Describe the history, evolution, and philosophy behind the Constitution of India.
2. Explain the fundamental rights and duties of citizens and the structure of the Indian government.
3. Analyze the functioning of constitutional bodies and judicial systems.
4. Understand the significance of constitutional amendments and landmark legal cases.
5. Demonstrate responsible citizenship and awareness of constitutional governance

UNIT-I: Constitution Drafting History

History of Making of the Indian Constitution, History Drafting Committee, (Composition and Working)

UNIT-II: Constitutional Philosophy

Philosophy of the Indian Constitution**,** Preamble**,** Salient Features

UNIT-III: Rights and Duties Framework

Contours of Constitutional Rights and Duties, Fundamental Rights Right to Equality**,** Right to Freedom**,** Right against Exploitation**,** Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies, Directive Principles of State Policy**,** Fundamental Duties.

UNIT-IV: Organs of Governance

Parliament**,** Composition**,** Qualifications and Disqualifications**,** Powers and Functions**,** Executive**,** President**,** Governor**,** Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V: Local Administration

District's Administration Head, Role and Importance. Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation. Panchayat Raj: Introduction, PRI: Zila Panchayat, Elected Officials and their Roles, CEO Zila Panchayat, Position and Role, Block Level, Organizational Hierarchy (Different Departments), Village Level, Role of Elected and Appointed Officials, Importance of Grass Root Democracy.

UNIT-VI: Election Commission

Role and Functioning, Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and Women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India (Bare Act), Government Publication, 1st Edition, 1950.
2. Dr. B. R. Ambedkar: Framing of Indian Constitution, Dr. S. N. Busi, Ava Publications, 1st Edition, 2016.

REFERENCE BOOKS:

1. Introduction to the Constitution of India, M. P. Jain, LexisNexis, 7th Edition, 2014.
2. Introduction to the Constitution of India, D. D. Basu, LexisNexis, 22nd Edition, 2015.
3. Indian Polity, M. Laxmikanth, McGraw Hill Education, 6th Edition, 2021.
4. Our Constitution, Subhash Kashyap, National Book Trust, 1st Edition, 2011.
5. The Constitution of India: A Contextual Analysis, Arun K. Thiruvengadam, Bloomsbury Publishing, 1st Edition, 2017.
6. The Constitution of India, P.M. Bakshi, Universal Law Publishing, 17th Edition, 2020.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., I Year, II Semester

PEDAGOGY STUDIES

(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic understanding of Teaching-Learning processes

Course Objectives: Students will be able to

1. To understand the concepts, principles, and theories of pedagogy and their application.
2. To evaluate the effectiveness of different teaching approaches in varied educational contexts.
3. To analyze the impact of teacher behavior, classroom environment, and instructional strategies on learning.
4. To assess the challenges in implementing pedagogical innovations in diverse settings.
5. To enable the design of learner-centered, inclusive, and effective educational practices.

Course Outcomes: Students will be able to understand

1. Explain key pedagogical theories and their relevance to classroom teaching.
2. Compare traditional and modern teaching strategies based on evidence from research.
3. Identify factors affecting student engagement, motivation, and learning outcomes.
4. Design instructional plans that incorporate effective pedagogical principles.
5. Critically evaluate and adapt teaching practices to meet diverse learner needs.

UNIT-I: Pedagogical Foundations

Introduction and Methodology, Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT-II: Global Pedagogical Practices

Thematic Overview, Pedagogical Practices are being used by Teachers in Formal and Informal Classrooms in Developing Countries, Curriculum, Teacher Education.

UNIT-III: Effective Pedagogy Evidence

Evidence on the Effectiveness of Pedagogical Practices, Methodology for the Indepth Stage, Quality Assessment of Included Studies, How Can Teacher Education (Curriculum And Practicum) and the School Curriculum and Guidance Materials best Support Effective Pedagogy? Theory of Change, Strength and Nature of the body of Evidence for Effective Pedagogical Practices, Pedagogic Theory and Pedagogical Approaches, Teachers' Attitudes and Beliefs and Pedagogic Strategies.

UNIT-IV: Professional development

Alignment with Classroom Practices and Follow-Up Support, Peer Support, Support from the Head Teacher and the Community, Curriculum and Assessment, Barriers to Learning, Limited Resources and Large Class Sizes.

UNIT-V: Future Pedagogical Research

Research Gaps and Future Directions, Research Design**,** Contexts**,** Pedagogy**,** Teacher Education**,** Curriculum and Assessment**,** Dissemination and Research Impact.

TEXT BOOKS:

1. Classroom interaction in Kenyan primary schools Ackers, J., and Hardman, F., Compare a Journal of Comparative and International Education, Volume 31, 2001.
2. Curricular reform in schools: The importance of evaluation, Agrawal, M, Journal of Curriculum Studies, Volume 36, 2003.

REFERENCE BOOKS:

1. Teacher training in Ghana - does it count? , Akyeampong, K, Multi-site teacher education research project (MUSTER) country report 1. Department for International Development (DFID), London, 1st Edition, 2003.
2. How Learning Works: Seven Research-Based Principles for Smart Teaching, Susan A. Ambrose, Jossey-Bass, 1st Edition, 2010.
3. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement, John Hattie, Routledge, 1st Edition, 2009.
4. Teaching for Quality Learning at University, John Biggs, Catherine Tang, McGraw-Hill Education, 4th Edition, 2011.
5. The Skillful Teacher: On Technique, Trust, and Responsiveness in the Classroom, Stephen D. Brookfield, Jossey-Bass, 3rd Edition, 2015.
6. Learning Theories: An Educational Perspective, Dale H. Schunk, Pearson Education, 7th Edition, 2015.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
STRESS MANAGEMENT BY YOGA
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic awareness of mental and physical health

Course Objectives:

1. To introduce the concept of stress and its impact on physical and mental well-being.
2. To provide an understanding of yoga as a tool for stress relief and emotional balance.
3. To teach various yogic practices including asanas, pranayama, and meditation for managing stress.
4. To cultivate self-awareness, relaxation, and resilience through regular yogic practice.
5. To promote a healthy lifestyle by integrating yogic discipline in daily life.

Course Outcomes: Students will be able to:

1. Understand the causes and physiological effects of stress.
2. Apply basic yogic techniques to reduce stress and enhance focus.
3. Practice breathing techniques and meditation to maintain emotional stability.
4. Demonstrate improved physical flexibility, mental clarity, and stress tolerance.
5. Incorporate yoga as a sustainable approach to managing academic, professional, and personal pressures.

UNIT-I:

Definitions of Eight parts of yoga. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III: Do`s and Dont`s in Life

Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha. Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT-IV:

Aasan and Pranayam

UNIT-V:

Various Yoga Poses and their Benefits for Mind and Body. Regularization of Breathing Techniques and its Effects, Types of Pranayam

TEXT BOOKS:

1. Yogic Asanas for Group Training – Part I, Janardan Swami Yogabhyasi Mandal, Janardan Swami Yogabhyasi Mandal, Nagpur, Standard Edition, 1990.
2. Rajayoga or conquering the Internal Nature, Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata, 2010.

REFERENCE BOOKS:

1. The Heart of Yoga: Developing a Personal Practice, T.K.V. Desikachar, Inner Traditions, 1st Edition, 1999.
2. Yoga for Stress Relief, Swami Shivapremananda, Jaico Publishing House, 1st Edition, 2002.
3. Light on Yoga, B.K.S. Iyengar, HarperCollins, Revised Edition, 2015.
4. The Relaxation Response, Herbert Benson, HarperTorch, Updated Edition, 2000.
5. Yoga for Wellness, Shri Yogendra, The Yoga Institute, 1st Edition, 2001.
6. Yoga as Medicine, Timothy McCall, Bantam Books, 1st Edition, 2007.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., I Year, II Semester
PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - II)

L	T	P	C
2	0	0	0

Prerequisite: Basic Communication and Interpersonal skills

Course Objectives:

1. To understand the concept of personality and its development through ethical and moral grounding.
2. To enhance self-awareness, confidence, and emotional intelligence.
3. To inculcate life-enlightening values drawn from Indian wisdom and philosophy.
4. To improve communication, leadership, and decision-making abilities.
5. To promote a positive attitude and holistic approach toward life and career.

Course Outcomes: Students will be able to

1. Explain the key elements of personality and factors influencing its growth.
2. Demonstrate improved self-confidence, empathy, and interpersonal relationships.
3. Apply principles from enlightened texts (e.g., Bhagavad Gita, Upanishads) to everyday decision-making.
4. Exhibit qualities of ethical leadership and responsible citizenship.
5. Lead a balanced, purposeful, and value-driven personal and professional life.

UNIT-I:

Neetisatakam-Holistic development of personality

1. Verses- 19,20,21,22 (wisdom)
2. Verses- 29,31,32 (pride & heroism)
3. Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

1. Verses- 52,53,59 (dont's)
2. Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day-to-day work and duties.

1. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
2. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
3. Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

1. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
2. Chapter 12 -Verses 13, 14, 15, 16,17, 18
3. Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

1. Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
2. Chapter 4-Verses 18, 38,39
3. Chapter18 – Verses 37,38,63

TEXT BOOKS:

1. Srimad Bhagavad Gita, Swami Swarupananda, Advaita Ashram (Publication Department), Kolkata, 2018.
2. Bhartrihari's Three Satakas, (Niti-sringar-vairagya), P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi, 1st Edition, 2002.

REFERENCE BOOKS:

1. Awakening the Giant Within, Anthony Robbins, Free Press, 1st Edition, 1992
2. The 7 Habits of Highly Effective People, Stephen R. Covey, Simon and Schuster, 30th Anniversary Edition, 2020
3. Wings of Fire: An Autobiography, A.P.J. Abdul Kalam, Universities Press, 30th Impression, 2014
4. Living with the Himalayan Masters, Swami Rama, Himalayan Institute Press, Revised Edition, 2002
5. The Monk Who Sold His Ferrari, Robin Sharma, Jaico Publishing House, 1st Edition, 1997
6. The Power of Now, Eckhart Tolle, New World Library, 1st Edition, 1999.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., II Year, I Semester
BUSINESS ANALYTICS
(Open Elective)

L	T	P	C
3	0	0	3

Prerequisite: Statistics and Probability, Mathematics for Analytics

Course objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision-making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools and Operations research techniques.

Course Outcomes: At the end of the course,

1. Understand and apply key business analytics concepts in various functional areas.
2. Analyze historical data using descriptive analytics for business reporting.
3. Develop predictive models to forecast business trends and customer behavior.
4. Apply prescriptive analytics techniques to support strategic decision-making.
5. Use tools such as Excel, R, Python, or Tableau for data analysis and visualization in a business setting.

UNIT- I: Business analytics

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, Competitive Advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical Methods, Review of Probability Distribution and Data Modelling, Sampling and Estimation Methods Overview.

UNIT- II: Trendiness and Regression Analysis

Modelling Relationships and Trends in Data, Simple Linear Regression, Important Resources, Business Analytics Personnel, Data and Models for Business Analytics, Problem Solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT- III: Business Analytics Structure and Techniques

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT- IV: Forecasting Techniques

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting, Appropriate Forecasting Models, Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT- V: Decision Analysis

Formulating Decision Problems, Decision Strategies With and Without Outcome Probabilities, Decision Trees and Value of Information, Utility and Decision Making. Recent Trends in Embedded and Collaborative Business Intelligence, Visual Data Recovery, Data Storytelling and Data Journalism.

TEXT BOOKS:

1. Business Analytics: Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, Pearson FT Press, 1st Edition, 2014.
2. Business Analytics, James R. Evans, Pearson Education, 3rd Edition, 2020.

REFERENCE BOOKS:

1. Business Analytics: Data Analysis and Decision Making, S. Christian Albright and Wayne L. Winston, Cengage Learning, 6th Edition, 2016.
2. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media, 1st Edition, 2013.
3. Business Analytics: The Science of Data-Driven Decision Making, U. Dinesh Kumar, Wiley India, 1st Edition, 2017.
4. Data Science for Business, Foster Provost, Tom Fawcett, O'Reilly Media, 1st Edition, 2013.
5. Predictive Analytics: The Future of Big Data, Eric Siegel, Wiley, 1st Edition, 2013.
6. Principles of Business Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson Education, 1st Edition, 2014.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., II Year, I Semester
WASTE TO ENERGY
(Open Elective)

L	T	P	C
3	0	0	3

Prerequisites: Renewable Energy Engineering and Technology

Course Objectives:

1. To understand various types of waste and their energy potential.
2. To study the technologies used for converting waste into energy, including thermal, biological, and chemical processes.
3. To explore waste handling, segregation, and preprocessing techniques.
4. To evaluate the environmental and economic aspects of waste-to-energy (WTE) systems.
5. To examine policies, challenges, and case studies related to WTE implementation.

Course Outcomes:

1. Classify different types of waste and assess their suitability for energy recovery.
2. Explain and compare WTE technologies such as incineration, gasification, pyrolysis, anaerobic digestion, and landfill gas recovery.
3. Analyze the performance and efficiency of WTE systems.
4. Assess environmental impacts and propose mitigation measures for WTE plants.
5. Design and evaluate small- and large-scale WTE projects considering technical and economic factors.

UNIT-I: Energy from Waste

Classification of Waste as Fuel, Agro Based, Forest Residue, Industrial Waste, MSW, Conversion Devices, Incinerators, Gasifiers and Digesters.

UNIT-II: **Biomass Pyrolysis**

Pyrolysis, Types, Slow Fast, Manufacture of Charcoal, Methods, Yields and Application, Manufacture of Pyrolytic Oils and Gases, Yields and Applications. Biomass Gasification: Gasifiers, Fixed Bed System, Downdraft and Updraft Gasifiers, Fluidized Bed Gasifiers, Design, Construction and Operation, Gasifiers Burner Arrangement for Thermal Heating, Gasifier Engine Arrangement and Electrical Power, Equilibrium and Kinetic Consideration in Gasifier Operation.

UNIT-III: **Biomass Combustion**

Biomass stoves, Improved Chullahs, Types, Some Exotic Designs, Fixed Bed Combustors, Types, Inclined Grate Combustors, Fluidized Bed Combustors, Design, Construction and Operation, Operations of all the above Biomass Combustors.

UNIT-IV: Biogas

Properties of Biogas (Calorific Value and Composition), Biogas Plant Technology and Status, Bio Energy System, Design and Constructional Features, Biomass Resources and their Classification, Biomass Conversion Process.

UNIT-V: Biomass Conversion and Waste to Energy

Thermo Chemical Conversion, Direct Combustion, Biomass Gasification, Pyroloysis and Liquefaction, Biochemical Conversion, Anaerobic Digestion, Types of Biogas Plants, Applications Alcohol Production from Biomass, Bio Diesel Production, Urban Waste to Energy Conversion, Biomass Energy Programme in India.

TEXT BOOKS:

1. Non-Conventional Energy, Ashok V. Desai, Wiley Eastern Ltd., 1st Edition, 1990.
2. Biogas Technology – A Practical Handbook, Vol. I & II, K.C. Khandelwal and S.S. Mahdi, Tata McGraw-Hill Publishing Co. Ltd., 1st Edition, 1983.

REFERENCE BOOKS:

1. Food, Feed and Fuel from Biomass, D.S. Challal, IBH Publishing Co. Pvt. Ltd., 1st Edition, 1991.
2. Biomass Conversion and Technology, C.Y. WereKo-Brobby and E.B. Hagan, John Wiley and Sons, 1st Edition, 1996.
3. Renewable Energy Engineering and Technology: Principles and Practice, V.V.N. Kishore, TERI Press, 1st Edition, 2009.
4. Biomass to Renewable Energy Processes, Jay Cheng, CRC Press, 2nd Edition, 2017.
5. Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Gary C. Young, Wiley, 1st Edition, 2010.
6. Anaerobic Digestion – Making Biogas – Making Energy: The Earthscan Expert Guide, Tim Pullen, Routledge, 1st Edition, 2015.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech., II Year, I Semester

PRINCIPLES OF AUTOMATION

(Open Elective)

L	T	P	C
3	0	0	3

Prerequisites: Control Systems, Manufacturing Processes

Course Objectives:

1. To understand the fundamentals of automation and its role in manufacturing and process industries.
2. To introduce the elements of automation systems such as sensors, actuators, and controllers.
3. To study the working principles of pneumatics, hydraulics, and programmable logic controllers (PLCs).
4. To develop knowledge of automated material handling and inspection systems.
5. To analyze the integration of automation systems with manufacturing processes for improved productivity.

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

1. Explain the role and types of automation in modern industry.
2. Apply knowledge of sensors, actuators, and control strategies in automation systems.
3. Design pneumatic and hydraulic circuits for industrial applications.
4. Develop and troubleshoot basic PLC programs for manufacturing automation.
5. Evaluate and integrate automation technologies to optimize production systems.

UNIT- I: Introduction to Automation

Automation In Production Systems, Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing Operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of Automated Systems, Advanced Automation Functions, Levels of Automation.

UNIT- II: Material Handling and Storage Systems

Introduction to Material Handling, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and Other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic Data Capture-Overview of Automatic Identification Methods, Bar Code Technology, Other ADC Technologies.

UNIT – III: Manual Assembly Line Design and Analysis

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design For Assembly, Analysis of Single Model Assembly Lines, Line Balancing Problem, Largest Candidate Rule, Kilbridge and Wester Method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in Assembly Line Design.

UNIT- IV: Automated Production and Transfer Line Systems

Transfer Lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with No Internal Storage, Analysis of Transfer Lines with Storage Buffers.

UNIT- V: Automated Assembly Systems and Analysis

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, And Quantitative Analysis of Assembly Systems, Parts Delivery System at Work Stations, Multi Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

TEXT BOOKS:

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover, Pearson Education, 4th Edition, 2015.
2. CAD/CAM: Principles, Practice and Manufacturing Management, Chris McMahon and Jimmie Browne, Pearson Edu. (LPE), 2nd Edition, 1999.

REFERENCE BOOKS:

1. Automation, Buckingham W, Haper and Row Publishers, New York, 1st Edition, 1961.
2. Automation for Productivity, Luke H.D, John Wiley and Sons, New York, 1st Edition, 1972.
3. Industrial Automation: Hands-On, Frank Lamb, McGraw-Hill Education, 2nd Edition, 2023.
4. Mechatronics: Principles and Applications, Godfrey C. Onwubolu, Elsevier, 3rd Edition, 2023.
5. Fundamentals of Industrial Automation, A.K. Gupta, New Age International, 1st Edition, 2016.
6. Robotics and Automation Handbook, Thomas R. Kurfess, CRC Press, 2nd Edition, 2013.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech., II Year, I Semester
COMPOSITE MATERIALS
(Open Elective)

L	T	P	C
3	0	0	3

Prerequisite: Mechanics of Materials, Materials Science

Course objectives:

1. To identify the properties of fiber and matrix materials used in commercial composites as well as some common manufacturing teaching
2. To predict the elastic properties of both long and short fiber
3. Understand the stress-strain relations.
4. To know macro mechanical analysis of lamina and laminates.
5. Establish the failure criteria for laminated structures.

Course Outcomes: At the end of the course, the students will be able to

1. Understand and differentiate various types of composites.
2. Understand different types of reinforcements and describe various manufacturing methods of composites
3. Analyze problems on macro and micro mechanical behavior of lamina
4. Analyze problems on macro mechanical behavior of laminate
5. Use the ideas developed in the analysis of composites towards using composites in aerospace design.

UNIT - I: Composite Materials and Applications

Introduction, Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and Nature Made Composites and Applications.

UNIT -II: Mechanical Behavior of Composites

Reinforcements: Fibers, Glass, Silica, Kevlar, Carbon, Boron, Silicon Carbide and Born Carbide Fibers, Particulate Composites, Polymer Composites, Thermoplastics, Thermosets, Metal Matrix and Ceramic Composites.

Manufacturing Methods: Autoclave, Tape Production, Moulding Methods, Filament Winding, Man Layup, Pultrusion and RTM.

UNIT -III: Macro Mechanical Analysis of Lamina

Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT -IV: Laminate Mechanics and Hygro-thermal Effects

Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygro thermal Effects in a Laminate, Warpage of Laminates.

UNIT -V: Laminated Composite Design and Failure

Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues, MMC and PMC.

TEXT BOOKS:

1. Mechanics of Composite Materials, R.M. Jones, McGraw-Hill Company, New York, 1st Edition, 1975.
2. Engineering Mechanics of Composite Materials, Isaac M. Daniel, Oxford University Press, 1st Edition, 1994.

REFERENCE BOOKS:

1. Analysis and Performance of Fiber Composites, B.D. Agarwal and L.J. Broutman, Wiley-Interscience, New York, 1st Edition, 1980.
2. Introduction to Composite Materials Design, Ever J. Barbero, CRC Press, 4th Edition, 2023.
3. Engineering Mechanics of Composite Materials, Isaac M. Daniel and Ori Ishai, Oxford University Press, 3rd Edition, 2023.
4. Composite Materials: Processing, Applications, and Characterization, M. Balasubramanian, Springer, 2nd Edition, 2022.
5. Analysis and Performance of Fiber Composites, Bhagwan D. Agarwal and Lawrence J. Broutman and K. Chandrashekhara, Wiley, 4th Edition, 2023.
6. Structural Analysis of Composite Materials, Mark E. Tuttle, CRC Press, 3rd Edition, 2022.
7. Mechanics of Composite Materials, Autar K. Kaw, CRC Press, 2nd Edition, 2006