CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
An Autonomous Institute I Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad, Telangana-500075, www.cbit.ac.in
Approved by | Affiliated to | UGC Autonomous | 10 Programs Accredited by | Grade A++ in | All India Ranking 151-200 Band
COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 46 years

DEPARTMENT OF INFORMATION TECHNOLOGY
SCHEME OF INSTRUCTION FOR
M.TECH - IT (ARTIFICIAL INTELLIGENCE AND ROBOTICS)
UNDER AICTE MODEL CURRICULUM

Institute Vision:
To be a center of excellence in technical education and research

Institute Mission:
To address the emerging needs through quality technical education and advanced research

Department Vision
To be a center of excellence in the field of Information Technology that yields pioneers and research experts who can contribute for the socio-economic development of the nation.

Department Mission:
- To impart state-of-the-art value based education in the field of Information Technology.
- To collaborate with industries and research organizations and excel in the emerging areas of research.
- To imbibe social responsibility in students.
- To motivate students to be trend setters and technopreneurs.

Program Educational Objectives (PEOs)
Post graduates of IT(AI & Robotics) will be able to
1. Pursue careers in industries that incorporate Artificial Intelligence and Robotics technologies to foster innovation and resolve challenges.
2. Adopt a research-oriented perspective and commit to lifelong learning, adhering to the highest level of professional code of ethics.

Program Outcomes:
At the end of the program, students will be able to:
PO1: An ability to independently carry out research /investigation and development work to solve practical problems.
PO2: An ability to write and present a substantial technical report/document.
PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes (PSOs)
After successful completion of the program, students will be able to:
PSO1: Develop innovative approaches to solve real-world challenges in the emerging fields of Manufacturing, Agriculture, Health-care, Education and Cyber Security.
PSO2: Conduct systematic research to provide advanced AI and Robotics solutions across multidisciplinary domains.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE Model Curriculum (with effect from 2024-25)

M.TECH - IT (ARTIFICIAL INTELLIGENCE AND ROBOTICS)

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	23ITC101	Fundamentals of Robotics	3	-	3	40	60	3
2	23ITC102	Artificial Intelligence and its Applications	3	-	3	40	60	3
3	23MTC105	Mathematical Foundations for AI & ML	3	-	3	40	60	3
4		Program Elective-1	3	-	3	40	60	3
5	23MEM103	Research Methodology and IPR	2	-	3	40	60	2
6		Audit Course-1	2	-	2	-	50	Non-Credit
PRACTICALS								
7	23ITC103	Robotics Lab	-	2	-	50	-	1.5
8	23ITC104	Artificial Intelligence Programming Lab	-	2	-	50	-	1.5
TOTAL			**16**	**08**	**17**	**350**	**350**	**17**

SEMESTER– I

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2024-25)

M.TECH - IT (ARTIFICIAL INTELLIGENCE AND ROBOTICS)

SEMESTER-II

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	23ITC201	Advanced Robotics	3	-	3	40	60	3
2	23ITC202	Machine Learning	3	-	3	40	60	3
3		Program Elective-2	3	-	3	40	60	3
4		Program Elective-3	3	-	3	40	60	3
5		Program Elective-4	3	-	3	40	60	3
PRACTICALS								
6	23ITC203	Machine Learning Lab	-	3	-	50	-	1.5
8		Laboratory-4 (Based on Elective)	-	3	-	50	-	1.5
9	23ITC225	Mini Project with Seminar	-	2	-	50	-	1
TOTAL			**14**	**12**	**14**	**360**	**290**	**19**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE-Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2024-25)

M.TECH - IT (ARTIFICIAL INTELLIGENCE AND ROBOTICS)

SEMESTER–III

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Program Elective-5	3	-	3	40	60	3
2		Open Elective	3	-	3	40	60	3
3		Audit Course-2	2	-	2	-	50	Non Credit
PRACTICALS								
4	23ITC301	Dissertation/Phase-I	-	20	-	100	-	10
TOTAL			6	20	6	180	120	**16**

SEMESTER–IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
PRACTICALS								
1	23ITC401	Dissertation/Phase-II	-	32	Viva-Voce	100	100	16
TOTAL			-	32	-	100	100	**16**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE-Continuous Internal Evaluation SEE-Semester End Examination

Total No. of Credits: 68

LIST OF COURSES

S.No	Code	Course	Credits
Program Core Courses			
1	23ITC101	Fundamentals of Robotics	3
2	23ITC102	Artificial Intelligence and its Applications	3
3	23MTC105	Mathematical Foundations for AI & ML	3
4	23ITC201	Advanced Robotics	3
5	23ITC202	Machine Learning	3
Mandatory Courses			
6	23MEM103	Research Methodology and IPR	2
Program Elective-1 Courses (without Lab)			
7	23ITE101	Cloud Computing	3
8	23ITE102	Cyber Security	3
9	23ITE103	System Engineering Concepts and Processes	3
10	23ITE104	Wireless Networks	3
Program Elective-2 (without Lab)			
11	23ITE201	High Performance Computing	3
12	23ITE202	Reinforcement Learning	3
13	23ITE203	Conversational AI	3
14	23ITE204	Computer Vision	3
ProgramElective-3 Courses (without Lab)			
15	23ITE205	Knowledge Engineering and Expert Systems	3
16	23ITE206	Cyber Physical Systems	3
17	23ITE207	Cognitive Robotics	3
18	23ITE208	Cloud Robotics	3
Program Elective-4 Course (with Lab)			
19	23ITE209	Deep Learning	3
20	23ITE210	Internet of Things	3
21	23ITE211	Unmanned Aerial Vehicles	3

22	23ITE212	Natural Language Processing	3
23	23ITE213	Robotic Process Automation	3
24	23ITE214	Robotics Programming using Python	3
25	23ITE215	Advanced Big Data Analytics	3
26	23ITE216	Augmented and Virtual Reality	3
Program Elective-5 Courses (without Lab)			
27	23ITE301	Generative AI	3
28	23ITE302	Human Robot Interaction	3
29	23ITE303	Metaverse in Robotics	3
30	23ITE304	Robotic Simulation and Localization Mapping	3
Audit Course – 1 and 2			
31	23EGA101	English for Research Paper Writing	0
32	23CEA101	Disaster Mitigation and Management	0
33	23EEA101	Sanskrit for Technical Knowledge	0
34	23ECA101	Value Education	0
35	23EGA102	Indian Constitution and Fundamental Rights	0
36	23EGA103	Stress Management by Yoga	0
37	23EGA104	Personality Development Through Life's Enlightenment Skills	0
Open Elective Courses			
38	23CSO101	Business Analytics	3
39	23MEO102	Introduction to Optimization Techniques	3
40	23CEO101	Cost Management of Engineering Projects	3
41	23MEO101	Industrial Safety	3
42	23MEO103	Composite Materials	3
43	23EEO101	Waste to Energy	3
Labs, Seminars & Projects			
Laboratory-1 Laboratory-2 and Laboratory-3 (Based on Core Courses)			

44	23ITC103	Robotics Lab	1.5
45	23ITC104	Artificial Intelligence Programming Lab	1.5
46	23ITC203	Machine Learning Lab	1.5
Laboratory--4 (Based on Elective-4 Courses)*			
47	23ITE217	Deep Learning Lab	1.5
48	23ITE218	Internet of Things Lab	1.5
49	23ITE219	Unmanned Aerial Vehicles Lab	1.5
50	23ITE220	Augmented and Virtual Reality Lab	1.5
51	23ITE221	Natural Language Processing Lab	1.5
52	23ITE222	Robotic Process Automation Lab	1.5
53	23ITE223	Robotics Programming using Python Lab	1.5
54	23ITE224	Advanced BigData Analytics Lab	1.5
Seminar and Projects			
55	23ITC225	Mini Project with Seminar	1
56	23ITC301	Dissertation Phase-I	10
57	23ITC401	Dissertation Phase-II	16

Program Core Courses

23ITC101 FUNDAMENTALS OF ROBOTICS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. Deliver the fundamentals of robotics.
2. Explore the various sensors and actuators of robotics.
3. Impart the end effectors of robotics.
4. Understand the image analysis in robotics.
5. Explore the various types of and its programming languages to drive the robots.

Course Outcomes:

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

1. Develop a basic skeleton of the robot by incorporating the sensors, actuators and end effectors.
2. Demonstrate the various sensors used in robots to sense the environment to act and react accordingly.
3. Apply the end effectors in the robots to pick and place the objects effectively.
4. Develop the effectors and grippers for robots to handle the objects.
5. Apply robotic languages to perceive, react and act accordingly in the environment to work effectively.

UNIT-I

Introduction to Robotics: Classification of Robots, History of Robotics, Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Robot Joints, Robot Coordinates, Robot Reference Frames, Programming Modes, Robot Characteristics, Robot Workspace, Robot Languages, Robot Applications

UNIT-II

Sensors: Sensor Characteristics, Sensor Utilization, Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Pressure Sensors, Torque Sensors, Micro switches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors, Range Finders, Sniff Sensors, Taste Sensors, Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices.

UNIT-III

Robot End Effectors: Types, Mechanical Grippers and Other types, Tools as End Effectors, The Robot/End Effector Interface, Considerations in Gripper Selection and Design. Basic Control Systems Concepts and Models, Controllers, Control System Analysis, Robot Activation and Feedback Components,

UNIT-IV

Image Processing and Analysis with Vision Systems: Basic Concepts, Fourier Transform and Frequency Content of a Signal, Frequency Content of an Image; Noise, Edges, Resolution and Quantization, Sampling Theorem, Image-Processing Techniques. Segmentation, Region Splitting, Binary Morphology Operations, Gray Morphology Operations.

UNIT-V

Robot Programming and Languages: Programming methods, Robot program as path in space, Motion Interpolation, WAIT, SIGNAL DELAY Commands, Branching. The Textual Robot languages, Generations of Robot programming languages, Robot language Structures, Constants, Variables, and other data Objects, Motion Commands, program Control and Subroutines.

Text Book:

Saeed B. Niku, Introduction to Robotics Analysis, Control, Application, John Wiley and Sons, 2011.

Suggested Reading:

1. R.K.Mittal and I J Nagrath, Robotics and Control, TMH, 2017.
2. Computational Intelligence, Davis Poole, Alan Mackwath, Randy Coehel, Oxford University Press1998.

23ITC102 ARTIFICIAL INTELLIGENCE AND IT'S APPLICATIONS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To provide students with a comprehensive understanding of artificial intelligence.
2. To familiarize students with problem-solving agents.
3. To explore various inference techniques in first-order logic
4. To evaluate different classical planning approaches
5. To investigate a range of AI applications, analyzing case studies.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the foundational concepts, history, and current state of artificial intelligence.
2. Apply problem-solving strategies including informed search methods.
3. Design knowledge-based agents using propositional and first-order logic.
4. Evaluate different classical planning approaches.
5. Understand AI applications and analyze Case studies.

Unit – I

Introduction: AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art. **Intelligent Agents:** Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, Solving Problems by Uninformed Search Strategies.

Unit - II

Solving Problems by Searching: Problem- Solving Agents, Example Problems, Searching for Solutions,, Informed (Heuristic) Search Strategies, Heuristic Functions.

Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches Algorithms for Planning as State-Space Search.

Unit - III

Logical Agents: Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic.

First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First- Order Logic, Knowledge Engineering in First-Order Logic. **Inference in First-Order Logic:** Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Unit - IV

Knowledge Representations: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited.

Unit – V

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian

Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks.
Applications of Artificial Intelligence: Range of Applications, AI Techniques for applications, AI Examples, Case studies: PARI, Aquachill Systems India, Agricultural Domain-Farmer's Intelligent Assistant, Automatic Car Parking System.
Reinforcement Learning: Introduction, passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.

Text Book:
Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, Third Edition, 2010.

Suggested Reading:

1. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi, ―Artificial Intelligence: Building Intelligent Systems‖, PHI, 2015.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:
1. Introduction to Artificial Intelligence: https://nptel.ac.in/courses/106105077
2. The future with AI: https://www.coursera.org/learn/introduction-to-ai

23MTC105 MATHEMATICAL FOUNDATIONS FOR AI & ML

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: Upon completing this course, students will be able to:

This course aim is to:

1. Discuss about vector space and Linear Mapping.
2. Understand the Matrix Decomposition.
3. Explore the stochastic processes.
4. Explain different estimates.
5. Fit the curve to the data using the least squares approximation.

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify the Basis and Dimension of vector space.
2. Compute the decomposition of the Matrix.
3. Determine the stochastic measures for the process.
4. Infer the estimation of the statistical Parameters.
5. Analyzing appropriate model for Regression diagnostic of the raw data.

UNIT I

Vector Spaces: Introduction to Vector Spaces, Subspace of a Vector Space, Linear Independence, Basis and Dimension. Linear Mapping: Introduction to Linear Mapping, Kernel and Range of a Linear Mapping, Rank and Nullity. The Matrix Representation of a Linear Mapping.

UNIT II

Matrix Decompositions: Introduction to Eigenvalues, Eigenvectors, and Diagonalization. Relevance of eigen values/vectors to machine learning, Cholesky Decomposition, Eigen decomposition, Singular Value Decomposition and Matrix Approximation. Principal component analysis and its application to dimensionality reduction.

UNIT III:

Reliability Theory: Introduction, Moments, Expectation Based on Multiple Random Variables, Transform Methods, Computation of Mean Time to Failure of Weibul and Exponential Probability Distributions. Stochastic Process: Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process and the Normal process.

UNIT – IV

Estimation: Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Likelihood Ratio Tests; Estimate Parameters Using MLE for probability distributions (Poisson, Exponential and Gaussian Distributions)

UNIT – V

Linear Predictors: Linear regression least squares, Statistical inference with the simple linear regression model, prediction and confidence intervals, Regression diagnostics. Linear Regression for Polynomial Regression Tasks.

Text Books:

1. Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science
2. Applications, John Wiley & Sons, 2016.
3. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press,2020.

Suggested Reading:

1. William M. Mendenhall Terry L. Sincich, STATISTICS for Engineering and the Sciences, SIXTH EDITION, CRC Press Taylor & Francis Group,2016.
2. David.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.

23ITC201 ADVANCED ROBOTICS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. Understand the basic kinematics mechanism of robots.
2. Explore the various types of trajectory planning in robots.
3. Present the essential knowledge about object recognition and vision.
4. Study the advances in AI for robots.
5. Explore the various techniques to develop a robot.

Course Outcomes:

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

1. Develop a robot to navigate from one place to another based on the kinematics to act and react.
2. Describe the trajectory planning of the robot to make the end-effector move continuously and smoothly from an initial state to the desired state.
3. Apply computer vision and image processing mechanism to spot people, objects, scenes for robots.
4. Develop various types of robots using various technologies including AI, ML and Computer vision and sensor integrations to operate autonomously and react according to the situation.
5. Use techniques and algorithms to design the robots according to the environment.

UNIT-I

Kinematics of Robotics**,** Position Analysis, Robots as Mechanisms, Conventions, Matrix Representation, Homogeneous Transformation Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots: Position, Orientation and Position and Orientation, Inverse Kinematic Programming of Robots, Degeneracy and Dexterity.

UNIT-II

Trajectory Planning, Introduction, Path versus Trajectory, Joint-Space versus Cartesian-Space Descriptions, Basics of Trajectory Planning, Joint-Space Trajectory Planning, Cartesian-Space Trajectories, Continuous Trajectory Recording,

UNIT-III

Object Recognition: Features, Moments, Template Matching, DF Descriptions, Depth Measurement with Vision Systems, Specialized Lighting, Image Data Compression, Color Images, Heuristics, Applications of Vision Systems.

UNIT-IV

AI and Advanced Robotics, Introducing the robot and development environment, Software components ROS,Python, Linux. Robot Control Systems and decision-making framework, The robot control system- a control loop with soft real-time control.

UNIT-V

A Concept for a Practical Robot Design Process, A System engineering-based approach, Use Cases, Storyboards, Giving the robot an Artificial Personality, Careers in Robotics, Issues in AI- real and not real, Understanding risk in AI.

Text Books:

1. Saeed B. Niku, Introduction to Robotics Analysis, Control, Application, John Wiley and Sons, 2011.
2. Francis X.Govers , Artificial Intelligence for Robotics, Packt Publishing , 2018

Suggested Reading:

1. R.K.Mittal and I J Nagrath, Robotics and Control, TMH, 2017.
2. Computational Intelligence, Davis Poole, Alan Mackwath, Randy Coehel, Oxford University Press1998.

23ITC202 MACHINE LEARNING

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To impart knowledge on the basic concepts underlying machine learning.
2. To be acquainted with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes:
After completion of this course, students will be able to
1. Define the basic concepts related to Machine Learning.
2. Describe the Feature Engineering Methods and Regression techniques.
3. Compare between Supervised and Unsupervised Learning.
4. Classification of algorithms.
5. Applying Machine Learning techniques to real world problems with case studies.

UNIT-I
Introduction to Machine Learning: Introduction, Well-Posed Learning Problems, Types of Learning, Perspectives and Issues in Machine Learning.
Concept Learning: Concept Learning Task, Concept learning as Search: General to Specific Ordering of Hypothesis, Find-S: Finding Maximally Specific Hypothesis, Candidate Elimination Algorithm.

UNIT-II
Feature Engineering: Introduction to Features and need of Feature Engineering, Feature Extraction and Selection.
Regression: Linear Regression, Multivariate Regression, Regression Types: Ridge, Lasso, Elastic Net.

UNIT-III
Naïve Bayes and Discriminant Analysis: Naïve Bayes Classifiers, Discriminant Analysis.
Ensemble Learning: Introduction to Ensemble Learning-Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier.
Instance-based Learning: Logically Weighted Regressions, Radial Basis functions, Linear SVM, K-means, Evaluation methods, DBSCAN.

UNIT-IV
Classification Algorithms: KNN, Linear Classification, Logistic Classification.
Unsupervised Learning: Clustering, types of clustering, K-Means clustering, Hierarchical clustering, Birch Algorithm, CURE Algorithm, Principal Component Analysis (PCA), Principal Component Regression (PCR).

UNIT-V
Reinforcement Learning: Introduction, Scope and Limitations, Examples, Applications of RL
Neural Network: Neural network ‗gradient descent, Activation functions, Parameter initialization, convolutional neural networks, recurrent neural network.
Case Studies:-Recommender Systems, Weather forecasting

Text Books:

1. Abhishek Vijavargia "Machine Learning using Python". BPB Publications. 1st Edition , 2018
2. Giuseppe Bonaccorso, Machine Learning Algorithms", 2nd Edition Packt , 2018
3. Tom Mitchel "Machine Learning", Tata McGraw Hill, 2017

Suggested Reading:

1. Abhishek Vijayvargia" Machine Learning using Python"BPB Publications, 1st Edition, 2018
2. Marsland.S"Machine Learning:An Algorithmic Perspective" st Edition Chapman and Hall / CRC 2009 https://doi.org/10.1201/9781420067194
3. Reema thareja : Python Programming".oxford Press,2017
4. Yuxi Liu: Python Machine Learning by Example". 2nd Edition, Pact, 2017

Web Resources:

1. https://www.guru99.com/machine-learning-tutorial.htm
2. https://www.tutorialspoint.com/machine_learning _with_python/index.htm
3. https://www.tutorialspoint.com/python/
4. https://docs.python.org/3/tutorial/
5. https://www.geeksforgeeks.org/machine-learning/

Mandatory Courses

23MEM103 RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

This course aim is to:

1. To motivate to choose research as career
2. To formulate the research problem, prepare the research design
3. To identify various sources for literature review and data collection report writing
4. To equip with good methods to analyze the collected data
5. To know about IPR copyrights

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs.
3. Collect the data by various methods: observation, interview, questionnaires.
4. Analyze problem by statistical techniques: ANOVA, F-test, and Chi-square.
5. Understand apply for patent and copyrights.

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT- III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non-parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, F-test, z-test

UNIT - V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright? How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, “Research Methodology, Methods & Technique”; NewAge International Publishers, 2004
2. R. Ganesan, “Research Methodology for Engineers”, MJP Publishers , 2011
3. Y.P. Agarwal, “Statistical Methods: Concepts, Application and Computation”, Sterling Publs, Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. Ajit Parulekar and Sarita D’ Souza, “Indian Patents Law – Legal & Business Implications”; Macmillan India ltd , 2006
2. B. L.Wadehra; “Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications”; Universal law Publishing Pvt. Ltd., India2000.
3. P. Narayanan; “Law of Copyright and Industrial Designs”; Eastern law House, Delhi 2010.

Program Elective-1 Courses (Without Lab)

23ITE101 **CLOUD COMPUTING**
(Program Elective - 1)

Instruction	3L per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on Data Bases and computing mechanisms.

Course Objectives:
This course aim is to:
1. To gain a comprehensive understanding of fundamental concepts in cloud computing, including its goals, benefits, risks, challenges, service models, and deployment models.
2. To explore cloud-enabling technologies such as cloud data center technology, virtualization, multitenant technology, and containerization, along with their roles and implications in cloud computing environments.
3. To analyze specialized cloud mechanisms and management mechanisms to understand their significance in optimizing cloud performance and resource utilization.
4. To examine various access-oriented and data-oriented security mechanisms implemented in cloud computing environments
5. To evaluate different cloud computing architectures to design scalable, resilient, and efficient cloud solutions aligned with organizational requirements and objectives.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the fundamental cloud computing concepts, including service models and deployment models.
2. Analyze cloud-enabled technologies and evaluate various cloud infrastructure components, storage technologies, and networking principles.
3. Apply the advanced cloud computing mechanisms and cloud management mechanisms
4. Analyze the security challenges, identify potential risks, and evaluate strategies for securing cloud deployments.
5. Critique different cloud computing architectures, evaluating their scalability, resilience, and suitability for diverse application scenarios leverage emerging trends such as edge computing and fog computing

UNIT - I
Fundamental Concepts of Cloud Computing: Goals and Benefits, Risks and Challenges, Cloud Computing Service and Deployment Models: Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Multi-Cloud

UNIT - II
Cloud-Enabling Technology: Cloud Data Center Technology, Modern Virtualization, Multitenant Technology, Service Technology and Service APIs, Fundamental of Containerization, Containers, Container Images, Multi-Container Types. **Cloud Infrastructure Mechanisms:** Logical Network Perimeter, Virtual Server, Hypervisor, Cloud Storage Device, Cloud Usage Monitor, Resource Replication, Ready-Made Environment.

UNIT - III
Specialized Cloud Mechanisms: Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Resource Cluster, Multi-Device Broker, State Management Database
Cloud Management Mechanisms: Remote Administration System, Resource Management System, SLA Management System, Billing Management System**.**

UNIT - IV
Cloud Computing Architectures: Workload Distribution Architecture, Elastic Resource Capacity Architecture, Multi Cloud Architecture, Hypervisor Clustering Architecture, Cloud Balancing Architecture **Specialized Cloud**

Architectures: Edge Computing Architecture, Fog Computing Architecture, Metacloud Architecture, Federated Cloud Application Architecture**.**

UNIT - V

Cloud Computing Security: Threat Agents, Common Threats, **Cloud Security and Cybersecurity Access-Oriented Mechanisms:** Cloud-Based Security Groups, Hardened Virtual Server Image, Identity and Access Management (IAM) System, **Cloud Security and Cybersecurity Data-Oriented Mechanisms:** Data Loss Prevention (DLP) System, Trusted Platform Module (TPM). **Cloud Delivery Model Considerations:** Case Study on Cloud Provider and Consumer Perspective.

Text Book:

Thomas Erl, Eric Barceló Monroy, “Cloud Computing: Concepts, Technology, Security, and Architecture”, 2nd Edition, 2023, Pearson, ISBN: 9780138052287.

Suggested Reading:

1. Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi, “Cloud Computing: Principles and Practice",
2. 2020.
3. Comer, D, “The Cloud Computing Book: The Future of Computing Explained”, 1st edition,. Chapman and
4. Hall/CRC, 2021. https://doi.org/10.1201/9781003147503.
5. Sean Howard, “Edge Computing with Amazon Web Services: A practical guide to architecting secure edge
6. cloud infrastructure with AWS”, 1st Edition, ISBN: 9781835081082, Packt Publishers, 2024.

23ITE102 **CYBER SECURITY**
(Program Elective - 1)

Instruction	3L Per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Operating System, Computer Network, Cryptography

Course Objectives:
1. The objectives of this course are
2. To Identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
3. To collect, Process, Analyze and Present Computer Forensics Evidence.
4. To understand the legal perspectives and Organizational implications of Cyber Security

Course Outcomes:
On Successful completion of this course, student will be able to
1. List the different types of cybercrimes and analyze legal frameworks to handle cybercrimes.
2. Identify the Tools and Methods used in cybercrimes.
3. Analyze and resolve cyber security issues and laws governing Cyberspace.
4. Describe the need of Digital Forensics and the importance of digital evidence in prosecution.
5. Interpret the commercial activities in the event of significant information security incidents in the Organization.

UNIT – I
Ethical aspects of Robotic Design: Introduction, Blame the Robot, Blaming Homo sapiens, Negligence and Product Liability Laws, Security aspects and laws involved in Robotic Design. Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT - II
Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber café and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector. Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - III
Cyber Security: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students:\ The Indian Scenario.

UNIT - IV
Understanding Cyber Forensics: Introduction ,Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

UNIT - V
Cyber security: Organizational Implications: 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. Real time case studies.

Text Books:

1. Sunit Belpre and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer
2. Forensics and Legal Perspectives”, Wiley India Pvt, Ltd, 2018.
3. Kevin Mandia, Chris Prosise, “Incident Response and computer forensics”, Tata McGraw Hill, 2016.
4. Angelo Cangelosi, Minoru Asada “Cognitive Robotics” MIT press 2022 2. Hooman Somani,”Cognitive Robotics”, CRC Press, 2016

Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, “Cyber Security and Cyber Laws”, Paperback – 2018.
2. Mark F Grady, Fransesco Parisi, “The Law and Economics of Cyber Security”, Cambridge university press, 2006.

Web Resources:

1. https://www.edx.org/learn/cybersecurity
2. https://www.coursera.org/courses?query=cyber%20security
3. https://swayam.gov.in/course/4002-cyber-law

23ITE103 SYSTEM ENGINEERING CONCEPTS AND PROCESSES
(Program Elective - 1)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To understand the Fundamental concepts of System Engineering.
2. To equip with knowledge of system design principles and development.
3. To explore System analysis and Design to validate the system functionality.
4. To instill a proactive Approach on risk identification and mitigation strategies.
5. To engage students in case studies and practical applications of system engineering.

Course Outcomes:

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

1. Demonstrate a clear understanding of system engineering concepts and processes.
2. Utilize design principles and development plans to create efficient systems.
3. Analyze and design the system to test and validate system functionality.
4. Identify potential risks and implement risk mitigation plans
5. Utilize Case Studies and applications of systems engineering.

UNIT-I

Introduction to Systems Engineering: Origins of Systems Engineering, Examples of Systems Requiring Systems Engineering, Systems Engineering Landscape -Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, Systems Engineering Approaches, Systems Engineering Activities and Products, Structure of Complex Systems- System Building Blocks and Interfaces, The System Environment, Interfaces and Interactions

UNIT-II

System Development Process- Systems Engineering through the System Life Cycle, The Systems Engineering Method, Developing the System Requirements, Performance Requirements Formulation, Analysis, Performance Requirements Validation, Concept Definition- Selecting the System Concept, System Development Planning, System Modeling Languages: Unified Modeling Language (UML) and Systems Modeling Language (SysML), Model-Based Systems Engineering (MBSE)

UNIT-III

Software Systems Engineering: Nature of Software Development, Software Development Life Cycle Models, Software Concept Development: Analysis and Design, Software Engineering Development: Coding and Unit Test, Software Integration and Test, Software Engineering Management

UNIT-IV

Decision Analysis And Support : Decision Making, Modeling throughout System Development, Modeling for Decisions, Simulation, Trade-Off Analysis, Evaluation Methods,
Reducing Program Risks, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Risk Reduction**.**

UNIT-V

Case Studies of Robotics in System Engineering: Autonomous Vehicles, Industrial Robotics in Manufacturing, Service Robots in Healthcare, Inventory management, Unmanned Aerial vehicles.

Text Books:

1. Benjamin S. Blanchard and Wolter J. Fabrycky, “Systems Engineering and Analysis”.

2. Alexander Kossiakoff, William N. Sweet, Sam Seymour, and Steven M. Biemer,"Systems Engineering Principles and Practice".

Suggested Reading:

1. Dennis M. Buede and William D. Miller, "The Engineering Design of Systems: Models and Methods" .
2. "INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities".

Web Resources

1. https://www.udemy.com/course/software-project-management-the-complete-course
2. https://www.coursera.org/specializations/product-management

23ITE104 **WIRELESS NETWORKS**

(Program Elective - 1)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To give an understanding of the basic knowledge on wireless LANs, Adhoc wireless networks, and protocols.
2. To give an overview of networking principles and how the wireless protocols
3. To know the basic background in wireless networks and various routing protocols.
4. To acquire the basic skills needed to know about Quality of Service issues.
5. To give an overview of the Energy management and Security in Adhoc Networks.

Course Outcomes:

Upon completing this course, students will be able to:

1. Describe the Wireless Adhoc Networks, Wireless LANs and Protocols
2. Explain the overview of Adhoc wireless networks and MAC Protocols.
3. Evaluate the issues involved in wireless network security and the Routing Protocols.
4. Illustrate the Quality of Service issues in Adhoc Networks.
5. Analyze the Energy management and Security in Adhoc Networks

UNIT I

Wireless LANS AND PANS: Introduction Fundamentals of WLANS, IEEE 802.11 Standard, HIPERLAN Standard, Bluetooth, Home RF. Wireless Internet: Wireless Internet, Mobile IP, TCP in wireless Domain WAP, Optimizing Web over Wireless.

UNIT II

Adhoc Wireless Networks: Introduction in Ad-Hoc wireless Networks, Ad-Hoc Wireless Internet. MAC Protocols For Adhoc Wireless Networks: Introduction, issues in designing a MAC protocol for adhoc wireless networks, design goals, classification of MAC protocols, contention based protocols.

UNIT III

Routing Protocols: Introduction, issues in designing a routing protocol for adhoc wireless networks, classification, table-driven routing protocols, on-demand routing protocols, hybrid routing protocols, hierarchical routing protocols, power-aware routing protocols.

Transport Layer And Security Protocols: Introduction, issues in designing a transport layer protocol for adhoc wireless networks, design goals of a Transport Layer Protocol for Ad-HocWireless Networks, classification of Transport Layer Solutions, TCP over adhoc other Transport Layer Protocol for Ad-Hoc wireless Networks Security in adhoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks, key management, secure routing in Ad-Hoc wireless networks.

UNIT IV –

Quality of Service: Introduction, issues and challenges in providing QoS in adhoc wireless networks, classification of QoS solutions, MAC layer solutions, network layer solutions, QoS frameworks for Adhoc wireless networks

UNIT V - Energy Management: Introduction, need for energy management in adhoc wireless networks, classification of energy management schemes, battery management schemes, transmission power management schemes, system power management schemes. Security in Ad-Hoc Networks

Text Books

1. C. Siva Ram Murthy, B.S. Manoj “Adhoc wireless networks architecture and protocols”, Prentice Hall of India,

New Delhi, (2006).
2. Jagannathan Sarangapani “Wireless Adhoc and sensor networks, protocols, performance and control” CRC press, New Delhi, (2007)

Suggested Reading:

1. C. K. Toh “Adhoc mobile wireless networks protocols & systems” Pearson Education India, New Delhi. (2009),
2. C .S. Raghavendra, Krishna M. Sivalingam “Wireless sensor networks”, Springer Science, USA, (2004).
3. Jared Kroff,”Cognitive Robotics: Intelligent Robotic Systems”, Wilford Press, 2016
4. Patnaik, Srikanta, "Robot Cognition and Navigation - An Experiment with Mobile Robots", SpringerVerlag Berlin and Heidelberg, 2007
5. David Vernon,”Artificial Cognitive Systems: A Primer” The MIT Press, 1st Edition, 2014.
6. Angelo Cangelosi, Minoru Asada “Cognitive Robotics” MIT press 2022

Program Elective-2 Courses (Without Lab)

23ITE201 **HIGH PERFORMANCE COMPUTING**
(Program Elective - 2)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To familiarize with the fundamentals of high performance & parallel computing systems.
2. To impart knowledge on openMP, MPI.
3. To introduce algorithms suited for Multicore processor systems.
4. To deal with accelerator technologies of GPUs with CUDA, OpenCL
5. To acquire knowledge on Filesystems, Expanded Parallel Programming Models.

Course Outcomes:
At the end of the course, the student will be able to
1. Analyze the advancements in parallel and high performance computing systems.
2. Optimize the performance on openMP, MPI environment.
3. Design algorithms suited for Multicore processor systems using OpenCL, OpenMP, and Threading techniques.
4. Write Programs using accelerator technologies of GPUs with CUDA, OpenCL
5. Summarize knowledge on Filesystems, Expanded Parallel Programming Models.

UNIT- I
Introduction: High Performance computing Disciplines, Impact of supercomputing on science, society and security, Anatomy, A, HPC Architectures, Key, Parallel Architecture Families—Flynn's Taxonomy, Multiprocessors, Shared-Memory Multiprocessors, Massively Parallel Processors, Commodity Clusters.

UNIT -II
OpenMP: Introduction, Overview, Parallel, Synchronization, Reduction.
MPI: Introduction, Message-Passing Interface Basics Message-Passing Interface Data Types, Communicators, Communication Collectives, Broadcast, Scatter, Gather, Allgather.

UNIT-III
Parallel Algorithms: Introduction, Fork–Join, Divide and Conquer, Manager–Worker, Embarrassingly Parallel, Halo Exchange, The Advection Equation Using Finite Difference, Sparse Matrix Vector Multiplication, Permutation: Cannon's Algorithm, Task Dataflow: Breadth First Search,

UNIT-IV
OpenACC: Introduction, Architecture of a modern GPU, OpenCL, C++ AMP, OpenACC,CUDA,Cuda program structure, A vector addition kernel, CUDA threads organization, CUDA device memory types ,matrix-matrix multiplication-a more complex kernel.

UNIT-V
File Systems: Role and Function of File Systems, POSIX File Interface, Parallel File System.
Expanded Parallel Programming Models: Advance in Message-Passing Interface, Advances in OpenMP, MPI+X, Extended High Performance Computing Architecture The World's Fastest Machine, Lightweight Architectures, Field Programmable Gate Arrays, Exascale Computing.

Text Book:

High Performance Computing, Modern Systems and Practices**,** Thomas Sterling,Matthew Anderson,Maciej Brodowicz, Foreword by C. Gordon Bell,School of Informatics, Computing, and Engineering, Indiana University, Bloomington, Morgan Kaufmann publishers,2018 Edition.

Suggested Reading:

1. **Programming Massively Parallel Processors:** A Hands-on Approach Second Edition,David B. Kirk and Wen-mei W. Hwu, 2013, 2010 David B. Kirk/NVIDIA Corporation and Wen-mei Hwu. Published by Elsevier Inc.
2. **An Introduction to Parallel Programming**, By Peter Pacheco, University of San Francisco, 2011 Edition.

23ITE202 **REINFORCEMENT LEARNING**

(Program Elective - 2)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To learn the concepts of reinforcement learning, Multi Armed bandits problem, Finite Markov Decision Process.
2. To introduce Dynamic programming, Monte Carlo methods and Temporal-Difference Learning.
3. To excel with Tabular Methods and Prediction with Approximation.
4. To provide approximate solutions methods for Reinforcement learning.
5. To familiarize with applications and case studies of reinforcement learning.

Course Outcomes:

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

1. Understand the concepts of Reinforcement Learning, Multi Armed Bandits and Finite Markov Decision process.
2. Apply Monte Carlo, Temporal Difference methods for policy evaluation and prediction.
3. Analyze the Tabular Methods and On-policy Prediction with Approximation.
4. Understand On-policy Control and Off-policy Methods with Approximation.
5. Apply Eligibility Traces, Policy Gradient Methods to improve the performance of reinforcement learning.

UNIT-I

Introduction: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope.

Multi Armed Bandits: A n-Armed Bandit Problem**,** Action-Value Methods, Incremental implementation, Tracking a Non-stationary problem, Optimistic initial values, Upper-confidence-Bound Action Selection, Gradient Bandits, Associative search.

Finite Markov Decision Process: The Agent-Environment Interface, Goals and Rewards, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions.

UNIT-II

Dynamic Programming: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous dynamic programming, Generalized Policy Iteration, Efficiency of dynamic programming.

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy prediction via Importance Sampling.

Temporal-Difference Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-policy TD control, Q-learning: Off-policy TD control.

UNIT-III

Planning and Learning with Tabular Methods: Models and Planning, Integrated Planning, acting and learning, Prioritized Sweeping, Full vs Sample Backups, Trajectory sampling, Heuristic search, Monte carlo tree search.

On-policy Prediction with Approximation: Value-function approximation, stochastic-gradient and semi- gradient methods, Linear methods, Feature construction for linear methods, Selecting step-size parameters manually.

UNIT-IV

On-policy Control with Approximation: Episodic Semi-gradient Control, Semi-gradient n-step Sarsa, Average Reward: A New Problem Setting for Continuing Tasks, Deprecating the Discounted Setting, Differential Semi-gradient n-step Sarsa,

Off-policy Methods with Approximation: Semi-gradient Methods, Examples of Off-policy Divergence, The Deadly Triad, Linear Value-function Geometry, Gradient Descent in the Bellman Error.

UNIT- V

Policy Gradient Methods: Policy Approximation and its advantages, The Policy Gradient theorem, Reinforce: Monte Carlo Policy Gradient, Reinforce with Baseline, Actor-Critic methods, Policy gradient for continuing problems, Policy parameterization for continuous actions.

Text Book:

Sutton & Barto, Reinforcement Learning: An Introduction‖, MIT Press 2018, 2nd Edition.

Suggested Reading:

1. Vincent François-Lavel, Peter Henderson, Riashat Islam, Marc G. Bellemare, Joelle Pineau, An Introduction to Deep Reinforcement Learning‖, Now Publishers, 2018
2. Csaba Szepesvari, Algorithms for Reinforcement Learning‖, Morgan & Claypool Publishers, 2010.
3. Maxim Lapan , Deep Reinforcement Learning Hands-On‖ Packt publisher, 2nd edition, 2020.

Web Resources:

1. Swayam Course: Reinforcement Learning: https://swayam.gov.in/nd1_noc19_cs55/preview
2. NPTEL Course : https://nptel.ac.in/courses/106106143

23ITE203 **CONVERSATIONAL AI**
(Program Elective - 2)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aims to:
1. To introduce the conversational design process and scripts using Dialog flow.
2. To understand the essential building blocks of interaction models.
3. To provide an understanding of linear and non-linear dialogues.
4. To train on the setup and use of web hooks and extracting parameter values and structuring responses.
5. To cover the deployment process of conversational agents.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Understand the foundational concepts of conversational design.
2. Create various interaction models and test these models.
3. Develop complex conversational flows.
4. Implement fulfillment strategies using web hooks and cloud functions.
5. Deploy conversational agents on cloud and testing to ensure optimal performance.

UNIT-I
Conversational Design Process: Introduction to virtual assistant/chatbot, use cases, what is conversational design, conversational design process, designing conversational flows, writing the script, designing your conversations, Introduction to Dialogflow, Setting up Dialogflow.

UNIT-II
Building blocks of Interaction models: Agents, types of Intents, creating Intents, training phrases, Entities, configuring rich responses, small talk and salutations, Configuring and testing Intents on Google Assistant, Working on Connected Flows.

UNIT-III
Linear and Non-linear dialogue: Actions & Parameters, understanding slot filling, context, extended Lead Generation, linear dialogue, nonlinear Dialogue, webhook, Fulfilment.

UNIT- IV
Fulfilment: Fulfilment using webhook, basic setup of webhook code, Extracting parameter values and structuring responses, fulfilment using cloud function.

UNIT-V
Deployment: Introduction to Heroku, Deploying to Heroku, Deploying on Alexa, Re-training, Validation & Testing.

Text Books:
1. Hands-on chatbot with Google Dialog flow, Loonycorn, O'Reilly, Packt publishing.2018.
2. Hands-on chatbots and conversational UI development, Srini Janarthanam, Packt publishing.2017.

Suggested Reading:
1. Amir Shevat, Designing Bots: Creating Conversational Experiences, O'Reilly Media, 2017.
2. Henry Lee, Build Conversational Alexa Skills: A Practical Guide to Connecting with Your Customers through Voice, Apress, 2019.

3. Henry Lee, Build Conversational Alexa Skills: A Practical Guide to Connecting with Your Customers through Voice, Apress, 2019.

23ITE204 **COMPUTER VISION**
(Program Elective - 2)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To understand the fundamental concepts related to computer vision and Image formation.
2. To Learn feature detection, matching and detection.
3. To become familiar with feature based alignment.
4. To develop skills on 3D reconstruction.
5. To Understand Object Detection Techniques.

Course Outcomes:
Upon completing this Course, Students will be able to:
1. Understand Fundamentals of computer vision and physics of color.
2. Employ Image processing techniques.
3. Illustrate 2D Feature Based Image Alignment, Feature Detection and Segmentation.
4. Apply 3D Image Reconstruction Techniques.
5. Develop Innovative Computer Vision Applications.

UNIT-I
Introduction to Computer Vision: Computer vision, Applications of computer vision, Computer vision pipeline, Image input, Image preprocessing, Feature extraction, Classifier learning algorithm. **[T3]**
Color: The Physics of Colour, Human Colour Perception, Representing Colour. Application: Finding Specularities, Surface Colour from Image Colour. **[T2]**

UNIT-II
Image Formation and Processing: Geometric primitives and transformations, Photometric image formation,The digital camera, Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization. **[T1]**

UNIT-III
Feature Detection, Matching and Segmentation: Points and patches, Edges, Lines, Segmentation, Active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts and energy-based methods. **[T1]**
Feature-based Alignment: 2D and 3D Feature Based Alignment, Pose estimation, Geometric intrinsic calibration. **[T1]**

UNIT-IV
3D Reconstruction: Shape from X, Active range finding, Surface representations, Point-based representations, volumetric representations, Model-based reconstruction, Recovering texture maps and albedosos. **[T1]**

UNIT- V
Object detection: General object detection framework, Region-based convolutional neural networks (R-CNNs) ,Single-shot detector (SSD) and You only look once (YOLO). **[T3]**
Generative adversarial networks (GANs): GAN architecture, Evaluating GAN models, Popular GAN applications.**[T3]**

Text Books:
1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Second Edition, 2022.

2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Deep Learning for Vision Systems, Mohamed Elgendy, Manning Publications, Second Edition 2020.

Suggested Reading:

1. R. Hartley and A. Zisserman, "Multiple View geometry", Cambridge University Press, 2002.
2. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Second Edition, Cambridge University Press, March 2004.
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

Web Resources:

1. CV online: http://homepages.inf.ed.ac.uk/rbf/CVonline
2. NPTEL Course: https://nptel.ac.in/courses/108103174
3. Computer Vision Basics: https://opencv.org/opencv-free-course/
4. Computer Vision Tutorial: https://docs.opencv.org/4.x/d9/df8/tutorial_root.html

Program Elective - 3
Courses (Without Lab)

23ITE205 KNOWLEDGE ENGINEERING AND EXPERT SYSTEMS
(Program Elective - 3)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To gain a thorough understanding of the fundamental concepts involved in creating knowledge bases and expert systems.
2. To become proficient in the tools and processes essential for developing expert systems.
3. To learn various methods to assess and evaluate the performance of expert systems.
4. To design and develop knowledge bases for expert systems, representing real-world concepts as knowledge units.
5. To apply Knowledge Engineering principles effectively in various contexts, including conducting comprehensive case studies on existing systems and comparing different methodologies and approaches.

Course Outcomes:

Upon completing this course, students will be able to:

1. To understand, define and describe various expert system applications, their relation to AI, key features, benefits, and selection criteria.
2. To identify principles of expert systems. Explain abduction, deduction, induction in expert systems and Apply reasoning techniques to develop simple expert systems.
3. To recognize and illustrate rule-based, logic-based, and network-based representations.
4. To analyze how expert systems handle uncertainties and evaluate architectures.
5. To apply diverse methodologies and tools to develop and enhance expert systems.

UNIT – I

The nature of Expert Systems: Introduction to Expert Systems, Types of applications of Expert Systems. Relationship of Expert Systems to Artificial Intelligence and to Knowledge-Based Systems. The nature of expertise. Distinguishing features of Expert Systems. Benefits of using an Expert System Choosing an application.

UNIT- II

Theoretical Foundations: Basics of Expert Systems. Working and Building Expert Systems. Basic forms of inference: abduction; deduction; induction.

UNIT-III

Knowledge Representation and Manipulation: The representation and manipulation of knowledge in a computer; Rule-based representations with backward and forward reasoning; logic-based representations with resolution refutation; taxonomies; meronomies; frames with inheritance and exceptions; semantic and partitioned nets query handling.

UNIT-IV

Components and Architectures of Expert Systems: Basic components of an expert system; Generation of explanations; Handling of uncertainties; Truth Maintenance Systems; Expert System Architectures; An analysis of some classic expert systems; Limitations of first generation expert systems; Deep expert systems; Co-operating expert systems and the blackboard model.

UNIT-V

Building Expert Systems: Building Expert Systems Methodologies for building expert systems: knowledge acquisition and elicitation; formalisation; representation and evaluation. Knowledge Engineering tools, Case Study.

Text Book:

P Jackson, Introduction to Expert Systems, Addison Wesley, 1997 (3nd Edition).

Suggested Reading:

1. P Jackson, Introduction to Expert Systems, Addison Wesley, 1990 (2nd Edition)
2. Elaine Rich, Kevin Knight, Artificial Intelligence, McGraw-Hill, Inc, 1991 (2nd Edition).
3. Jackson. Jean-Louis Lauriere, Problem Solving and Artificial Intelligence, Prentice Hall, 1990.

Web Resources:

1. NPTEL : https://archive.nptel.ac.in/courses/106/106/106106140/
2. COURSERA : https://www.coursera.org/in/articles/expert-system-in-ai
3. ONLINE : https://www.geeksforgeeks.org/expert-systems/

23ITE206 **CYBER PHYSICAL SYSTEMS**
(Program Elective - 3)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To introduce fundamental concepts of Cyber Physical Systems (CPS).
2. To explore various design approaches of CPS.
3. To discover the available sensors useful for CPS.
4. To walk through the design of controllers beyond Embedded Systems.
5. To assess various real time scheduling methods available for CPS.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Understand the significance of Cyber Physical Systems in safety critical domains.
2. Choose the appropriate CPS design for a given real time scenario.
3. Perform hybrid automaton based design of CPS.
4. Devise real time sensing and communication of CPS.
5. Analyze and verify the CPS models.

UNIT-I
Introduction - Definition of Cyber-Physical System, Key Features of Cyber-Physical Systems, Applications, **The Design Process**- Model, Design, Analysis. Properties of Systems- Causal Systems, Memoryless Systems, Linearity and Time Invariance, Stability. Real-time Sensing and Communication in CPS.
(Textbook1: ch 1, Textbook2 ch 1,2)

UNIT-II
Synchronous Model: Reactive Components - Variables, Valuations, and Expressions, Inputs, Outputs, and States. Initialization, Update, Executions, Extended-State Machines; Composing Components Block Diagram, Input/output Variable Renaming, Parallel Composition, Output Hiding;
Asynchronous Model: Asynchronous Processes- States, Inputs, and Outputs, Input, Output, and Internal Actions, Executions, Extended-State Machines, Operations on Processes , Safety Requirements .
(Textbook 1: Ch. 2, Ch. 4)

UNIT-III
Design of Embedded Systems: Models of Sensors and Actuators: Linear and Affine Models, Dynamic Range, Quantization, Noise, Sampling, Sidebar, Decibels, Harmonic Distortion, Signal Conditioning, Common Sensors, Measuring Tilt and Acceleration, Measuring Position and Velocity, Measuring Rotation, Measuring Sound, Other Sensors, Actuators, Light-Emitting Diodes, Motor Control
(Textbook 2: Ch.7)

UNIT-IV
Embedded Processors: Types of Processors, Microcontrollers, DSP Processors , Graphics Processors, Parallelism, Parallelism vs. Concurrency, Pipelining: Instruction-Level Parallelism .Multicore Architectures.
Analysis and Verification: Invariants, Linear Temporal Logic, Propositional Logic Formulas, LTL Formulas, Using LTL Formulas (Textbook 2: Ch. 8, Ch.13)

UNIT-V
Timed Model: Timed Processes- Timing-Based Light Switch ,Buffer with a Bounded Delay ,Multiple Clocks, Formal Model, Timed Process Composition ,Modeling Imperfect Clocks.

Real-Time Scheduling: Scheduling Concepts, EDF Scheduling, Fixed-Priority Scheduling.
(Textbook 1: Ch. 7, Ch.8)

Text Books:

1. Alur, R. (2015). Principles of cyber-physical systems. MIT press.
2. Lee, Edward Ashford, and Sanjit Arunkumar Seshia. Introduction to embedded systems: A cyber-physical systems approach. MIT press, 2016.

Suggested Reading:

1. Lee, Edward Ashford, and Sanjit Arunkumar Seshia. Introduction to embedded systems: A cyber-physical systems approach. MIT press, 2016.
2. "Cyber-physical systems". Program Announcements & Information. The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA. 2008-09-30. Retrieved 2009-07-21.

Web Resources:

1. https://web.archive.org/web/20100624002916/http://varma.ece.cmu.edu/CPS/Position-Papers/Rajesh-Gupta.pdf
2. https://www.sciencedirect.com/topics/computer-science/cyber-physical-systems
3. https://dst.gov.in/interdisciplinary-cyber-physical-systems-icps-division

23ITE207 **COGNITIVE ROBOTICS**
(Program Elective - 3)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To characterize the Ethical and Philosophical aspects of Cognitive Robotics
2. To understand the Chemical and Physical aspects of Cognitive Robotics
3. To know the Cultural and Social Aspects of Cognitive Robotics
4. To demonstrate the Social Cognition of Robots during Interacting with Humans
5. To describe the Psychological and AI aspects of Cognitive Robotics.

Course Outcomes:
Upon completing this course, students will be able to:
1. Explain the Ethical and Philosophical aspects of Cognitive Robotics.
2. Illustrate the Chemical and Physical aspects of Cognitive Robotics
3. Analyze the methods and software/hardware technologies for robotics research and applications.
4. Explain the state of the art in cognitive and intelligent robotics models, and how this informs the design of future robot applications.
5. Analyze the AI aspects of Cognitive Robotics.

UNIT I – Introduction- Cognitive robotics fundamentals, Context and Definition, Embodied Cognition Theories, AI and Knowledge-Based Systems, Behavior- Based Robotics, History of Cognitive Robotics.
Ethical aspects of Cognitive Robotics
Introduction, Blame the Robot, Blaming Homo Sapiens, Negligence and Product Liability Laws, Robot Cars, Insurance.
Philosophical aspects of Cognitive Robotics, Designing Modular AI Robots Inspired by Amerindian Material Culture, Introduction, Evolution of Technology and Ideas, The Amerindian World and the Techno–Animistic Paradigm Shift, Animism: Material and Metamorphosis, Formation of a Robotic Community.

UNIT II - Chemical Aspects of Cognitive Robotics
A Learning Planet, Introduction, Perspective, the Second Law, Control of Fire, Emergence of Learning,
Physical Aspects of Cognitive Robotics, Embodiment In Cognitive Robotics: An Update, Introduction, Talking Chinese, Meaning And Recent Theoretical Deba, Recent Practical Implementations of the Embodiment of Emotions, Motivations and Intentional States, Imagined Physics: Exploring Examples of Shape-Changing Interfaces, Introduction, Shape-Changing Interfaces, Imagined Physics, Movement and Incidental Effects of Actuators.

UNIT III - Cultural & Social Aspects of Cognitive Robotics
Effects of Cultural Context and Social Role On Human–Robot Interaction, Introduction, Effects of Cultural Context, Factors Influencing Human–Robot Interaction, Effects of Cultural Context on Decision Making, Effects of Robots' Social Role: Autonomy Level and Group Orientation, Social Robots, Autonomy Level Of Robots, Group Orientation, Effects of Robots' Social Role On Decision Making,
A Cognitive Model for Human Willingness to Collaborate With Robots, Introduction, A Cognitive Model For Determining Human Willingness to Engage With Collaborative Robots, Cultural Robotics.

UNIT IV - Social Cognition of Robots during Interacting with Humans
Introduction, Speech Acts and Dialogue Context, Model Speech Acts as Dialogue Context Change, Multiple Dialogue Contexts, Speech Act Model With Multiple Contexts, Context Awareness in Dialogue, Computational Model of Context Awareness Reasoning Using DBN, Experiment, A Speech Act Model with Multiple Contexts, Infer Social Context from Dialogue, Noise in Dialogue Context Awareness, Pragmatic Prediction with Dialogue Contexts, The Most Likely Pragmatic Speech Acts Sequence.

UNIT V - Psychological Aspects of Cognitive Robotics

On The Crossroads of Cognitive Psychology and Cognitive Robotics, Early History of the fields, Action Control, Acquisition of Action Control

Artificial Intelligence Aspects of Cognitive Robotics, Introduction, A Cognitive Robotics Approach, Perceiving the Environment, Interacting with the environment, Integration, Avoiding a Moving Obstacle, Reaching and Grasping Objects.

Text Books:

1. Angelo Cangelosi, Minoru Asada "Cognitive Robotics" MIT press 2022
2. Hooman Somani,"Cognitive Robotics", CRC Press, 2016

Suggested Reading:

1. Jared Kroff,"Cognitive Robotics: Intelligent Robotic Systems", Wilford Press, 2016
2. Patnaik, Srikanta, "Robot Cognition and Navigation - An Experiment with Mobile
3. Robots",SpringerVerlag Berlin and Heidelberg, 2007
4. Howie Choset, Kevin LynchSeth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge, 2005.
5. David Vernon,"Artificial Cognitive Systems: A Primer" The MIT Press, 1st Edition, 2014.

23ITE208 **CLOUD ROBOTICS**
(Program Elective - 3)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To understand the basics of cloud robotics and its potential benefits.
2. To identify challenges and requirements in developing cloud robotics.
3. To explore offloading robot processing to the cloud and its implications.
4. To examine technologies for enabling connectivity in cloud robotics.
5. To learn generic reference models for cloud robotics architectures.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Explain the basics and benefits of cloud robotics.
2. Evaluate Requirements for Cloud-Based Robotic Systems.
3. Analyze the impact of cloud-based processing for robots.
4. Understand and apply connectivity technologies for cloud robotics.
5. Use reference architecture for a generic cloud robotics application.

UNIT-I
Introduction to cloud robotics: Empowering robots using the cloud, challenges in developing cloud robotics: Enabling requirements, Implementation aspects and reproducibility.

UNIT-II
Offloading Robots processing to the cloud: Cloud-Enabled Cyber Physical Systems, Requirements, Current Limitations, and challenges, Mobility assistance service enabled by the cloud (case study), Impact of cloud based HRI.

UNIT-III
Connectivity for Mobile Robots: Enabling Technologies for Cloud Robotics: Wireless Indoor Connectivity, A General Architecture for Cloud Robotics in Clinical Healthcare.

UNIT-IV
Cloud-Robot Communication: common practices and software: The Robot operating system, the pound cloud communication framework, Experimentation platform: A virtualized testbed for cloud robotics

UNIT-V
A common methodology for cloud robotics experimentation: Towards an open cloud robotics methodology, robotic platform and cloud platform for experimentation, cloud based services for robotics tasks, human- robot interaction (case study) and autonomous navigation service (case study)

Text Book:
Implementing Cloud Robotics for Practical Applications From Human-Robot Interaction to Autonomous Navigation By Ricardo C. Mello, Moises R. N. Ribeiro, Anselmo Frizera-Neto · 2023

Suggested Reading:

1. Learning Robotics using Python, Lentin Joseph, Packt Publishing, 1st Edition, 2015.
2. Programming Robots with ROS: A Practical Introduction to the Robot Operating System, Morgan Quigley, Brian Gerkey and William Smart. O'Reilly Media, 1st Edition, 2015.
3. Mobile Robots: Mathematics, Models and Methods, Alonzo Kelly, Cambridge University Press, 1st Edition, 2013
4. Introduction to Autonomous Mobile Robots, Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, The MIT Press; 2nd Edition, 2011.
5. A Gentle Introduction to ROS, Jason M. O'Kane, CreateSpace Independent Publisher; 1st Edition, 2013.
6. Robot Operating System (ROS), Open Source Robotics Foundations, www.ros.org
7. A Survey of Research on Cloud Robotics and Automation. Ben Kehoe, Sachin Patil, Pieter Abbeel, Ken Goldberg. IEEE Transactions on Automation Science and Engineering (T-ASE): Special Issue on Cloud Robotics and Automation. Vol. 12, no. 2

Web Resources:

1. https://www.uipath.com/product/automation-cloud-robots
2. https://www.nokia.com/networks/5g/use-cases/cloud-robotics/
3. https://github.com/Airbotics/awesome-cloud-robotics
4. https://www.blueprism.com/guides/cloud-rpa/

Program Elective-4 Course
(With Lab)

23ITE209 **DEEP LEARNING**
(Program Elective - 4)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Python, Machine learning concepts

Course Objectives:
This course aim is to:
1. To understand the basics of perceptron,Neural Networks and their functional units.
2. To appraise the significance of hyper-parameter tuning in training an MLP.
3. To explore various optimizers and regularization techniques.
4. To familiarize with existing convolutional neural network architectures.
5. To investigate the concepts of RNNs, Transformers, Autoencoders for language modeling.

Course Outcomes:
Upon successful completion of the course the students will be able to:
1. Explain the basic concepts of neural networks and deep learning.
2. Design and Implement Artificial neural networks to various applications.
3. Improve the performance of the models using hyper-parameter tuning.
4. Apply convolutional neural networks to real world applications.
5. Build language or sequential models using RNNs, Transformers, and Auto encoders.

UNIT-I
Introduction to Artificial Neural Networks: From Biological to Artificial Neurons, Implementing MLP, Activation functions: Sigmoid, Linear, Tanh, ReLu, Leaky ReLu, Softmax, loss functions, Fine-Tuning Neural Network Hyper parameters.

UNIT-II
Training Deep Neural Networks: The Vanishing/Exploding Gradients Problems, Reusing Pre trained Layers, Optimizers: Gradient Descent (GD), Momentum based Gradient Descent, Nesterov Accelerated Gradient, AdaGrad, RMSProp, Adam and Avoiding Overfitting through Regularization. **Deep Learning Computation:** Parameter Management, Deferred Initialization, File I/O, GPUs.

UNIT-III
Convolutional Neural Networks: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Input and Multiple Output Channels, Pooling, Convolutional Neural Networks (LeNet). **Modern Convolutional Neural Networks**: Deep Convolutional Neural Networks (AlexNet), Networks Using Blocks (VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet).

UNIT-IV
Recurrent Neural Networks: Introduction, types of recurrent neural networks, vector representation of words, Implementation of Recurrent Neural Networks, Backpropagation Through time, problems in recurrent neural networks. **Modern Recurrent Neural Networks:** Gated Recurrent UNITs (GRU), Long Short-Term Memory (LSTM), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, Encoder-Decoder Architecture, Sequence to Sequence Learning.

UNIT-V

Introduction to Attention Mechanism, transformers and autoencoders, **Generative Adversarial Networks**: Purpose of GAN, Build blocks of GAN, Implementation of GAN, Challenges of GAN models, improved training approaches and tips for GAN, Introduction to conditional GAN.

Text Books:

1. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow”, O’Reilly Media, 2nd Edition, 2019.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, “Dive into Deep Learning”, d2l.ai, 2021
3. Ganguly Kuntal, “Learning generative adversarial networks: next-generation deep learning simplified”, Packt Publishing, 2017.

Suggested Reading:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Ian Goodfellow, Yoshua Bengio, Aaron , Courville, “Deep Learning”, MIT Press, 2016
3. Indra den Bakker, “Python Deep Learning Cookbook”, PACKT publisher, 2017
4. Wei Di, Anurag Bhardwaj, Jianing Wei, “Deep Learning Essentials”, Packt publishers, 2018
5. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
6. Huang, Shih-Chia, and Trung-Hieu Le. Principles and labs for deep learning. Academic Press, 2021.

Web Resources:

1. https://www.coursera.org/specializations/machine-learning
2. http://nptel.ac.in/courses
3. https://drive.google.com/file/d/1lxhe8p-asfBVP3114uXjJJq-ljxF6tO5/view (Vector Representation of words)

23ITE210 **INTERNET OF THINGS**
(Program Elective - 4)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aim is to:

1. To introduce the basic concepts of Internet of Things
2. To know various IoT enabling technologies and the design methodology for IoT.
3. To develop skills to use Raspberry Pi device and its interfaces.
4. To provide various IoT Application Domains
5. To impart IIoT concepts and its significance.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply and understand IoT Protocols, Communication models and APIs.
2. Interpret IoT enabling Technologies & levels and Design methodology.
3. Explore physical devices like Raspberry Pi3 and IoT & M2M, SDN&NFV differences.
4. Infer Domain Specific IoT Applications
5. Get acquainted with Industrial IoT with real time Scenarios.

UNIT-I

Introduction: Introduction to Internet of Things- Definitions & Characteristics of IoT,
Physical Design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs.

UNIT-II

IoT Enabling Technologies-Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication. Embedded Systems, **IoT Levels & Deployment Templates.**
IoT Platforms Design Methodology: Introduction, **Steps-**Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-III

IoT Physical Devices and End Points: Raspberry Pi About the board, Raspberry Pi interfaces-Serial, SPI, I2C, Sensors and Actuators. **Python Web Application Framework**: Django Framework-Roles of Model, Template and View. **IoT and M2M** – Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

UNIT-IV

Domain Specific IoTs: Various types of IoT Applications in Home Automation- smart lighting, Smart appliance, smoke and gas detectors, Cities, Environment, Energy, Retail, Logistics Agriculture, Industry, Health & Life Style-Wearable Electronics.

UNIT-V

Industrial IoT: Introduction to Industrial IoT, IIoT Architecture, IIoT Communication Protocols**,** Industry 4.0 Globalization and Emerging Issues, Security and Fog Computing. **Case studies:** Manufacturing Industry, Automotive Industry, Mining Industry.

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2014.
2. Misra, C. Roy, and A. Mukherjee, 2020 “Introduction to Industrial Internet of Things and Industry 4.0”. CRC Press.

Suggested Reading:

1. Samuel Greengard, “The Internet of Things”, 1st Edition, MIT Press, 2015.
2. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, “IoT: Building Arduino-Based Projects”, 1st Edition, Packt Publishing Ltd, 2016.
3. Jeeva Jose, “Internet of Things”, Khanna Book Publishing Company, 2018.

Web Resources:

1. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs05.
2. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

23ITE211 **UNMANNED AERIAL VEHICLES**
(Program Elective - 4)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
To explain the principle of locomotion and describe different types of mobile robots and the basics of Unmanned Arial Vehicles (Drones) and its various applications.
1. To Learn working principle of the drone and explains the components that are used to build the drone devices.
2. To provide hands on experience on design, fabrication and flying of UAV category aircraft.
3. To explain the rules and regulations to the specific country to fly drone.
4. To introduce safety measures to be taken during flight.

Course Outcomes (COs):
After the completion of the course, the student will be able to:
1. Explain the principle of locomotion (L2) distinguish between ground, aerial, water-surface and underwater robots (Identify the parts and functions of UAV and drones.).
2. Demonstrate the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts.
3. Determine the payload and its corresponding propeller's RPM to successfully fly the drone.
4. Design a drone with an automatic recovery mechanism.
5. Design a mission-controlled surveillance drone.

UNIT I
Fundamentals of Mobile Robot: Introduction to mobile robots - principle of locomotion - **types of mobile robots:** ground robot, aerial robot, underwater robot and water-surface robot - principles of underwater vehicle construction. **Introduction to Flight and UAVs:** Basics of Flights, Different types of flight vehicles , Components and functions of an airplane, Forces acting on Airplane, Physical properties and structure of the atmosphere; **UAV (Unmanned Aerial Vehicle):** Definition, History , Characteristics of UAV , Applications of UAV (Defence, Civil, Environmental monitoring) , Difference between Aircraft and UAV.

UNIT-II
Fundamental Components of a Drone: Types of Drones, Components of a Drone Frames: Lightweight and sold material, Working principles of Electromagnetic Motors , Types of Motors (Brushed DC motor, Brushless DC motor, Induction Motor) ,Microcontroller/microprocessor (Arducopter Flight Controller) , Working principles of Electromagnetic radiations, Radio Transmitter and Receiver , Li-ion Battery , Electric Speed Controller , Global Positioning System and Camera.

UNIT-III
Payload for UAV: Payloads, Classification of Payloads, Camera, Sensors, Radars , various measuring devices , classification of payload based on applications, Hyper spectral sensors, laser detection and range, synthetic aperture radar , thermal cameras, ultra-sonic detectors , case study on payloads.

UNIT-IV
Launch and Recovery: Launching systems, UAV Launch Methods for Fixed, Wing Vehicles, Vertical Take-off and Landing UAV Launch, Automatic Recovery systems. Regulatory and regulations: Civil Aviation Requirements, DGCA RPAS Guidance Manual, UAS Rules 2021**.**

UNIT-V
UAV Navigation and Guidance System: Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite – Way point Navigation. Dijkstra's Algorithm, A- star Algorithm, UAV Guidance, Types of guidance, UAV communication systems, and Ground control station, Telemetry, UAS future.

Text Books:

1. George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, “Autonomous Vehicles Technologies, Regulations, and Societal Impacts”, Elsevier Publications, 2021.
2. Sabiha Wadoo, Pushkin Kachroo, Autonomous Underwater Vehicles, 1st Edition, CRC Press, 2011. (Unit-I, II, IV and V)
3. Andey Lennon “Basics of R/C model Aircraft design” Model airplane news publication.
4. Theory, Design, and Applications of Unmanned Aerial Vehicles.

Suggested Reading:

1. Tom White. Hadoop - The Definitive Guide, 4th Edition, O’Reilly Publications, India, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman. Big Data for Dummies, John Wiley & Sons, Inc., 2013.
3. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010
4. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011.

Web Resources:

1. Wheeled Mobile Robots, IITM IIT Palakkad, and NPTEL. 2. Nikolaus Correll, Introduction to Autonomous Robots, 1st edition, April 23, 2016
2. Robotics and Control: Theory and Practice, IIT Roorkee, NPTEL

23ITE302 **HUMAN ROBOT INTERACTION**
(Program Elective - 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To learn about Human Robot Interaction
2. To learn about design morphology of HRI
3. To learn the spatial interaction of HRI
4. To know the verbal and nonverbal interaction with robots
5. To understand the emotions, research methods and applications

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Know the basic about HRI
2. Able to explain the design morphology
3. Apply the spatial Interaction of HRI
4. Examine the verbal and nonverbal interaction with robots
5. Know the emotions and basic applications of HRI

UNIT-I
Introduction: Definition: HRI as an interdisciplinary endeavour, The evolution of HRI
How a Robot works: The making of a Robot, Robot Hardware, Sensors, Actuators, Software, and Limitations of Robotics on HRI

UNIT-II
Design: Design in HRI: Robot Morphology, Design Patterns, Design principles in HRI Anthropomorphization in HRI Design: Theorizing, Designing and Measuring Design Methods, Prototyping Tools, From Machine to People and the in between

UNIT-III
Spatial Interaction: Use of Space in Human Interaction: Proxemics, Group spatial Interaction Dynamics Spatial Interaction for Robots: Localization and Navigation, Socially appropriate positioning, spatial dynamics, Informing Users

UNIT-IV
Nonverbal Interaction: Functions of Nonverbal cues in Interaction
Types of Nonverbal interaction: Gaze & Eye Movement, Gesture, Mimicry and Imitation, Touch, Posture & Movement, Interaction rhythm and timing Nonverbal Interaction in Robots: Robot perception of nonverbal cues, Generating nonverbal cues in robots
Verbal Interaction:
Human-Human Verbal Interaction, Speech Recognition, Dialogue Management, Speech Production

UNIT-V
Emotions: Understanding Human Emotions, Emotions for Robots
Research Methods: Defining a research question and approach, choosing among qualitative, quantitative and mixed methods, Defining the context of interaction, Choosing a robot for your study, Selecting appropriate HRI measures
Applications: Service Robots, Robots for learning, Robots for entertainment, Robots in Healthcare and Therapy, Service robots, Collaborative robots, Self-driving cars

Text Book:

Bartneck, C., Belpaeme, T., Eyssel, F., Kanda, T., Keijsers, M., & Šabanović, S. (2024). Human-robot interaction: An introduction. Cambridge University Press.

Suggested Reading:

Barattini, P., Vicentini, F., Virk, G. S., & Haidegger, T. (Eds.). (2019). Human-robot interaction: safety, standardization, and benchmarking. CRC Press.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_me92/preview
2. https://nptel.ac.in/courses/112104293
3. https://www.shiksha.com/online-courses/foundations-of-cognitive-robotics-course-nptel806

23ITE212 **NATURAL LANGUAGE PROCESSING**
(Program Elective - 4)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. Familiarize various Natural Language Processing (NLP) Fundamentals.
2. Understand various text representations and labeling techniques.
3. Understand various NLP models and named entities.
4. Learn RNN for NLP.
5. Understand usage of GRU and LSTM models for machine translation and other NLP applications

Course Outcomes:
Upon completing this course, students will be able to:
1. Understand the fundamentals of Natural Language Processing (NLP) to analyze and manipulate text data.
2. Apply NLP mechanisms for analyzing the significance of words.
3. Analyze the word embedding techniques and classification algorithms for text data.
4. Make use of the Deep learning algorithms and Transformer model for NLP.
5. Develop NLP applications using appropriate NLP tools and techniques.

UNIT – I
Introduction to NLP: Logical view of a document in Information Retrieval systems, Definition, History, NLP in the real world, Approaches to NLP, NLP Pipeline.
Language Processing and Python: Computing with Language: Texts and Words, Regular Expressions. A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics.
Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency.

UNIT- II
Basic Vectorization approaches of Text Representation: One-Hot Encoding, Bag of Words, Bag of N-Gram, TF-IDF; Distributed universal text and handcrafted feature Representations, Neural language models, N-gram language model.
Processing Raw Text: Accessing Text from the Web and from Disk, Text Processing with Unicode.
Categorizing and Tagging Words: Using a Tagger, Tagged Corpora, Mapping Words to Properties using Python Dictionaries, Automatic Tagging.

UNIT-III
Word Embeddings: Count Vector, Frequency based Embedding, Prediction based Embedding, Word2Vec and Glove.
Learning to Classify Text: Supervised Classification and Text classification with Machine learning algorithms.

UNIT-IV
Deep learning for NLP: RNN for language model, Sequence Labelling and Sequence Classification, Encoder-Decoder with RNNs, GRUs and LSTMs for machine translation, Convolutional neural networks for sentence classification and Evolution metrics for NLP.
Transformers for NLP: Attention, Transformers and BERT.

UNIT-V
Case Study on NLP: Sentiment analysis, Machine translation, Automated speech recognition systems, Question-answering based systems, Topic modelling, Text Generation and Summarization.

Text Books:

1. Steven Bird, Ewan Klein, and Edward Lope, Natural Language Processing with Python. O‟Reily, 2009.
2. Deep Learning for Natural Language Processing Develop Deep Learning Models for Natural Language in Python (Jason Brownlee), Machine Learning Mastery, 2017.
3. Lewis Tunstall, Leandro von Werra, Thomas Wolf - Natural Language Processing with Transformers_ Building Language Applications with Hugging Face-O'Reilly Media (2022).

Suggested Reading:

1. Ricardo, Baeza-yates, BerthierRibeiro-Neto, “Modern Information Retrieval”, Pearson Education, 2008.
2. Akshay Kulkarni, Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Apress, 2019.
3. Sudharsan Ravichandiran, Getting Started with Google BERT Build and train state-of-the-art natural language processing models using BERT.

Web Resources:

1. https://models.quantumstat.com/
2. https://www.coursera.org/learn/attention-models-in-nlp
3. https://github.com/keon/awesome-nlp

23ITE213 **ROBOTIC PROCESS AUTOMATION**
(Program Elective - 4)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To introduce fundamental concepts of Robotic Process Automation (RPA).
2. To impart practical applications of different RPA platforms.
3. To explore various types of variables, Control Flow, and data manipulation techniques.
4. To acquire knowledge of Image, Text, and Data Tables Automation.
5. To learn different techniques for handling exceptions in automation processes.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Explain the basic concepts of RPA technology.
2. Build real-world tasks by utilizing a range of RPA platforms effectively.
3. Utilize different types of variables, control flow, and data manipulation techniques within an RPA workflow.
4. Apply control techniques and Optical Character Recognition (OCR) to improve Automation.
5. Implement exception-handling mechanisms within an RPA workflow to manage potential errors.

UNIT-I
RPA Foundations- Flavors of RPA, history of RPA, The Benefits of RPA, The downsides of RPA, RPA Compared to BPO, BPM and BPA, Consumer Willingness for Automation, The Workforce of the Future. RPA Skills: On-Premise Vs. the Cloud, Web Technology, Programming Languages and Low Code- OCR, Databases, APl's, Al-Cognitive Automation, Agile, Scrum, Kanban and Waterfall Devops- Flowcharts, Fundamentals of RPA tools.
(Textbook 1: Ch. 1, Ch. 2, Textbook 3: Ch 3)

UNIT-II
RPA Platforms- Components of RPA, RPA Platforms, about UiPath, The future of automation, Record and Play, downloading and installing UiPath Studio, Learning Ui Path Studio, Task recorder, Step- by- step examples using the recorder, Hyper Automation vs RPA.
(Textbook 2: Ch. 1, Ch. 2, And Textbook3: Ch.4)

UNIT-III
Sequence, Flowchart, and Control Flow-sequencing the workflow, Activities, Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control Flow, Data Manipulation, Data table usage with examples, Clipboard Management-File operation with step-by-step example-CSV/Excel to data table and vice versa.
(Textbook 2: Ch. 3, Ch. 4)

UNIT-IV
Taking Control of the Controls- Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls, mouse and keyboard activities, Working with Ui Explorer: Handling events, Revisit recorder, Screen and web Scraping.
(Textbook 2: Ch. 5)

UNIT-V

Exception Handling, Debugging, and Logging- Exception handling, Common exceptions and ways to handle them, Logging and taking screenshots, Debugging techniques, Collecting crash dumps, Error reporting, Future of RPA, Process Mining, the realism of hyper automation..

(Text book 2: Ch. 8, Text book 1; Ch. 13, Textbook3: Ch1)

Text Books:

1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 2020, lSBN-13 (electronic):978-7-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, "Learning Robotic Process Automation", Publisher: Packet Publishing Release Date: March 2018 ISBN: 9787788470940
3. Hyper automation with Generative AI By Navdeep Singh Gill, Jagreet Kaur, Bpb Publications, 2023

Suggested Reading:

1. Gerardus Blokdyk,"Robotic Process Automation RPA a Complete Guide-2020 Edition",1st Edition,5STARCooks,2019.
2. Frank Casale, Rebecca Dilla, Iieidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
3. Richard Murdoch, "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant"
4. Srikanth Merianda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation"

Web Resources:

1. Learning Robotic Process Automation, https://www.packtpub.com/in/business/learning-robotic-process-automation
2. Automation Anywhere University, https://university.automationanywhere.com/
3. https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation- anywhere/11461411
4. www.uipath.com/rpa/robotic-process-automation
5. https://www.coursera.org/specializations/roboticprocessautomatio

23ITE214 **ROBOTICS PROGRAMMING USING PYTHON**
(Program Elective - 4)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To understand the python basic concepts.
2. To impart knowledge on fundamentals of ROS and Gazebo.
3. To acquire the skills to simulate the robotic arm.
4. To do programming vision sensors using Python and ROS.
5. To gain skills to create GUI for robot using Qt and Python.

Course Outcomes:
At the end of the course, the student will be able to
1. Familiarize with the fundamentals of Python basic concepts.
2. Understand the fundamentals of ROS and Gazebo.
3. Simulate the Gazebo and integrate with ROS.
4. Analyze the vision sensors through Python and ROS programming.
5. Create GUI for robot using Qt and Python

UNIT- I
Python Basics: Python Introduction and applications, strings, Lists, and Tuples, Mapping and Set Types, Dictionaries, Functions, concepts of files and basic file operations, writing and reading data to and from a .csv file.

UNIT-II
Introduction to Robotic Operating System (ROS): ROS Introduction, ROS Concepts- ROS File System, ROS Computation Graph, ROS Community, Introduction to Catkin, Creating ROS Package, Introduction to Gazebo.

UNIT-III
Simulating Robots using ROS and Gazebo: Simulating the robotic arm using ROS and Gazebo, Creating the robotic arm simulation model for Gazebo, adding the gazebo_ros_control, simulating the robotic arm with Xtion Pro, moving the robot joints using ROS controllers in Gazebo.

UNIT-IV
Programming Vision Sensors Using Python and ROS: List of robotic vision sensors and image processing libraries, Introduction to OpenCV, OpenNI, and PCL, Programming Kinect with Python using ROS, OpenCV, and OpenNI.

UNIT-V
GUI for Robot using Qt and Python: Introduction to Qt, Introduction to PyQt and PySide, Qt designer, Qt Signals and slots, converting a Qt UI file into Python file, Adding a slot definition to PyQt code.

Text Books

1. "Think Python: How to Think Like a Computer Scientist", Allen B. Downey, Second Edition, O'Reilly, 2016
2. "Learning Robotics using Python" - Lentin Joseph, Second Edition, 2018, Packt Publishing.
3. "Mastering ROS for Robotics Programming" - Lentin Joseph, Third Edition, 2021, Packt Publishing.

Suggested Reading:

1. Robotics: Control, Sensing, Vision, Intelligence" Fu K. S., Gonzelez R. C., Lee C. , McGraw Hill Book Co., 2008.
2. "Robotics and Control" R. K. Mittal, I. J. Nagrath,Tata-McGraw-Hill Publications,2017

Web Resources:
1. https://www.coursera.org/specializations/robotics.
2. Udemy course on "ROS for Beginners: Basics, Motion, and OpenCV"

23ITE215 **ADVANCED BIG DATA ANALYTICS**
(Program Elective - 4)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. Familiarize students with the MapReduce programming paradigm and its applications in distributed data processing.
2. Introduce Apache Spark as a unified analytics engine for large-scale data processing.
3. Explore SQL queries and DataFrame operations in Spark SQL.
4. Introduce Apache Kafka as a distributed streaming platform.
5. Demonstrate Flink state management, event time processing, and windowing operations.

Course Outcomes:
After completion of the course students are expected to be able to:
1. Analyze real-world scenarios where MapReduce, Pig, and Hive are suitable for Big Data processing tasks.
2. Implement Spark Streaming and Structured Streaming for real-time analytics.
3. Gain proficiency in using Spark SQL for structured data processing and querying.
4. Develop real-time stream processing applications using Kafka Streams.
5. Develop proficiency in using Flink DataStream API and DataSet API for data processing.

UNIT-I
Introduction to Big Data: Introduction, Big Data Enabling Technologies, Hadoop Stack for Big Data
The Hadoop Distributed Files system: Overview, The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems.
MapReduce: Overview, Developing a MapReduce Application, How MapReduce works, MapReduce Types and Formats, MapReduce Features, MapReduce Examples.
Legacy Framework: Pig vs Hive, Pig Latin Data Processing Operators, Generating examples, HiveQL

UNIT-II
Big Data with Spark: Introduction to Apache Spark, Spark Architecture, RDDs (Resilient Distributed Datasets),DataFrame API, Spark Streaming and Structured Streaming, Windowing and Stateful Operations in Streaming, Machine Learning Pipelines in Spark with examples, Real-World Applications and Use Cases.

UNIT-III
Spark SQL: Introduction to Spark SQL, Spark SQL Architecture and Components, DataFrames and Datasets in Spark SQL, SQL Queries and DataFrame Operations, Query Optimization and Performance Tuning in Spark SQL, Integration with External Data Sources, Advanced Analytics and Window Functions in Spark SQL, Real-time Streaming with Structured Streaming in Spark SQL, Machine Learning Integration with MLlib and SQL, Real-world Applications and Use Cases of Spark SQL

UNIT-IV
Apache Kafka Stream Processing: Introduction to Apache Kafka, Kafka Architecture, Kafka Topics and Partitions, Producers and Consumers in Kafka, Kafka Connect for Data Integration, Kafka Streams for Stream Processing, Fault Tolerance and Replication in Kafka, Kafka APIs and Client Libraries, Kafka Ecosystem (e.g., Kafka Connectors, Kafka MirrorMaker), Real-World Use Cases and Applications.

UNIT-V
Apache Flink stream processing: Introduction to Apache Flink, Flink Architecture and Concepts, Flink DataStream API, Flink DataSet API, Flink State Management, Event Time Processing in Flink, Windowing and Time-based Operations in Flink, Flink Connectors (e.g., Kafka, HDFS, JDBC), Flink Table API and SQL, Flink Batch Processing, Flink Streaming SQL and use cases and applications.

Text Books:
1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.

2. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018.
3. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017.
4. Fabian Hueske, Vasiliki Kalavri, "Stream Processing with Apache Flink: Fundamentals, Implementation, and Operation of Real-Time Data Streaming", O'Reilly Media, 2019.

Suggested Reading:

1. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018
2. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017.

23ITE216 **AUGMENTED AND VIRTUAL REALITY**
(Program Elective - 4)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objective:
This course aim is to:
1. To familiarize the students with the fundamentals of Virtual Reality.
2. To impart the knowledge of 3D orientation for understanding the behaviour of VR system with the environment.
3. To deal with the Development Tools and Frameworks in Virtual Reality.
4. To introduce the applications of Virtual Reality Systems.
5. To introduce technology and features of augmented reality

Course Outcomes:
After successful completion of the course, student will be able to:
1. Describe the basic concepts of Virtual Reality and 3D Computer Graphics.
2. Apply 3D manipulation techniques in Virtual Reality.
3. Analyze Development Tools and Frameworks in Virtual Reality.
4. Develop a Virtual Reality application.
5. Evaluate Augmented Reality Systems

UNIT-I
Introduction to VR and AR: Fundamentals of VR and AR, Technology and Features of Augmented Reality, Comparison of AR and VR, Challenges with AR, AR Systems and Functionality, Human factors, Human visual system, Perception of depth, color, contrast, resolution, Stereo Rendering, VR Hardware: Head-coupled displays etc. VR Software, Geometric Modeling: From 2D to 3D, 3D space curves, 3D boundary representation. The Graphics Pipeline and OpenGL, Overview and Transformations, Rotation, translation, scaling, model view matrix, projection matrix, Lighting and Shading, OpenGL Shading Language (GLSL), GLSL vertex and fragment shaders.

UNIT-II
Visual computation in virtual reality: 3D Interaction Techniques: 3D Manipulation Techniques and Input Devices, 3D Travel Tasks, Travel Techniques, Theoretical Foundations of Wayfinding, Types of Centred- Wayfinding Support, Evaluating Wayfinding Aids, System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Muti-modal System Control Techniques, Case Study: Mixing System Control Methods, Symbolic Input Tasks.

UNIT-III
Framing using 3D virtual reality: Development Tools and Frameworks in Virtual Reality: VR. X3D Standard; Vega, MultiGen, Virtools etc., World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Graphical User Interface, Control Panel, 2D Controls.

UNIT-IV
VR applications: Pose Tracking I, Tracking with light house, Pose Tracking II, Advanced positional tracking, Panoramic Imaging and Cinematic, VR Spatial Sound and the Vestibular System, VR Engines and Other Aspects of VR, Latency, eye tracking, post-rendering warp. The Future: Virtual environment, modes of interaction Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games, Demonstration of Digital, Entertainment by VR

UNIT- V
Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Text Books:

1. LaValle "Virtual Reality", Cambridge University Press, 2016.
2. John Vince, ―Virtual Reality Systems ―, Pearson Education Asia, 2007.

Suggested Reading:

1. Alan B Craig, William R Sherman and Jeffrey D Will, ―Developing Virtual Reality Applications: Foundations of Effective Design‖, Morgan Kaufmann, 2009.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013
3. Ange Anderson, Virtual Reality, Augmented Reality and Artificial Intelligence in Special Education, 2019

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106138/
2. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/
3. https://www.coursera.org/learn/ar?
4. https://www.coursera.org/specializations/virtual-reality

Program Elective-5 Courses (Without Lab)

23ITE301 **GENERATIVE AI**

(Program Elective - 5)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	

Course Objectives:

The objectives of this course are to:

1. Gain a comprehensive understanding of the fundamentals of Generative AI.
2. Familiarize with LangChain for building AI applications
3. Learn to use generative AI for Software Development and Data Science
4. Customize generative AI Models effectively
5. Explore applications of Generative AI

Course Outcomes:

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

1. Explain the fundamentals of Generative AI and LangChain.
2. Develop practical generative AI applications.
3. Apply generative AI techniques in Software Development and Data Science.
4. Customize and evaluate Generative AI Models.
5. Create innovative solutions using Generative AI.

Unit – I:

Generative AI: Introduction, Understanding LLMs, text to image models, AI in other domains; LangChain: LLM Limitations, LangChain, Key Components of LangChain, Working of LangChain, Comparison.

Unit – II:

Getting Started with LangChain: Set up the dependencies, Exploring API model Integrations, Local models, Building an application for customer service; Building capable applications: fact checking, summarising, Extracting information from documents, Answering questions with tools, Exploring reasoning strategies; Building a Chatbot like ChatGPT: Chatbot, Understanding retrieval and vectors, Loading and retrieving in LangChain, Implementing a chatbot

Unit – III:

Developing Software with Generative AI: Software development and AI, Writing code with LLMs, Automating software development; LLMs for Data Science: impact of generative models on data science, Automated data science, Using agents to answer data science questions, Data exploration with LLMs

Unit – IV:

Customizing LLMs and Their Output: Conditioning LLMs, Fine Tuning, Prompt Engineering; Generative AI in Production: get LLM Apps ready for production, Evaluate LLM apps, Deploy LLM apps, Observe LLM apps; Future of Generative Models: current state of generative AI, Economic consequences, Societal implications

Unit – V:

Composing Music with Generative Models: Music generation, using LSTMs, using GANs, MuseGAN; Play Video Games with Generative AI: Reinforcement learning: Actions, agents, spaces, policies, and rewards; Finding new drugs with generative models

Text Books:

1. Ben Auffarth - Generative AI with LangChain_ Build large language model (LLM) apps with Python, ChatGPT and other LLMs-Packt (2023)
2. Joseph Babcock, Raghav Bali - Generative AI with Python and TensorFlow 2_ Create images, text, and music with VAEs, GANs, LSTMs, Transformer models-Packt Publishing (2021)

Suggested Reading:

1. Ahmed J. Obaid, Bharat Bhushan, Muthmainnah S., S. Suman Rajest - Advanced Applications of Generative Ai and Natural Language Processing Models-IGI Global (2023)
2. Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni, Dilip Gudivada - Applied Generative AI for Beginners_ Practical Knowledge on Diffusion Models, ChatGPT, and Other LLMs-Apress (2023)
3. Daniel Jurafsky, James H Martin, "Speech and Language processing: An introduction to NLP, Computational Linguistics, and Speech Recognition" 3rd Edition

Web Resources:

1. https://learn.microsoft.com/en-us/training/modules/fundamentals-generative-ai/
2. https://learn.microsoft.com/en-us/training/modules/responsible-generative-ai/
3. https://learn.microsoft.com/en-us/training/modules/create-images-with-generative-ai/
4. https://learn.microsoft.com/en-us/training/modules/intro-generative-ai-explore-basics/
5. https://learn.microsoft.com/en-us/training/modules/create-prompts-for-generative-ai-training-tools/
6. https://learn.microsoft.com/en-us/training/modules/challenge-project-ideate-business-with-ai/
7. https://platform.openai.com/docs/guides/prompt-engineering/strategy-write-clear-instructions
8. https://www.cloudskillsboost.google/paths/118
9. https://jalammar.github.io/illustrated-transformer/

23ITE303 **METAVERSE IN ROBOTICS**
(Program Elective - 5)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To present and discuss Metaverse characteristics, concepts and layers.
2. To explain and analyze Metaverse technologies, tools, platforms, and applications.
3. To discuss design theories and practices relevant to the Metaverse.
4. To explore cybersecurity and cybercrime in the Metaverse.
5. To examine open challenges in the Metaverse.

Course Outcomes:
After completion of the course students are expected to be able to:
1. Understand the characteristics, and interdisciplinary nature of the Metaverse, the opportunities and risks it presents.
2. Analyze Metaverse layers, the technologies used in creating them, as well as design theories and practices for Metaverse.
3. Examine and discuss Metaverse platforms, applications and the latest technological developments in this area.
4. Identify cybersecurity issues, understand cybercrime, and discuss the open challenges.

UNIT-I
Introduction to Metaverse: Metaverse evolution, Metaverse importance and characteristics, the interdisciplinary nature of the Metaverse, Metaverse opportunities, and risks, Computer-mediated communication (social presence theory, social information processing theory, media richness theory, cyborg theory), Avatar-mediated communication
The seven layers of Metaverse: Experience, Discovery, Creator economy, Spatial computing, Decentralization, Human interface, Infrastructure

UNIT-II
Metaverse Technologies: AR/VR/MR/XR, 3D reconstruction, Game engines, Smart glasses, wearables, haptic devices, headsets and headwear, Blockchain, smart contracts, tokens, NFTs, Cryptography, Artificial Intelligence (AI), Internet of Things (IoT), Edge computing and 5G, 6G.

UNIT-III
Design Theories, Practices, and Tools: Social presence and co-presence, Motion sickness and cybersickness, Uncanny valley, Sense of self-location, sense of agency and sense of body ownership, Universal simulation principle, Prototyping, Evaluation techniques (qualitative and quantitative)
Tools and technologies for Metaverse UX and UI: Tools and services for avatar systems, spatial user interface design, and Cross-platform user experience design, Multimodal user interface, Technologies and devices for human-computer interaction in Metaverse.

UNIT-IV
Metaverse platforms: Decentraland, SANDBOX, Roblox, Axie Infinity, uHive, Hyper Nation, Nakamoto (NAKA), Metahero (HERO), Star Atlas (ATLAS), Bloktopia (BLOK), Stageverse, Spatial, PalkaCity, Viverse, Sorare, Illuvium, Upland, Second Life, Sansar, Sensorium Galaxy
Metaverse and cybersecurity: Cybersecurity concerns in Metaverse, Cybersecurity risks in Metaverse: process, people, technology, Best practices for preventing cyberattacks in Metaverse and Best practices for preventing cyberattacks in Metaverse.

UNIT-V
Metaverse and cybercrime: Scam and theft, Rug pull, Money manipulation and wash trading, Money laundering
Metaverse challenges and open issues: Persiste–ncy, Interoperability and scalability, Maturity, Regulation, Usefulness and ease-of-use, Privacy and data security, Content creation, NFTs and creator economy.
Metaverse applications: Gaming and entertainment, Travel and tourism, Education and learning, Remote working, Commerce and business, Real estate, Banking and Finance, Healthcare, Social media, and Fashion.

Text Book:

Winters, T., 2021, "The Metaverse", independently published, ISBN: 979-8450959283

Suggested Reading:

1. Ball, M., 2022, “The Metaverse and How It Will Revolutionize Everything“, Liveright, ISBN: 978-1324092032.
2. Christodoulou, K. Katelaris, L., Themistocleous, M, Christoudoulou P. and Iosif E, 2022, “NFTs and the Metaverse Revolution: Research Perspectives and Open Challenges", Blockchains and the Token Economy: Theory and Practice, Eds: Lacity M., Treiblmaier H., (2022), Palgrave Macmillan, Cham, pp. 139-178.
3. Damar, M. (2021). Metaverse shape of your life for future: A bibliometric snapshot. Journal of Metaverse, 1(1), 1–8.
4. Day, J. (2022) Metaverse will see cyberwarfare attacks unlike anything before: ’Massively elevated’, February 28, https://www.express.co.uk/news/science/1570844/metaverse-news-cyber- warfare-attacks-virtual-worlds-russia-china-spt.

23ITE304 **ROBOTIC SIMULATION AND LOCALIZATION MAPPING**
(Program Elective - 5)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aim is to:
1. To understand the basic concepts of Robotic simulations
2. To describe principles functions of Robots, Standard Robot part and its usage
3. To know about Simulation packages, Loading Simulation, and analysis of robot elements
4. To demonstrate the concept of Robotic motion, types of simulation motion
5. To characterize the mobile robotic localization and mapping.

Course Outcomes:
Upon completing this course, students will be able to:
1. Explain the basic Robotic systems, movement and Robot Applications.
2. Illustrate the Robotic principles, Robotic functions, selecting robot views
3. Analyze the Simulation Package and Robot motion control
4. Explore the Robotic motion concepts such as harmonic motion, parabolic motion etc.
5. Illuminate the concepts of Mobile Robot Localization.

UNIT I-INTRODUCTION
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
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-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 IV-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.

UNIT V- MOBILE ROBOT LOCALIZATION
Introduction, The Challenge of Localization: Noise and Aliasing, To Localize or Not to Localize: Localization-Based Navigation versus Programmed Solutions, Belief Representation, Map Representation, Probabilistic Map-Based Localization, Other Examples of Localization Systems, Autonomous Map Building

Text Books:

1. Daniel L. Ryan, Robotics Simulation, CRC Press Inc., 1994.
2. Roland Siegwart and Illah R. Nourbakhsh "Introduction to Autonomous Mobile Robots" MIT Press 2004

Suggested Reading:

1. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
2. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning. 2009.
3. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
4. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
5. Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning, 2009.
6. Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, the MIT Press, 2003.

7. John J. Craig, Introduction to Robotics Mechanics and Control, Third Edition, Pearson, 2008
8. Bijay K. Ghosh, Ning XI, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999.
9. Carl D. crane III and Joseph Duffy, Kinematic Analysis of Robot manipulation, Cambridge University press, 2008

AUDIT Course – 1 and 2

23EGA101 **ENGLISH FOR RESEARCH PAPER WRITING**
(M.E/M. Tech - Common to all Branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	
Credits	0

Prerequisite: Writing to express science and technological concepts with good taste for research and development.

Course Objectives:
This course aims to:
1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to write a research paper.
5. Understand how to implement the intricacies of writing and publishing a research paper.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Improve work performance and efficiency. Illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

UNIT - I
Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II
Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III
Process of writing a research paper, Writing to Draft a Format, Develop content, Adapting, Reviewing, Paraphrasing & Plagiarism Checks.

UNIT - IV
Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V
Research Paper Publication Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

Text Books:

1. Kothari, C. R. and Gaurav, Garg, Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

Suggested Reading:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Handbook for writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009

3. Bailey, Stephen. “Academic Writing: A Handbook for International Students”, Routledge, 2018

Web Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23CEA101 DISASTER MITIGATION AND MANAGEMENT

(Audit Course I and II - Common to all branches)

Instruction	2L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	Pass/Fail

Course Objectives:

This course aims to

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. To impart knowledge to students about the nature, causes, consequences and mitigation measures of the various natural disasters.
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters.
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions.

Course Outcomes:

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

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels.
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management.
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same.
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management.

UNIT-I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster-Natural and manmade; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT-II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT-III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related major power break downs, Fire accidents, traffic accidents, oil spills and stampedes disasters due to double cellular construction in multistoried buildings.

UNIT-IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economic, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-V:

Concept of Disaster Policies and legislation for disaster risk reduction.

Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local in situations, NGOs and other stakeholders; DRR programmers in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni," Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh," Handbook of Disaster Management: Techniques &Guidelines", Rajat Publication, 2008.
3. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II".
4. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.

Suggested Reading:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

23EEA101 **SANSKRIT FOR TECHNICAL KNOWLEDGE**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Course Objectives:
This course aim is to:
1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. To make the novice, Learn the Sanskrit to develop the logic in mathematics, science & other subjects
3. To explore the huge knowledge from ancient literature

Course Outcomes:
After completion of this course, students will be able to:
1. Develop passion towards Sanskrit language
2. Decipher the latent engineering principles from Sanskrit literature
3. Correlates the technological concepts with the ancient Sanskrit history.
4. Develop knowledge for the technological progress
5. Explore the avenue for research in engineering with aid of Sanskrit

UNIT-I
Introduction to Sanskrit language: Sanskrit Alphabets-vowels-consonants--parts of speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive voice-Past/Present/Future Tense-syntax-Simple Sentences (elementary treatment only)

UNIT-II
Role of Sanskrit in Basic sciences: sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythagoras theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series). The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of michealson and morley theory).

UNIT-III
Role of Sanskrit in Engineering-I
(**Civil, Mechanical, Electrical and Electronics Engineering**):
Building construction-soil testing--town planning-Machine definition-crucible-furnace- Generation of electricity in a cell-magnetism-Solar system-Sun: Pingala chandasutram (origination of digital logic system)

UNIT-IV
Role of Sanskrit in Engineering-II
(Computer Science Engineering & Information Technology):
Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

UNIT-V
Role of Sanskrit in Engineering-III
(Bio-technology and Chemical Engineering):
Classification of plants plants, the living-plants have senses-classification of living creatures- Chemical laboratory location and layout equipment-distillation vessel

Text Books:

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press, 1937.
2. Motilal Banarsidass Publishers, ISBN 13: 978-8120801783, 2015
3. Kpail Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Pride of India, Samskrita Bharti Publisher, ISBN: 81-87276 27-4, 2007
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers, ISBN: 81-7081 618-1, 2005

23ECA101 VALUE EDUCATION

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

Prerequisite: Knowledge about Universal Human values.

Course Objectives:
This course aims to
1. Understand Value Education, Self-development and National development.
2. Imbibe good human values and Morals in students.
3. Cultivate individual and National character.

Course Outcomes:
After completion of the Course, Students will be able to:
1. Summarize classification of values and values for self-development.
2. Identify the importance of values in personal and professional life.
3. Apply the importance of social values for better career and relationships.
4. Compile the values from holy books for personal and social responsibility.
5. Discuss concept of soul and reincarnation, values Dharma, Karma and Guna.

UNIT – I
Human Values, Ethics and Morals: Concept of Values, Human Values, Indian Concept of Humanism, Values for Self-Development, Social Values, Individual Attitudes, Work Ethics, Moral and Non – Moral Behavior, Standards and Principles based on Religion, Culture and Tradition.

UNIT –II
Value Cultivation and Self-Management: Need and Importance of Cultivation of Values such as Sense – of Duty, Devotion to Work, Self – Reliance, Confidence, Concentration, Integrity & Discipline and Truthfulness.

UNIT – III
Spiritual Outlook and Social Values: Personality and Behavior Development, Scientific Attitude and Spiritual (Soul) Outlook, Cultivation of Social Values such as Positive Thinking, Punctuality, Love & Kindness, Avoiding Fault finding in others, Reduction of Anger, Forgiveness, Dignity of Labor, True Friendship, Universal Brotherhood and Religious Tolerance., Happiness vs Suffering, Love for Truth, Aware of Self – Destructive Habits, Appreciation and Co-Operation.

UNIT – IV
Values in Holy Books: Self – Management, Good Health and Internal & External Cleanliness**,** Holy Books versus Blind Faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT – V
All Religions and Same Message: Mind your Mind, Self – Control**,** Concept of Soul, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory, The Qualities of Devine and Devilish, Satwic, Rajasic and Tamasic Gunas.

Text Books:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya Dayal Goyandaka, “Srimad Bhagavad Gita”, with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

Suggested readings:

1. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2nd
2. Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher’s manual

23EGA102 **INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS**
(M.E/M. Tech - Common to all Branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on basics of the Constitution and the Government.

Course Objectives:
This course aims to:
1. The history of Indian Constitution and its role in the Indian democracy.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Have knowledge of the various Organs of Governance and Local Administration.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the making of the Indian Constitution and its features.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies.
3. Have an insight into various Organs of Governance - composition and functions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.
5. Understand Electoral Process, special provisions.

UNIT-I
History of making of the Indian constitutions - History, Drafting Committee (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT-II
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-III
Organs of Governance - Parliament: Composition, Qualifications, Powers and Functions
Union executives : President, Governor, Council of Ministers, Judiciary, appointment and transfer of judges, qualifications, powers and functions.

UNIT-IV
Local Administration - District's Administration head: Role and importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: ZillaPanchayat, Elected Officials and their roles, CEO ZillaPanchayat: positions and role.
Block level: Organizational Hierarchy (Different departments) Village level: role of elected and appointed officials. Importance of grass root democracy.

UNIT-V
Election commission: 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:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Busi, S. N., Dr. B. R. Ambedkar, Framing of Indian Constitution'', 1st Edition, Ava Publishers, New Delhi, 2015.
3. Jain, M. P., "Indian Constitution Law", 7th Edition, Lexis Nexis, New Delhi, 2014.
4. Basu, D.D. "Introduction to the Constitution of India", Lexis Nexis, New Delhi. 2015.

Suggested Reading:

1. Bhargava, Rajeev. (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.
2. NCERT, Indian Constitution at Work, 1st Edition, Government of India, New Delhi 2006, reprinted in 2022.
3. Ravindra Sastry, V. (ed.), Indian Government & Politics, 2nd edition, Telugu Akademy, 2018.

Web Resources:

http://www.nptel.ac.in/courses/103107084/Script.pdf

23EGA103 **STRESS MANAGEMENT BY YOGA**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Knowledge on Yoga Practices.

Course Objectives:
This course aims to:
1. Create awareness about different types of stress and the role of yoga in the management of stress.
2. Promote positive health and overall well-being (Physical, mental, emotional, social and spiritual).
3. Prevent stress related health problems by yoga practice.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency

UNIT - I
Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali).

UNIT - II
Meaning and definition of Stress - Types of stress - Eustress and Distress.Anticipatory Anxiety and Intense Anxiety and depression.Meaning of Management- Stress Management.

UNIT - III
Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT - IV
Asanas- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT – V
Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.
Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

1. Janardhan, Swami, "Yogic Asanas for Group Training - Part-I": Yogabhyasi Mandal, Nagpur.
2. Vivikananda, Swami**.** "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and R. Nagaratna, “Yoga Perspective in Stress Management”, Swami Vivekananda Yoga Prakashan, Bangalore.

Web Resources:
1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. https://freevideolectures.com/course/3539/indian-philosophy/11

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS
(M.E/M. Tech - Common to all Branches)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	0

Prerequisite: Awareness on Personality Development.

Course Objectives:
This course aims to:
1. Learn to achieve the highest goal happily.
2. Become a person with stable mind, pleasing personality and determination.
3. Awake wisdom among themselves.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

UNIT - I
Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT - II
Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (dont's) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

UNIT - III
Introduction to Bhagavadgeetha for Personality Development – Shrimad Bhagawad Geeta: Chapter 2– Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

UNIT - IV
Statements of basic knowledge – Shrimad Bhagawad Geeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad Bhagawat Geeta.

UNIT - V
Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. Gopinath, P., "Bhartrihari's Three Satakam(Niti-sringar-vairagya)", Rashtriya Sanskrit Sansthanam, New Delhi, 2018.
2. Swarupananda, Swami, "Srimad Bhagavad Geeta", Advaita Ashram (Publication Dept), Kolkata, 2017.

Web Resources:
http://nptel.ac.in/downloads/109104115/

Open Elective Courses

23CSO101 **BUSINESS ANALYTICS**

Instruction	3L hrs per week
Duration of SEE	3 hrs
SEE	60
CIE	40
Credits	3

Course Objectives:

The objectives of this course are

1. Understanding the basic concepts of business analytics and applications.
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics.
3. Prepare the students to model business data using various data mining, decision making methods.

Course Outcomes:

On Successful completion of the course, students will be able to

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.
6. Create viable solutions to decision making problems.

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization.

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. Clustering: Distance and similarity measures used in clustering, clustering algorithms, K-Means and Hierarchical algorithms, Prescriptive Analytics- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

Textbooks:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015.

Suggested Readings:

S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015.

Web Resources::

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

23MEO102 INTRODUCTION TO OPTIMIZATION TECHNIQUES
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aims to
1. Come to know the formulation of LPP models
2. Understand the Transportation and Assignment techniques
3. Come to know the procedure of Project Management along with CPM and PERT techniques
4. Understand the concepts of queuing theory and inventory models
5. Understand sequencing techniques

Course Outcomes:
Upon completion of this course, students will be able to:
1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

UNIT - I
Operations Research: Definition, Scope, Models, Linear programming problems (LPP), Formulation, Graphical Method, and Simplex Method

UNIT - II
Transportation Models: Finding an initial feasible solution, North West corner method, Least cost method, Vogel's approximation method, Finding the optimal solution, Special cases in transportation problems, Unbalanced transportation problem, Degeneracy in transportation, Profit maximization in transportation.

UNIT- III
Project Management: Definition, Procedure and objectives of project management, Differences between PERT and CPM, Rules for drawing network diagram, Scheduling the activities, Fulkerson's rule, Earliest and latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, Duration of the project, Free float, Independent float and total float

UNIT - IV
Queuing Theory and Inventory:: Kendols notation, Single server models, Inventory control, Deterministic inventory models, Probabilistic inventory control models.

UNIT - V
Sequencing Models: Introduction, Objectives, General assumptions, Processing 'n' jobs through two machines, Processing 'n' jobs through three machines

Text Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,2008

Suggested Reading:

1. Hitler Libermann, Operations Research, McGraw Hill Pub, 2009
2. Harvey MWagner, Principles of Operations Research, Prentice Hall of India,2010

23CEO101 COST MANAGEMENT OF ENGINEERING PROJECTS

(OPEN ELECTIVE– Common to All Branches)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

This course aims

1. To enable the students to understand the concepts of Project management.
2. To provide knowledge on concepts of Project Planning and scheduling.
3. To create an awareness on Project Monitoring and Cost Analysis
4. 4.To provide adequate knowledge to the students on Recourse Management Costing-Variance Analysis.
5. To train the students with the concepts of Budgetary Control for cost management and to provide basic platform on Quantitative techniques for cost management.

Course Outcomes:

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

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. 2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work breakdown plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and leveling using network diagrams.
5. Learn the concepts of budgetary control and apply quantitative techniques for optimizing project cost.

UNIT-I:

Project Management: Introduction to project management, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, and responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependence, time and resource estimation. Work breakdown structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III:

Project Monitoring and Cost Analysis: Introduction-Cost concepts in decision making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a costing system; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff- Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT-IV:

Resources Management and Costing-Variance Analysis: Planning, Enterprise Resource Planning, Resource scheduling and leveling. Total quality Management and Theory of constraints. Activity-Based Cost Management, Benchmarking; Balanced Scorecard and Value-Chain Analysis.

Standard Costing and Variance Analysis: Pricing strategies: Pareto analysis. Target costing, Life cycle costing. Cost of service sector. Just-in-time approach, Material Requirement

UNIT-V:

Budgetary Control: Flexible Budgets; Performance budgets; zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management: Linear programming, PERT/CPM, Transportation Assignment problems, simulation, learning curve theory.

Text Books:

1. Charles T Horngren "Cost Accounting A Managerial Emphasis", Pearson Education; 14 edition (2012).
2. Charles T. Horngren and George Foster, "Advanced Management Accounting" Prentice-Hall; 6th Revised edition (1 February 1987).
3. Robert S Kaplan Anthony A. Atkinson, "Management & Cost Accounting" , Pearson; 2 edition (18 October 1996).

Suggested Reading:

1. K. K Chitkara, “Construction Project Management: Planning, scheduling and controlling”, Tata McGraw Hill Education. (2004).
2. Kumar Neeraj Jha “Construction Project Management Theory and Practice”, Pearson Education India; 2 edition (2015).

23MEO101 **INDUSTRIAL SAFETY**
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aims
1. Familiarize the cause for industrial accidents and preventive steps to be taken.
2. Elucidate fundamental concepts of Maintenance Engineering.
3. Explain about wear and corrosion along with preventive steps to be taken
4. Provide basic concepts and importance of fault tracing.
5. Provide steps involved in carrying out periodic and preventive maintenance of various equipment used in industry

Course Outcomes:
Upon completion of this course, students will be able to:
1. Identify the causes for industrial accidents and suggest preventive measures.
2. Identify the basic tools and requirements of different maintenance procedures.
3. Apply different techniques to reduce and prevent Wear and corrosion in Industry.
4. Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
5. Apply periodic and preventive maintenance techniques as required for industrial equipment like motors, pumps and air compressors and machine tools etc.

UNIT - I
Industrial Safety: Accident, Causes, Types, Results and control, Mechanical and electrical hazards, Types, Causes and preventive steps/procedure, Describe salient points of factories act 1948 for health and safety, Wash rooms, Drinking water layouts, Light, Cleanliness, Fire, Guarding, Pressure vessels, Safety color codes, Fire prevention and firefighting, Equipment and methods.

UNIT – II
Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primaryand secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III
Wear and Corrosion and their Prevention: Wear, Types, Causes, Effects, Wear reduction methods, Lubricants, Types and applications, Lubrication methods, General sketch, Working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, Corrosion prevention methods.

UNIT–IV
Fault Tracing: Fault tracing, Concept and importance, Decision tree concept, Need and applications, Sequence of fault finding activities, Show as decision tree, Draw decision tree for problems in machine tools, Hydraulic, Pneumatic, Automotive, Thermal and electrical equipments like any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V
Periodic and Preventive Maintenance: Periodic inspection, Concept and need, Degreasing, Cleaning and repairing schemes, Overhauling of mechanical components, Overhauling of electrical motor, Common troubles and remedies of electric motor, Repair complexities and its use, Definition, Need, Steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance, Repair cycle concept and importance

Text Books:

1. H. P. Garg, Maintenance Engineering, S. Chand and Company
2. Audels, Pump-hydraulic Compressors, McGraw Hill Publication

Suggested Readings:

1. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
2. Winterkorn, Hans, Foundation Engineering Handbook, Chapman & Hall London

23MEO103 **COMPOSITE MATERIALS**
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
This course aims to
1. Provide concepts of Composite materials and their constituents.
2. Explain the Classification of the reinforcements and evaluate the behavior of composites.
3. Provide Fabrication methods of metal matrix composites.
4. Explain manufacturing of Polymer matrix composites.
5. Elucidate Failure mechanisms in composite materials.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Classify and characterize the composite materials.
2. Describe types of reinforcements and their properties.
3. Understand different fabrication methods of metal matrix composites.
4. Understand different fabrication methods of polymer matrix composites.
5. Decide the failure of composite materials.

UNIT - I
Introduction: Definition, Classification and characteristics of composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II
Reinforcements: Preparation, Layup, Curing, Properties and applications of glass fibers, Carbon fibers, Kevlar fibers and boron fibers, Properties and applications of whiskers, Particle reinforcements, Mechanical behavior of composites, Rule of mixtures, Inverse rule of mixtures, Isostrain and Isostress conditions.

UNIT – III
Manufacturing of Metal Matrix Composites: Casting, Solid state diffusion technique, Cladding, Hot isostatic pressing, Properties and applications, Manufacturing of ceramic matrix composites, Liquid metal infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, And Weaving. Properties and applications.

UNIT–IV
Manufacturing of Polymer Matrix Composites: Preparation of moulding compounds and prepegs, Hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding, Properties and applications.

UNIT – V
Strength: Lamina failure criteria, Strength ratio, Maximum stress criteria, Maximum strain criteria, Interacting failure criteria, Hygrothermal failure, Laminate first play failure, Insight strength

Text Books:

1. K.K.Chawla, "Composite Materials- Science and Engineering", 4th edition, Springer Verlag, 2019.
2. 2 . WD Callister, Jr., Adapted by R. Balasubramaniam , "Materials Science and Engineering, An introduction".,

Suggested Readings:

1. Deborah D.L. Chung, "Composite Materials Science and Applications" 2nd edition, Springer Verlag, 2010.
2. Sanjay K. Mazumdar, "Composites Manufacturing- materials, product and process engineering", 1st edition, CRC press, 2002.
3. Daniel Gay, "Composite Materials Design and Applications" 3rd edition, CRC press, 2015.

23EEO101 **WASTE TO ENERGY**

Instruction	3 hrs. per week
Duration of End examination	3 hrs.
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims:

1. To know the various forms of waste
2. To understand the processes of Biomass Pyrolysis.
3. To learn the technique of Biomass Combustion.

Course Outcomes:

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

1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Choose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT-I

Introduction to Energy from Waste:

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digesters

UNIT-II

Biomass Pyrolysis:

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gasses, yields and applications.

UNIT-III

Biomass Gasification:

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers– Design, construction and operation –Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV

Biomass Combustion:

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors,

UNIT-V

Biogas:

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system -Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Biodiesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

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

Suggested Readings:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Laboratories

(Lab 1, 2&3 Based on Core Courses)

23ITC103 ROBOTICS LAB

Instruction	2L Hours per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aim is to:

1. Understanding the basics of robotics includes sensors, actuators and grippers.
2. Know the various battery devices and sensors of robotics.
3. Explore the linux commands to control the robot through OpenCV
4. Understand the OpenCV mechanism to handle the images.
5. Explore the various ways for image region extractions.

Course Outcomes:

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

1. Use the various devices to build a basic skeleton of the robot with movement, identifying, picking and placing the object.
2. Apply the electrical connection with the battery for the robot to identify the object.
3. Demonstrate the controlling of the robot's mechanism and also show the influence of robotic motion.
4. Develop the OpenCV programs to identify the images and apply the various sensors to visualize the images.
5. Demonstrate the OpenCV programs to identify the region extractions of the images.

List of Experiments

1. Introduction to various robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Explain the procedure to connect the electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controllers.
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Webots
6. Robot programming with Sensor inputs to Read sensor data using Python,
7. Robot programming with Sensor inputs to visualize sensor data using Python.
8. Open CV to Create an Image and display an image, Read and change pixel values.
9. Open CV to Create colored shapes and save image
10. Open CV to Extraction of Regions of Interest.

Text Book:

Saeed B. Niku, Introduction to Robotics Analysis, Application, John Wiley and Sons, 2011.

Suggested Reading:

1. R.K.Mittal and I J Nagrath, Robotics and Control, TMH, 2017.
2. Computational Intelligence, Davis Poole, Alan Mackwath, Randy Coehel, Oxford University Press1998.

23ITC104 ARTIFICIAL INTELLIGENCE PROGRAMMING LAB

Instruction	2L Hours per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To familiarize with search and game playing strategies.
2. To introduce logic programming concepts.
3. To learn probabilistic reasoning on uncertain data.
4. To learn knowledge representation and inference.
5. To learn building AI Systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Design and implement basic intelligent agents that perceive their environment.
2. Demonstrate the ability to optimize pathfinding in a grid environment.
3. Create and implement a simple knowledge-based agent using logical rules.
4. Demonstrate the ability to apply Bayesian methods to real-world problems and data analysis.
5. Design and implement a recommendation system tailored for an online store.

List of Experiments

1. Create a grid environment where an agent navigates to a goal, avoiding obstacles.
2. Implementation of BFS to find the shortest path in a maze or graph.
3. Implementation of A* search to find the shortest path in a grid.
4. Implementation of Minimax algorithm to play Tic-Tac-Toe.
5. Create a simple knowledge-based agent that makes decisions based on given rules.
6. Create an agent that uses logical statements to decide actions.
7. Create an agent that selects products based on user preferences and availability.
8. Implementation of Bayes' rule to calculate posterior probabilities.
9. Create a basic recommendation system for an online store.
10. Implementation of a simple rule-based system to manage parking slots.

Text books:

1. Russell, Norvig, Artificial Intelligence: A Modern Approach‖, Pearson Education, Third Edition, 2015.
2. Allen B. Downey,Think Python How to Think Like a Computer Scientist‖, Second Edition, O'Reilly, 2016.

Suggested Reading:

1. Saroj Kaushik, Artificial Intelligence‖, Cengage Learning India, 2011.
2. Rich, Knight, Nair: Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, Markov Decision Process with Applications to Finance‖, Springer, 2011.
4. Nilsson. N., Artificial Intelligence: A New Synthesis‖, First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., A Classical Approach to Artificial Intelligence‖, Khanna Publishing House, Delhi.

Web Resources:

1. AI Programming Languages:https: //www.coursera.org/articles/ai-programming-languages
2. Artificial Intelligence: A Modern Approach: http://aima.cs.berkeley.edu/

23ITC203 MACHINE LEARNING LAB

Instruction	3L Hours per week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To be acquainted with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes:

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

1. Build classification algorithms and artificial neural networks and evaluate the accuracy.
2. Examine the Bayesian classifier and its variants for predicting the probabilities.
3. Design solutions based on optimization using genetic algorithms.
4. Implement k-means, k-nearest and SVM algorithms.
5. Understand reinforcement learning and choose the best learning mechanism to the problem.

List of Programs:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples of .csv file.
2. For a given set of training data examples stored in a .csv file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation Algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .csv file. Compute the accuracy of the classifier, considering few test data sets.
6. Design genetic algorithm which reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation.
7. Demonstrate SVM algorithm used for character recognition task.
8. Apply EM algorithm to cluster a set of data stored in a .csv file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for the experiment and draw graphs.

Text Books:

1. Tom Mitchel ―Machine Learning‖, Tata McGraW Hill, 2017.
2. Giuseppe Bonaccorso, ―Machine Learning Algorithms‖, 2nd Edition, Packt, 2018,

Suggested Reading:

1. Ethem Alpaydin, ―Introduction to Machine Learning‖, PHI, 2004
2. StephenMarshland, ―Machine Learning: An Algorithmic Perspective‖,CRC PressTaylor & Francis, 2nd Edition, 2015
3. Abhishek Vijavargia ―Machine Learning using Python‖, BPB Publications, 1st Edition, 2018
4. ReemaThareja ―Python Programming‖, Oxford Press, 2017

5. Yuxi Liu, ―Python Machine Learning by Example‖, 2nd Edition, PACT, 2017 With effect from Academic Year 2020-2021

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

Laboratory - 4

(Based on Elective -4 courses)

23ITE217 **DEEP LEARNING LAB**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Pre-requisites: Python, Machine learning concepts

Course Objectives:
This course aims:
1. To explore the concepts of perceptron and multilayer perceptron's.
2. To extract knowledge on hyper-parameter tuning.
3. To understand the performance of various optimizers.
4. To appraise various convolutional neural network architectures.
5. To acquire knowledge on RNNs, LSTMs, BiLSTMs.

Course Outcomes:
Upon successful completion of the course the students will be able to:
1. Design and Implement Multilayer Neural Networks to solve various problems.
2. Improve the performance of the models using hyper-parameter tuning.
3. Analyze the performance of various optimizers.
4. Apply convolutional neural networks to real time problem solving.
5. Build various RNNs to perform language modeling and data analysis.

List of Programs

1. Implement a perceptron learning algorithm for solving following boolean functions.
    1. i) AND gate ii) OR Gate iii) XOR Gate problems.
2. Implement MLP algorithm for handwritten digit classification using MNIST dataset.
3. Implement MLP algorithm for graduate admission prediction using appropriate dataset.
4. Improve the performance of Deep Learning models with hyper-parameter tuning.
5. Compare the performance of various optimizers.
6. Remove overfitting of the model using regularization techniques.
7. Implement a convolutional neural network for image classification on the Fashion-MNIST dataset.
8. Implement a VGG16 model for image classification with or without transfer learning.
9. Build Recurrent Neural Networks to solve the sentiment analysis problem.
10. Design and implement Encoder-Decoder architecture for language translation.

Text Books:

1. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, 2nd Edition, 2019.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", d2l.ai, 2021
3. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017

Suggested Reading:

1. Ian Goodfellow, Yoshua Bengio, Aaron , Courville, "Deep Learning", MIT Press, 2016
2. Indra den Bakker, "Python Deep Learning Cookbook", PACKT publisher, 2017
3. Wei Di, Anurag Bhardwaj, Jianing Wei, "Deep Learning Essentials", Packt publishers, 2018
4. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
5. Huang, Shih-Chia, and Trung-Hieu Le. Principles and labs for deep learning. Academic Press, 2021.

Datasets:
1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

Web Resources:

1. https://www.coursera.org/specializations/machine-learning
2. http://nptel.ac.in/courses

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To familiarize students with Python Programming.
2. To Experiment with On-Boarding Raspberry Pi / Arduino.
3. To Programming with Raspberry Pi Pins / Arduino Pins using sensors.
4. To introduce the concept of cloud data in IoT environment.
5. To Understand IoT Applications in real time scenario.

Course Outcomes:

Upon completing this course, students will be able to:

1. Write python programs that run on Raspberry Pi/Arduino.
2. Apply Python concepts to Program with LEDS, Switches, Buzzer, and Relay.
3. Implement Applications using sensors for Raspberry Pi / Arduino.
4. Demonstrate Read and write cloud data using Thing speak.
5. Develop simple IoT systems of different Case studies.

List of Programs

1. Study and Configure Raspberry Pi.Write Program using Raspberry Pi to Interface LEDs, Switch and Buzzer and Relays.
2. Interface different Sensors using Raspberry Pi
    1. a)Temperature & Humidity b) PIR c) GAS d) LDR d) Rain e) Soil moisture.
3. Uploading and reading the Cloud data using Thing speak platform.
4. Mini Project Implementation on:
5. Home Automation (e.g., Smart Lighting),
6. Smart City Applications (e.g., Smart Parking , Traffic Lighting)
7. Smart Environment (e.g., Pollution Monitoring, Weather Monitoring)
8. Smart Agriculture (e.g., Smart Irrigation) etc.

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press,2014.
2. Misra, C. Roy, and A. Mukherjee, 2020 “Introduction to Industrial Internet of Things and Industry 4.0”. CRC Press.

Suggested Reading:

1. Samuel Greengard, “The Internet of Things”, 1st Edition, MIT Press, 2015.
2. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, “IoT: Building Arduino-Based Projects”, 1st Edition, Packt Publishing Ltd, 2016.
3. Jeeva Jose, “Internet of Things”, Khanna Book Publishing Company, 2018.

23ITE219 **UNMANNED VEHICLES LAB**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To understand the basic components of Unmanned Arial Vehicles (Drones) and its various applications.
2. To provide hands on experience on design, fabrication and flying of UAV category aircraft.
3. To integration of drones with other hardware and software applications.

Course Outcomes (COs):

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

1. Identify the parts and functions of UAV and drones.
2. Demonstrate the concepts of Aerodynamics, Propulsion & Structures of Model Aircrafts.
3. Determine the payload and its corresponding propeller's RPM to successfully fly the drone.
4. Design a drone with automatic recovery mechanism.
5. Design a mission-controlled surveillance drone.

List of Programs

1. Connect a single BLDC drone motor with LIPO battery using Electric Speed Controller (EDC) and XT60 connector.
2. Measure the speed of the BLDC drone motor using a laser tachometer
3. Write a Raspberry Pi program to control the BLDC motor connected to the microprocessor.
4. Connect four BLDC drone motors with one LIPO battery using four different Electric Speed Controllers (EDC).
5. Write a program to control all the 4 BLDC motors connected to the microprocessor.
6. Write a Raspberry Pi program to measure the battery level (remaining battery level) of the Li-ion battery connected to the BDLC motors and alert the user if the battery is less than 30%.
7. Using 433 MHz TX and Rx, design a BLDC motors based Remote Control car using Raspberry Pi Module.
8. Measure the temperature of the drone using DHT11 sensor in Raspberry Pi microcontroller.
9. Design and assemble a radio transmitter and receiver module using Raspberry Pi.
10. Connect the camera module with the microprocessor and perform face detection.
11. Assemble an arducopter flight controller with GPS Module.

Laboratory Equipment/Software/Tools Required:

1. Drone Frames (4-Axis Quadcopter with integrated PCB wires), BDLC Motors, Li-ion Battery, Battery Chargers, Propellers, Electric Speed Controller (EDC), EDC XT-60 Connectors (EDC M2F, EDC F2F, EDC F2F), Li-ion Battery Connectors, Arducopter Flight Controller, 2.4Ghz Transmitter and Receiver module, 433 MHz RF Transmitter Receiver wireless modules, GPS system, Sim800A Model, RC car frame, BDC motors, RC car tires, 9A Battery, Battery connectors.

2. Raspberry Pi 4+ 8GB Ram, Arduino Mega, Breadboard, connecting wires, Resistors, capacitors, Sensors (Ultrasonic Sensor, Inertia measurement unit, Inertial sensor, Proximity sensor, Gas Sensor, DHT11 Temperature sensor, Heat Sensor, IR sensor), PCB Boards, Soldering kit.

Text Books:

1. Andey Lennon “Basics of R/C model Aircraft design” Model airplane news publication.
2. Theory, Design, and Applications of Unmanned Aerial Vehicles.

Suggested Reading:

1. Tom White. Hadoop - The Definitive Guide, 4th Edition, O’Reilly Publications, India, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman. Big Data for Dummies, John Wiley & Sons, Inc., 2013.
3. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010
4. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011.

23ITE220 **AUGMENTED AND VIRTUAL REALITY LAB**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To introduce AR and VR Apps
2. To present Mobile VR in Unity
3. To familiarize AR Space - Pose Tracking and Environment Detections
4. To illustrate the UX in Augmented Reality
5. To introduce AR Content with Unity and Vuforia

Course Outcomes:

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

1. BuildAR and VR Apps with Unity
2. Develop Mobile VR in Unity
3. Demonstrate Augmented Reality SpacePose Tracking and Environment Detections
4. Design the UX in Augmented Reality
5. Create AR Content with Unity And Vuforia

List of Programs

1. Develop AR App using Unity
2. Develop VR App using Unity
3. Implement Handheld AR App with Unity
4. Implement Mobile VR in Unity
5. Build AR Foundation with Unity's AR Foundation Package
6. Demonstrate AR Space - Pose Tracking and Environment Detections
7. Develop UX in AR - Raycast, Light Estimation, Physics and Occlusion
8. Implement AR Content with Unity
9. Implement AR Content with Vuforia

Text Books:

1. Steve Aukstakalnis Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR 1st Edition
2. Dieter Schmalstieg and Tobias Hollerer, Augmented Reality: Principles and Practice, 1st Edition

Suggested Reading:

1. Tony Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, 1st Edition
2. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality

Web Resources:

1. https://www.coursera.org/specializations/unity-xr
2. https://www.coursera.org/learn/xr-introduction
3. https://www.coursera.org/learn/mobile-vr-app-development-unity
4. https://www.coursera.org/learn/handheld-ar

23ITE221 **NATURAL LANGUAGE PROCESSING LAB**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. To familiarize with the NLTK Tool Kit.
2. To learn pre-processing and tagging of text.
3. To understand the concepts of tf-idf, word to vec, Bag of words.
4. To familiarize with morphologies.
5. To understand Deep learning models.

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply NLTK modules for regular expressions and extract information from plain text.
2. Analyze pre-processing steps and apply Parts of Speech (PoS) tagging in NLP.
3. Implement word embeddings for capturing semantic relationships among words.
4. Build a RNN model to classify the text data.
5. Design a LSTM model to predict the next word.

LIST OF EXPERIMENTS

1. Given a text document perform the following tasks:
    a. Count the no. of words and distinct words.
    b. Using list addition, the set and sorted operations, compute the vocabulary of the sentences.
    c. Perform pattern recognition in a text using regular expressions.
2. From the Brown Corpus find out the conditional frequency distributions for the selected Genres and Words.
3. Generate word forms from root and suffix information using Morphological analysis and generation: Inverse processes.
4. Demonstrate the morphology of a word by the use of the Add-Delete table.
5. Implement Tokenization and Segmentation of the Text using Regular Expressions of NLTK.
6. Calculate bigrams from a given corpus and calculate probability of a sentence.
7. Calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.
8. Find POS tags of words in a sentence using Viterbi decoding.
9. Develop a POS tagger which is sensitive to the context and size of training corpus HMM and a trigram feature.
10. Implement BOW, TF-IDF vectorization models for text.
11. Implement a movie review classifier using RNN model on Kaggle dataset.
12. Demonstrate the capabilities of LSTM to predict the next word in an English sentence.

Text Books:

1. Steven Bird, Ewan Klein, and Edward Lope, Natural Language Processing with Python. O‟Reily, 2009.
2. Deep Learning for Natural Language Processing Develop Deep Learning Models for Natural Language in Python (Jason Brownlee), Machine Learning Mastery, 2017.
3. Lewis Tunstall, Leandro von Werra, Thomas Wolf - Natural Language Processing with Transformers_ Building Language Applications with Hugging Face-O'Reilly Media (2022).

Suggested Reading:

1. Ricardo, Baeza-yates, BerthierRibeiro-Neto, “Modern Information Retrieval”, Pearson Education, 2008.
2. Akshay Kulkarni, Adarsha Shivananda, Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Apress, 2019.
3. Sudharsan Ravichandiran, Getting Started with Google BERT Build and train state-of-the-art natural language processing models using BERT.

Web Resources:

1. https://models.quantumstat.com/
2. https://www.coursera.org/learn/attention-models-in-nlp
3. https://github.com/keon/awesome-nlp

23ITE222 ROBOTIC PROCESS AUTOMATION LAB

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

The course is introduced:

1. To understand and apply the foundational concepts of RPA in practical scenarios.
2. To effectively use RPA platforms for creating and managing automation tasks.
3. To develop skills in sequencing workflows and using various control flows and data manipulation techniques.
4. To develop expertise in interacting with and automating user interface elements.
5. To handle exceptions and debug RPA workflows effectively.

Course Outcomes:

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

1. Apply the basic concepts of RPA to real-world problems.
2. Utilize RPA platforms to build and manage automation tasks.
3. Create workflows using sequences, control flows, and data manipulation techniques.
4. Explain interactions with user interface elements.
5. Solve issues related to exceptions and debug RPA workflows.

List of Programs

1. Identify and utilize various components of an RPA platform to automate a simple task.
2. Implement basic operations on different data types.
3. Create a bot to perform Desktop and Gmail Login Steps using Web Recoding.
4. Create a bot to perform email automation, which can ready emails to extract pdf attachments.
5. Create an automation project that uses control flow, loops, and decision-making activities.
6. Create a bot to read pdf and Performing OCR and then entering the extracted data into an excel.
7. Implement clipboard management tasks to automate copying and pasting data between applications.
8. Automate file operations, such as reading from and writing to CSV/Excel files, and converting data tables.
9. Create an automation workflow that performs mouse and keyboard activities on different controls.
10. Create an RPA workflow that demonstrates common exceptions and their handling techniques.

Text Books:

1. Tom Taulli, “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, 2020, lSBN-13 (electronic):978-7-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, “Learning Robotic Process Automation”, Publisher: Packet Publishing Release Date: March 2018 ISBN: 9787788470940

Suggested Reading:

1. Frank Casale, Rebecca Dilla, Iieidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, “Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant”
3. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”

Web Resources:

1. Learning Robotic Process Automation, https://www.packtpub.com/in/business/learning-robotic- process-automation
2. Automation Anywhere University, https://university.automationanywhere.com/
3. https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation- anywhere/11461411
4. www.uipath.com/rpa/robotic-process-automation
5. https://www.coursera.org/specializations/roboticprocessautomation

23ITE223 ROBOTICS PROGRAMMING USING PYTHON LAB

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

The course is introduced to:

1. To understand and apply the foundational concepts of python.
2. To be able to acquire knowledge on ROS Concepts
3. To eEffectively use ROS and Gazebo for simulating the robots.
4. To illustrate the OpenCV package.
5. To design GUI for robot using PyQt and PySide.

Course Outcomes:

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

1. Develop List, sets, tuples, dictionaries, functions concepts.
2. Understand ROS Concepts to do Robot Programming.
3. Apply the basic concepts to set up a world, add a robot and program it using Gazebo simulator.
4. Use OpenCV package to read, capture and display images
5. Create GUI for Robot using PyQt and PySide.

List of Programs

1. Write programs to create List, tuples, sets and with different operations.
2. Write a program to create a Dictionary and with different operations.
3. Write a program to explore built-in functions and create examples on Lambda functions.
4. Creating ROS Package that contain two python nodes
5. Create ROS Catkin workspace
6. Testing the Gazebo with ROS Interface
7. Simulating TurtleBot using Gazebo and ROS
8. Python program for reading and displaying an image using python OpenCV interface.
9. Python program for capturing the image from Web Camera.
10. Displaying Kinect images using Python, ROS and cv_bridge.
11. Designing a GUI for a Robot using PyQt and PySide
12. Convert a Qt UI file into a Python file and complete the “Hello World” application using PyQt.

Text Books

1. “Think Python: How to Think Like a Computer Scientist”, Allen B. Downey, Second Edition, O’Reilly, 2016
2. “Learning Robotics using Python” - Lentin Joseph, Second Edition, 2018, Packt Publishing.
3. “Mastering ROS for Robotics Programming” - Lentin Joseph, Third Edition, 2021, Packt Publishing.

Suggested Reading:

1. Robotics: Control, Sensing, Vision, Intelligence” Fu K. S., Gonzelez R. C., Lee C. , McGraw Hill Book Co., 2008.
2. “Robotics and Control” R. K. Mittal, I. J. Nagrath,Tata-McGraw-Hill Publications,2017

Web Resources :

1. https://www.coursera.org/specializations/robotics
2. Udemy course on “ROS for Beginners: Basics, Motion, and OpenCV”

23ITE224 ADVANCED BIG DATA ANALYTICS LAB

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course aims:

1. Familiarize students with foundational Big Data technologies and frameworks.
2. Introduce advanced data processing paradigms like MapReduce, Spark, and stream processing.
3. Develop proficiency in using Apache Spark for large-scale data analytics and machine learning.
4. Explore real-time data processing capabilities using Apache Kafka and Apache Flink.
5. Provide practical experience in designing and implementing data pipelines for diverse Big Data applications.

Course Outcomes:

After completion of the course students are expected to be able to:

1. Understand the principles and components of Big Data technologies such as Hadoop, HDFS, MapReduce, Pig, and Hive.
2. Implement MapReduce applications for distributed data processing and analyze scenarios suitable for Pig and Hive.
3. Gain proficiency in Apache Spark, including RDDs, DataFrames, Spark SQL, and Spark Streaming for batch and real-time data processing.
4. Develop skills in Apache Kafka for building real-time data pipelines, including topics, partitions, producers, consumers, and Kafka Streams.
5. Utilize Apache Flink for stream processing and batch processing tasks, including state management, event time processing, and integrating with external data sources.

List of Experiments:

1. Setup Hadoop and HDFS, perform basic file operations.
2. Implement MapReduce for word count, debug jobs.
3. Write Pig scripts, execute HiveQL queries, compare performance.
4. Install Apache Spark, develop RDD-based applications.
5. Convert RDDs to DataFrames, perform Spark SQL operations.
6. Implement real-time analytics with Spark Streaming.
7. Develop structured streaming applications in Spark.
8. Build machine learning pipelines with Spark MLlib.
9. Set up Kafka, develop producers and consumers.
10. Implement stream processing with Kafka Streams.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018..
3. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017.
4. Fabian Hueske, Vasiliki Kalavri, "Stream Processing with Apache Flink: Fundamentals, Implementation, and Operation of Real-Time Data Streaming", O'Reilly Media, 2019.

Suggested Reading:

1. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018
2. Neha Narkhede, Gwen Shapira, Todd Palino, "Kafka: The Definitive Guide", 2nd Edition, O'Reilly Media, 2017.

Seminars and Projects

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Outcomes:

Upon completing this course, students will be able to:

1. Formulate a specific problem and give a solution.
2. Develop model/models either theoretical/practical/numerical form.
3. Solve, interpret/correlate the results and discussions.
4. Conclude the results obtained.
5. Write the documentation in standard format.

Guidelines:

- As part of the curriculum in the II- semester of the program each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of the work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department committee: Supervisor and two faculty coordinators

Guidelines for awarding marks (CIE):		**Max. Marks: 50**
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

23ITC301 **DISSERTATION PHASE- I**

Instruction	20 Hrs Per Week
CIE	100 Marks
Credits	10

Course Outcomes:

At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/international refereed
3. Journals and contact resource persons for the selected topic of research.
4. Students will learn to write technical reports.
5. Students will develop oral and written communication skills to present.
6. Students will defend their work in front of a technically qualified audience.

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of a report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for the award of Marks: Max. Marks: 50		
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: The Department committee has to assess the progress of the student every two weeks.

23ITC401 **DISSERTATION PHASE- II**

Instruction	32 Hours per week
Duration of SEE	Viva
SEE	100 Marks
CIE	100 Marks
Credits	16

Course Outcomes:

At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

- It is a continuation of Project work started in semester III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS ChairPerson) guide/co-guide.
- The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE:		**Max. Marks: 100**
CIE (Continuous Internal Evaluation)		**Max. Marks: 50**
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report in standard format
	20	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications

	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Max. Marks: 100

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s)	20	PowerPoint Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project ● Innovations ● Applications ● Live Research Projects ● Scope for future study ● Application to society
	20	Viva-Voce