DEPARTMENT OF INFORMATION TECHNOLOGY

SCHEME OF INSTRUCTION FOR
M.TECH (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)
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 AI & DS will be able to
1. Undertake careers in industry involving innovation and problem solving using Artificial Intelligence and Data Science technologies
2. Possess research orientation and adopt lifelong learning.

Program Specific Outcomes (PSOs)
After successful completion of the program, students will be able to:
1. Develop solutions to real world problems in the emerging areas of Manufacturing, Agriculture, Health-care, Education and Cyber Security.
2. Systematically investigate and provide Artificial Intelligence and Data Science based solutions in multidisciplinary domains.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE Model Curriculum (with effect from 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER– I

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 Core-1	3	-	3	40	60	3
2		Program Core-2	3	-	3	40	60	3
3		Program Elective-1	3	-	3	40	60	3
4		Program Elective-2	3	-	3	40	60	3
5	20MEC103	Research Methodology and IPR	2	-	2	30	45	2
6		Audit Course-1	2	-	-	-	50	Non-Credit
PRACTICALS								
7		Laboratory-1 (Based on Core-1)	-	2	-	50	-	1
8		Laboratory-2 (Based on Core-2)	-	2	-	50	-	1
9		Laboratory-3 (Based on Elective-2)	-	4	-	50	-	2
TOTAL			**16**	**08**	**-**	**340**	**335**	**18**

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 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

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		Program Core-3	3	-	3	40	60	3
2		Program Core-4	3	-	3	40	60	3
3		Program Elective-3	3	-	3	40	60	3
4		Program Elective-4	3	-	3	40	60	3
5		Audit Course-2	2	-	-	-	50	Non-Credit
PRACTICALS								
6		Laboratory-4 (Based on Core-3)	-	2	-	50	-	1
7		Laboratory-5 (Based on Core-4)	-	2	-	50	-	1
8		Laboratory-6 (Based on Elective-4)	-	4	-	50	-	2
9	20ITC107	Mini Project with Seminar	-	4	-	50	-	2
TOTAL			**14**	**12**	**-**	**360**	**290**	**18**

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 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

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
PRACTICALS								
3	20ITC108	Dissertation/Phase-I	-	20	-	100	-	10
TOTAL			6	20	-	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	20ITC109	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.	20MTC101	Mathematical Foundations of Data Science	3
2.	20ITC101	Artificial Intelligence	3
3.	20ITC102	Introduction to Data Science	3
4.	20ITC103	Machine Learning	3
Mandatory Courses			
5.	20MEC103	Research Methodology and IPR	2
Program Elective-1, Elective-3 and Elective-5 Courses (without Lab)			
6.	20ITE101	Soft Computing	3
7.	20ITE102	Cloud Computing	3
8.	20ITE103	Information Retrieval Systems	3
9.	20ITE104	Time Series Analysis & Forecasting	3
10.	20ITE105	Social Network Analytics	3
11.	20ITE106	Block Chain Technology	3
12.	20ITE107	Intelligent Bio Informatics	3
13.	20ITE108	Recommender Systems	3
14.	20ITE109	Reinforcement Learning	3
15.	20ITE110	GPU Computing	3
16.	20ITE111	Scalable Algorithms and Systems for Data Analysis	3
Program Elective-2 and Elective-4 Courses (with Lab)			
17.	20ITE112	Digital Image Processing and Analysis	3
18.	20ITE113	Cyber Security	3
19.	20ITE114	Big Data Analytics	3
20.	20ITE115	Augmented and Virtual Reality	3
21.	20ITE116	Predictive Analytics with R	3
22.	20ITE117	Natural Language Processing	3
23.	20ITE118	Robotic Process Automation	3
24.	20ITE119	Deep Learning	3
25.	20ITE120	Internet of Things	3
26.	20ITE121	Advanced Algorithms	3
Audit Course – 1 and 2			
27.	20EGA101	English for Research Paper Writing	0
28.	20CEA101	Disaster Mitigation and Management	0
29.	20EEA101	Sanskrit for Technical Knowledge	0
30.	20ECA101	Value Education	0
31.	20EGA102	Indian Constitution and Fundamental Rights	0
32.	20ITA101	Pedagogy Studies	0
33.	20EGA103	Stress Management by Yoga	0
34.	20EGA104	Personality Development Through Life's Enlightenment Skills	0
Open Elective Courses			
35.	20CSO101	Business Analytics	3
36.	20MEO102	Introduction to Optimization Techniques	3
37.	20CEO101	Cost Management of Engineering Projects	3
38.	20MEO101	Industrial Safety	3
39.	20MEO103	Composite Materials	3
40.	20EEO101	Waste to Energy	3
Labs, Seminars & Projects			
Laboratory-1 and Laboratory-3 (Based on Core Courses)			
41.	20MTC102	Mathematical Foundations of Data Science Lab	1
42.	20ITC104	Artificial Intelligence Lab	1
43.	20ITC105	Introduction to Data Science Lab	1
44.	20ITC106	Machine Learning Lab	1

Laboratory-2 and Laboratory-4 (Based on Elective-2 and Elective-4 Courses)*			
45.	20ITE122	Digital Image Processing and Analysis Lab	2
46.	20ITE123	Cyber Security Lab	2
47.	20ITE124	Big Data Analytics Lab	2
48.	20ITE125	Augmented and Virtual Reality Lab	2
49.	20ITE126	Predictive Analytics in R Lab	2
50.	20ITE127	Natural Language Processing Lab	2
51.	20ITE128	Robotic Process Automation Lab	2
52.	20ITE129	Deep Learning Lab	2
53.	20ITE130	Internet of Things Lab	2
54.	20ITE131	Advanced Algorithms Lab	2
Seminar and Projects			
55.	20ITC107	Mini Project with Seminar	2
56.	20ITC108	Dissertation Phase-I	10
57.	20ITC109	Dissertation Phase-II	16

*** Lab courses for Laboratory-2 and Laboratory-4 must be in one-to-one correspondence with the Elective courses opted in Program Elective-2 and Program Elective-4, respectively.**

20MTC101 MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

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

Course Objectives:

1. To discuss vector space and sub space.
2. To explain the linear transformation.
3. To discuss about the stochastic process
4. To explain different estimates
5. To discuss the least squares approximation for fitting**.**

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify the Basis and Dimension of vector space.
2. Calculate the Rank and Nullity of linear transformation.
3. Determine the stochastic measures for the process.
4. Infer the estimation of the statistical observations.
5. Analysing appropriate model for the raw data.

UNIT I

General Vector Spaces: Introduction to General Vector Spaces, Subspace of a Vector Space, Linear Independence and Basis, Dimension, Properties of a Matrix, solutions to a non-homogeneous system of linear equations

UNIT II

Linear Transformations: Introduction to Linear Transformations, Kernel and Range of a Linear Transformation, Rank and Nullity, Inverse Linear Transformations, The Matrix of a Linear Transformation, Composition and Inverse Linear Transformations.

UNIT III:

Expectation: Introduction, Moments, Expectation Based on Multiple Random Variables, Transform Methods, Moments and Transforms of Some Distributions (Weibul and Exponential), Computation of Mean Time to Failure. **Stochastic Process:** Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process andthe normal process.

Unit – IV

Concepts of Inference: Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Hypothesis Testing, Likelihood Ratio Tests; **Inferences for Single Samples:** Inferences on Mean (Large Samples), Inferences on Mean (Small Samples), Inferences on Variance.

Unit – V

The least squares Approximation: The least squares method, The model for simple linear regression, Fitting a line, goodness of fit, Statistical inference with the simple linear regression model, perdition and confidence intervals, Regression diagnostics. Multiple linear regression, The model for multiple linear regression, Goodness of fit, multiple correlation coefficient, Statistical inference for multiple regression, ANOVA tables.

Text Books.

1. Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley & Sons, 2016:
2. Randall Pruim, Foundations and Applications of Statistics (An Introduction Using R), American Mathematical Society, 2010.
3. Kuldeep Singh, Linear Algebra Step by Step, Oxford University Press,2014.

Reference Books:

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.

20ITC101 **ARTIFICIAL INTELLIGENCE**

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

Course Objectives:

1. To learn basics of AI and concept of Intelligent Agent.
2. To learn the various Searching techniques
3. To learn first order and second order predicate Logic to infer knowledge
4. To learn classical and real world planning approaches
5. To learn uncertainty and probabilistic reasoning models

Course Outcomes:

Upon completing this course, students will be able to:

6. Understand the basics of AI and concept of Intelligent Agent.
7. Compare the Searching techniques
8. Understand and apply the first order and second order predicate Logic to infer the knowledge
9. Analyze classical and real world planning approaches
10. Understand the uncertainty and apply the probabilistic reasoning models

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 Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; **Solving Problems by Searching:** Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions

Unit - II

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, **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; **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

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

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; **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.

Unit - V

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited; **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient

Representation of Conditional Distributions, Exact Inference in Bayesian Networks, **Probabilistic Reasoning over Time:** Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4th Edition.

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. https://onlinecourses.nptel.ac.in/noc19_cs19/
2. https://www.coursera.org/learn/ai-for-everyone

20ITC102 **INTRODUCTION TO DATA SCIENCE**

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

Course Objectives:

1. To introduce the fundamentals of Data Science.
2. To familiarise with Numpy, Pandas and handle large data.
3. To facilitate learning of data pre-processing.
4. To introduce plotting and visualisation.
5. To present grouping and aggregate operations

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the process of Data Science.
2. Understand machine learning and handle large unstructured data.
3. Make use of the packages Numpy, Pandas and interact with Web API and databases.
4. Choose suitable pre-processing techniques to process raw data.
5. Interpret the data from visualisations.
6. Apply appropriate group and aggregation operations.

UNIT-I

Data science in a big data world: Benefits and uses of data science and big data, Facets of data, The data science process, **The data science process:** Overview of the data science process, Don't be a slave to the process, Defining research goals and creating a project charter, Retrieving data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, Presenting findings and building applications on top of them

UNIT-II

Machine learning: machine learning, The modeling process, Types of machine learning, Semi-supervised learning, **Handling large data on a single computer:** The problems you face when handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Introduction to NoSQL

UNIT-III

Graph databases: Introducing connected data and graph databases, **Text mining and text analytics:** Text mining in the real world, Text mining techniques. **NumPy Basics:** The NumPy ndarray, Universal Functions: Fast Element-Wise ArrayFunctions, **Getting Started with Pandas:** Introduction to pandas data structures, Essential functionality

UNIT-IV

Data Loading, Storage, and File Formats: Reading and writing data in text format, Binary data formats, Interacting with Web APIs, Interacting with Databases, **Data Cleaning and Preparation:** Handling missing data, Data transformation, **Data Wrangling: Join, Combine, and Reshape**: Hierarchical Indexing, Combining and Merging Datasets, Reshaping: Reshaping with hierarchical indexing

UNIT-V

Plotting and Visualization: Matplotlib primer, Plotting with pandas and seaborn, **Data Aggregation and Group Operations**: GroupBy Mechanics, Data Aggregation, Apply: General split-apply-combine, Pivot Tables and Cross-Tabulation.

Text Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science: Big Data, Machine Learning, and more, using Python Tools", Manning Publications, 2016

2. William McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy and IPython”, Second Edition, O’Reilly Media, 2017.

Suggested Reading:

1. Joel Grus, “Data Science from Scratch-First Principles with Python”, O’Reilly Media, 2015
2. John V. Guttag, “Introduction to Computation and Programming Using Python– with Application to Understanding Data”, Second Edition, The MIT Press, 2016.
3. Alberto Boschetti, Luca Massaron, “Python Data Science Essentials: A Practitioner's Guide Covering Essential Data Science Principles, Tools, and Techniques”, Third Edition, 2018.
4. Allen B. Downey, “Think Python How to Think Like a Computer Scientist”, Second Edition, O'Reilly, 2016.

Web Resources:

1. https://www.kaggle.com
2. https://www.dataschool.io/
3. https://www.analyticsvidhya.com/blog/2018/05/24-ultimate-data-science-projects-to-boost-your-knowledge-and-skills/
4. https://www.linkedin.com/in/randylaosat

20ITC103 **MACHINE LEARNING**

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

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint 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. Understand the concepts of Machine learning and Concept learning
2. Build classification algorithms and artificial neural networks and evaluate the accuracy.
3. Examine the Bayesian classifier and its variants for predicting the probabilities.
4. Design solutions based on optimization using genetic algorithms.
5. Develop search control knowledge by inductive and analytical learning
6. Understand reinforcement learning and choose the best learning mechanism to the problem.

UNIT-I

Introduction: Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning, types of Machine Learning.

Concept learning and the general to specific ordering: Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Decision Tree learning: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT-II

Artificial Neural Networks: Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks.

Evaluating Hypotheses: Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT-III

Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm.

Instance-Based Learning: Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT-IV

Genetic Algorithms: Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

Analytical Learning: Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge.

UNIT- V

Combining Inductive and Analytical Learning: Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators

Reinforcement Learning: Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

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

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.guru99.com/machine-learning-tutorial.htm
4. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20MTC102 MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE LAB

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate R programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in R statistical packages.
6. Manage data using files.

Course Outcomes:

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

1. Identify and setup program development environment.
2. Implement the algorithms using R programming language constructs.
3. Identify and rectify the syntax errors and debug program for semantic errors.
4. Solve problems in a statistical approach using functions.
5. Implement file operations.

List of Programs

1. Execution of Eigen values and Eigen vectors
2. Solution of non homogenous system of linear equations
3. Inverse matrix of linear transformation
4. Verification of MTTF for the continuous Distributions.
5. Likely Hood Ratio Test by Hypothesis Testing.
6. F-Test by Hypothesis Testing.
7. Compute the significance level (P value).
8. Linear Predicted Model.
9. Multiple Regression Model.
10. ANOVA for Multiple Regression)

Reference Books:

1. R For Statistics by Cornillon Pierre Andre Et Al , T and F India,January 2015
2. An Introduction to Statistical Learning: with Applications in R,Springer; 2017.R Statistics Cookbook, Francisco Jureting, Packt publishing ltd,2019.

20ITC104 **ARTIFICIAL INTELLIGENCE LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To familiarize with search and game playing strategies.
2. To introduce logic programming concepts through Prolog.
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. Solve AI problems through Python Programming
2. Demonstrate an intelligent agent
3. Evaluate Search algorithms
4. Build knowledge representation system and infer knowledge from it.
5. Apply probabilistic reasoning on data.

List of Programs

1. Implementation of uninformed search techniques.
2. Implementation of informed search techniques.
3. Implementation of game search.
4. Implementation of a program to represent knowledge
5. Implementation of a program to construct a Bayesian network from given data.
6. Implementation of a program to infer from the Bayesian network.
7. Installation of Prolog and demonstration of basic operations.
8. Mini Project work

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. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu/

20ITC105 **INTRODUCTION TO DATA SCIENCE LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce data structures in Python.
2. To familiarise with data types and file formats.
3. To gain knowledge on data pre processing and data visualization.
4. To acquaint with supervised and unsupervised learning algorithms.
5. To explore various case studies.

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify appropriate data structures for storing and processing the data.
2. Choose suitable data type to handle real time data and explain file formats.
3. Apply pre processing techniques on raw data
4. Interpret the data from visualisations.
5. Build supervised and unsupervised models to solve real world problems.

List of Programs

1. Implementation of Python programs using Functions, Conditionals, Recursion, Iteration, Strings.
2. Demonstrate the usage of Python data structures. (List, Tuples, Sets, Dictionaries, Strings)
3. Explore various kinds of data like time series, text, etc.
4. Implement file handling operations in Python for various file formats.
5. Implementation of pre processing techniques on any two datasets.
6. Visualise data using packages matplotlib, seaborn, etc., and provide your inference.
7. Build Classifiers and perform prediction.
8. Demonstrate various Clustering Techniques.
9. Predict the price of a house (Boston Housing Dataset).

Text Books:

1. Allen B. Downey, “Think Python How to Think Like a Computer Scientist”, Second Edition, O'Reilly, 2016.
2. William McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython”, Second Edition, O’Reilly Media, 2017.
3. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.

Suggested Reading:

1. Joel Grus, “Data Science from Scratch-First Principles with Python”, O’Reilly Media, 2015.
2. Rachel Schutt, Cathy O’Neil, “Doing Data Science, Straight Talk from the Frontline”, O’Reilly, 2014.

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resources:

1. https://www.analyticsvidhya.com/blog/2018/05/24-ultimate-data-science-projects-to-boost-your-knowledge-and-skills/
2. https://www.learndatasci.com/tutorials/data-science-statistics-using-python/
3. https://www.kaggle.com/getting-started
4. https://www.datacamp.com/community/tutorials

19MEC103 **RESEARCH METHODOLOGY AND IPR**

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	45 Marks
CIE	30 Marks
Credits	2

Course Objectives:

To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes:

At the end of the course, student 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, 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, Ftest, 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"; New Age 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., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

20ITC106 **MACHINE LEARNING LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint 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

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://towardsdatascience.com/introduction-to-genetic-algorithms-including-example-code-e396e98d8bf3
3. https://www.geeksforgeeks.org/machine-learning/
4. https://www.guru99.com/machine-learning-tutorial.htm
5. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20ITE101 **SOFT COMPUTING**

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

Course Objectives:

1. Learn about soft computing techniques, their applications and Be familiar with the design of neural networks and related algorithms.
2. Understand Fuzzy Logic, Various fuzzy systems and their functions.
3. Learn mathematical background for optimized genetic programming
4. Understand advanced soft computing techniques.
5. Introduce real time applications of soft computing techniques.

Course Outcomes:

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

1. Understand soft computing techniques and their role in building intelligent machines.
2. Demonstrate fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
3. Apply genetic algorithms to provide optimized solutions.
4. Explain rough set theory and swarm intelligence techniques to solve problems.
5. Build real time applications using soft computing techniques

UNIT-I

Introduction to soft computing: Concept of computing systems, classification of soft computing techniques, "Soft" computing versus "Hard" computing Characteristics of Soft computing, Applications of Soft computing techniques, Structure & functioning of biological brain & Neuron, and concept of learning/training. Model of an Artificial Neuron, transfer/activation functions, perceptron learning model, binary & continuous inputs, linear separability. **Multilayer Neural Networks:** Feed Forward network - significance, training, loss function, Back-Propagation algorithm, convergence & generalization, momentum, applications. Feedback network -Hopfield Nets: architecture, energy functions, training algorithms & examples, competitive learning, self-organizing maps.

UNIT-II

Fuzzy Logic: Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic -extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making..

UNIT-III

Genetic algorithm: concepts, creation of offspring, working principle, encoding, fitness functions, reproduction, genetic modeling. Generation cycle & convergence of GA, application areas of GA. **Hybrid Soft Computing Techniques and Applications**: Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

UNIT- IV

Advanced soft computing techniques: Rough Set Theory - Introduction, Set approximation, Rough membership, Attributes, optimization. SVM - Introduction, obtaining the optimal hyper plane, linear and nonlinear SVM classifiers. **Introduction to Swarm Intelligence**: What is swarm intelligence? Various animal behavior which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization.

UNIT V

Applications of Soft Computing: Image registration – Object recognition – Automated feature extraction – navigation – Integration of soft computing and GIS for flood forecasting and monitoring, Landslide susceptibility, Highway alignment, smart city planning, agriculture, solid waste disposal

Text Books:

1. S. N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
2. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication

Suggested Reading:

1. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications Prentice Hall, 1997.
2. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning Pearson Education India, 2013.

Web Resource:

1. https://nptel.ac.in/courses/106/105/106105173/
2. https://www.javatpoint.com/artificial-neural-network
3. https://www.javatpoint.com/fuzzy-logic

20ITE102 **CLOUD COMPUTING**

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

Course Objectives:

1. To familiarize basic concepts of cloud computing and enabling technologies.
2. To introduce Auto-Scaling, capacity planning and load balancing in cloud.
3. To impart knowledge on issues related to security, privacy and compliance.
4. To introduce cloud management standards and programming models.
5. To deal with the concepts of Service oriented architecture and cloud database technology.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand different types of cloud computing concepts and the techniques.
2. Determine the issues related to scaling, capacity planning and load balancing.
3. Assess the cloud infrastructure, information security and compliance issues.
4. Analyse the Portability and Interoperability issues of cloud virtualization.
5. Evaluate the importance of SOA and cloud database technology.

UNIT-I

Introduction-Limitations of the Traditional Computing Approaches, Three Layers of Computing, Three Layers in Traditional Computing, The End of Traditional Computing, Influences behind Cloud Service Adoption. Benefits and challenges: Origin of the Term 'Cloud Computing', Early Initiatives, Utility Computing, Metering and Billing in Cloud, Separation of Data Center Operation, Benefits of Cloud Computing, Challenges of Cloud Computing, How Cloud Computing Addresses Business Challenges, Ethical Issues in Cloud Computing, Cloud Computing: Network as Computer, Role of Web Service, Role of API, Ubiquitous Cloud, Confusion Between Cloud and Internet. Cloud computing services, Resource Virtualization, Resource pooling, sharing and provisioning.

UNIT-II

Scaling in cloud- Introduction to Scaling, Scaling in Traditional Computing, Scaling in Cloud Computing, Foundation of Cloud Scaling, Scalable Application , Scaling Strategies in Cloud, Auto-Scaling in Cloud, Types of Scaling , Performance and Scalability , the Resource Contention Problem , Cloud Bursting: A Scenario of Flexible Scaling, Scalability is a Business Concern

Capacity Planning- Capacity Planning, Capacity Planning in Computing, Capacity Planning in Cloud Computing, Approaches for Maintaining Sufficient Capacity, Steps for Capacity Planning

Load Balancing- Load Balancing , Importance of Load Balancing in Cloud Computing, Load Balancing in Cloud, Goals of Load Balancing, Categories of Load Balancing, Load Balancing Algorithms, Case study on Google cloud and Amazon Elastic Compute Cloud (EC2), File System and Storage.

UNIT-III

Content Delivery Network: CDN Service Operations, Evolution of CDN, Advantages of CDN, Disadvantages of CDN, CDN Service Provider, Security Reference Model

Security Issues- Cloud security, threats to Cloud Security, Infrastructure Security, Information Security, Identity Management and Access Control, Cloud Security Design Principles, Cloud Security Management Frameworks, Security-as-a-Service, Privacy and Compliance Issues.

UNIT-IV

Portability and Interoperability Issues- Challenges in the Cloud, The Issues in Traditional Computing, Addressing Portability and Interoperability in Cloud, Portability and Interoperability Scenarios, Machine Imaging or Virtual Machine Image, Virtual Appliance, Difference between Virtual Machine Image and Virtual

Appliance, Open Virtualization Format (OVF), Cloud Management and a Programming Model Case Study, Popular Cloud Services.

UNIT-V

Service-Oriented Architecture: The Pre-SOA Era, Role of SOA in Cloud Computing, Service-Oriented Architecture, Goal of System Designing, Service Represents Business Functionality, Open Standard Implementation, Benefits of SOA, SOA and Cloud Computing.

Database Technology: Database in Cloud, Data Models, Database-as-a-Service, Relational DBMS in Cloud, Non-relational DBMS in Cloud.

Text Book:

1. Sandeep Bhowmik, “Cloud Computing”, Cambridge University Press, 2017.

Suggested Reading:

1. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, “Distributed and Cloud Computing from Parallel Processing to the Internet of Things”, Elsevier, 2012.
2. Barrie Sosinsky” Cloud Computing Bible”, Wiley-India, 2010
3. Ronald L. Krutz, Russell Dean Vines “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley- India,2010
4. John W. Rittenhouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2009.

Web Resources:

1. https://nptel.ac.in/courses/106105167/1

20ITE103 **INFORMATION RETRIEVAL SYSTEMS**

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

Course Objectives:

1. To familiarize with different Information Retrieval models.
2. To learn query languages for data retrieval.
3. To introduce various methods for efficient retrieval of information.
4. To impart knowledge on text operations.
5. To introduce Parallel and Distributed IR models.

Course Outcomes:

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

1. Understand different Information Retrieval models.
2. Evaluate the performance of queries for retrieval of data.
3. Analyze the methods for efficient information retrieval.
4. Perform text operations and build indices.
5. Analyze searching techniques and understand Parallel and Distributed IR models.

UNIT-I

Introduction: Basic concepts, Past, Present and Future of IR, The Retrieval Process.
Modeling: Introduction, A Taxonomy of IR Models, Retrieval: Adhoc and Filtering, A formal characterization of IR Models, Classic Information Retrieval, Alternative Set Theoretic Models, Alternative Algebraic Models, Alternative Probabilistic Models.

UNIT-II

Structured Text Retrieval Models, **Models for Browsing Retrieval Evaluation:** Introduction, Retrieval Performance Evaluation, Reference Collections **Query languages:** Introduction, Keyword-based querying, pattern Matching, Structural Queries, Query Protocols

UNIT-III

Query operations: Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic Global Analysis
Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup Languages, Multimedia

UNIT-IV

Text Operations: Introduction, Document Preprocessing, Document Clustering, Text Compression, Comparing Text Compression Techniques **Indexing:** Introduction, Inverted Files, Other Indices for Text, Boolean Queries

UNIT- V

Searching: Sequential Searching, Pattern Matching, Structural Queries, Compression
Parallel and Distributed IR: Introduction, Parallel IR, Distributed IR.

Text Book:

1. Ricardo, Baeza-yates, BerthierRibeiro-Neto, “Modern Information Retrieval”, Pearson Education, 2008.

Suggested Reading:

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, “Introduction to Information Retrieval”, Cambridge University Press, 2009.
2. David A. Grossman, OphirFrieder, "Information Retrieval - Algorithms and Heuristics", Springer, 2nd Edition, 2004.
3. Gerald Kowalski, “Information Retrieval Systems: Theory and Implementation”, Springer.

4. William B. Frakes, Ricardo Baeza- Yates, “Information Retrieval – Data Structures & Algorithms”, Pearson Education, 2008.

Web Resources:

1. https://class.coursera.org/nlp/lecture
2. http://www.dcs.gla.ac.uk/Keith/Preface.html

20ITE104 TIME SERIES ANALYSIS AND FORECASTING

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

Course Objectives:

1. To introduce time series analysis,trend analytics and forecasting based on past data.
2. To give an overview of the basic concepts and techniques that would be applicable for commonly-found analytics use cases in the industry.
3. To familiarize students with the tools and techniques required to process, model, and visualize time series data.
4. To enable students to confidently think through a problem and come up with its solution in time series forecasting.
5. To develop an expertise in generating data-driven business insights.

Course Outcomes:

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

1. Distinguish between time series and non-time series data and choose the right approach to solve a given problem
2. Select the appropriate techniques for a time series problem based on the internal structures of the given data.
3. Pre-process and visualize time series data through re sampling, group-by, and calculation of moving averages
4. Extract estimated trend and noise based on the parameters related to time series signal composition such as the presence of trend, seasonality, and residual noise.
5. Describe Autoregressive models which include moving average (MA), autoregressive (AR), Auto Regressive Moving Average (ARMA), and Auto Regressive Integrated Moving Average (ARIMA) for predicting future trends.
6. Develop forecasting models for time series data using different RNNs such as Vanilla RNN, Gated Recurrent Units, and Long Short-Term Memory units

UNIT-I

Introduction to Time Series: Different types of data- Cross-sectional data, Time series data, Panel data, Internal structures of time series- General trend, Seasonality, Run sequence plot, Seasonal sub series plot, Multiple box plots, Cyclical changes, Unexpected variations, Models for time series analysis- Zero mean models, Random walk, Trend models, Seasonality models, Autocorrelation and Partial autocorrelation

UNIT-II

Understanding Time Series Data: Advanced processing and visualization of time series data, Resampling time series data- Group wise aggregation, Moving statistics, Stationary processes- Differencing, First-order differencing, Second-order differencing, Seasonal differencing, Augmented Dickey-Fuller test, Time series decomposition-Moving averages, Moving averages and their smoothing effect, Seasonal adjustment using Moving Average, Weighted Moving Average, Time series decomposition using Moving Averages, Time series decomposition using statsmodels.tsa

UNIT-III

Exponential Smoothing based Methods: Introduction to time series smoothing, First order exponential smoothing, Second order exponential smoothing, Modeling higher-order exponential smoothing

UNIT-IV

Auto-Regressive Models: Auto-regressive models, Moving average models, Building datasets with ARMA, ARIMA, Confidence interval

UNIT- V

Deep Learning for Time Series Forecasting: Multi-layer perceptrons-Training MLPs, MLPs for time series forecasting, Recurrent neural networks- Bi-directional recurrent neural networks, Deep recurrent neural networks, Training recurrent neural networks, Solving the long-range dependency problem, Long Short Term Memory, Gated Recurrent Units, Choosing between LSTM and GRU, Recurrent neural networks for time series forecasting, Convolutional neural networks- 2D convolutions, 1D convolution, 1D convolution for time series forecasting

Text Books:

1. Dr. Avishek Pal, Dr. PKS Prakash, "Practical Time Series Analysis:Master Time Series Data Processing, Visualization, and Modeling Using Python", PacktPublishing, First Edition, 2017.

Suggested Reading:

1. Douglas C. Montgomery, Cheryl L. Jen,"Introduction To Time Series Analysis And Forecasting", 2nd Edition, Wiley Series, 2015
2. Soren Bisgaard Murat Kulahci , "Time Series Analysis And Forecasting By Example", Technical University Of Denmark by John Wiley & Sons, Inc., 2011.

Web Resources:

1. NPTEL course in Applied Time Series Analysis, https://nptel.ac.in/courses/103/106/103106123/
2. https://b-ok.cc/book/3413340/2eb247
3. https://b-ok.cc/book/1183901/9be7ed
4. https://b-ok.cc/book/2542456/2fa94
5. https://b-ok.cc/book/2802612/149485

20ITE105 SOCIAL NETWORK ANALYSIS

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

Course Objectives:

1. Describe about the current web development and emergence of social web
2. Design modeling, aggregating and knowledge representation of semantic web
3. Describe Association rule mining algorithms
4. Summarize knowledge on extraction and analyzing of social web
5. To know the application in real time systems.

Course Outcomes:

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

1. Understand the basics of social network analysis.
2. Analyze Ontology representation of social network data.
3. Apply supervised and unsupervised algorithms on social networks.
4. Interpret the semantic content of social media data.
5. Build social network model for real time applications.

UNIT-I

INTRODUCTION: Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT-II

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION:

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modeling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

UNIT-III

ALGORITHMS AND TECHNIQUES: Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighboring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks.

UNIT-IV

EXTRACTING AND ANALYZING WEB SOCIAL NETWORKS: Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and their Evolutions in Dynamic Networks.

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UNIT- V

APPLICATIONS:A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Text Books:

1. Peter Mika, ”Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
2. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012.
3. Przemyslaw Kazienko, Nitesh Chawla,”Applications of Social Media and Social Network Analysis”, Springer,2015.

Suggested Reading:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1 st edition, 2011
3. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014
4. Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010.

Web Resource:

1. https://swayam.gov.in/nd1_noc19_cs66/preview

20ITE106 **BLOCK CHAIN TECHNOLOGY**

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

Course Objectives:

1. To provide Conceptual understanding of how block chain technology can be used to improve business processes.
2. To facilitate understanding of bit coin and working with consensus in Bitcoin.
3. To impart knowledge about designing and building Permissioned block chains.
4. To introduce the concepts of Cryptocurrency, Ethereum virtual machine, Crytpocurrency regulations.
5. To familiarize with platforms such as Hyperledger Fabric involved in building block chain applications.

Course Outcomes:

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

1. Outline the concepts of block chain technology.
2. Understand the bit coin, working with consensus in Bitcoin.
3. Develop knowledge about designing and building Permissioned block chains.
4. Describe the concepts of Cryptocurrency, Ethereum virtual machine, Crytpocurrency regulations.
5. Design smart contract using Hyperledger Fabric frameworks.

UNIT-I

Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography.

UNIT-II

Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. **Working with Consensus in Bitcoin:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) —basic introduction, HashcashPoW, BitcoinPoW

UNIT-III

Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Overview of Consensus models for Permissioned block chain Distributed consensus in closed environment. Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Block chain enabled Trade, We Trade — Trade Finance Network, Supply Chain Financing, Identity on Block chain

UNIT-IV

Crypto currency: History, Distributed Ledger, Mining strategy and rewards, Ethereum- Construction,- Ethereum Virtual Machine(EVM)-Wallets for Ethereum, Decentralized Autonomous Organization, Smart Contract, Vulnerability Attacks. Crypto currency Regulation: Stake holders, Roots of Bitcoin, Legal Aspects- Crypto currency Exchange, Black Market and Global Economy.

UNIT- V

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda. Applications: Internet of Things, Payments in Automotive Suppliers, Tracing the Food/Meat, Monitoring Cold Chain, Health Industry, Medical Record Management System, Supply chain management, and future of Block chain.

Text Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten,Andrew Miller and Steven Gold feder, Bitcoin and Crypto currency Technologies: A Comprehensive Introduction, Princeton University Press(July19,2016).
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", 1st Edition O'Reilly, 2015.

Suggested Reading:

1. Iran Bashir “Mastering Blockchain” 2nd Edition Paperback 2018.
2. Daniel Drescher, “Block Chain Basics”, 1st Edition, Apress, 2017.
3. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing.

Web Resource:

1. www.blockchain.com
2. https://www.blockchain.com/btc/blocks?page=1
3. https://andersbrownworth.com/blockchain/hash

20ITE107 **INTELLIGENT BIOINFORMATICS**

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

Course Objectives:

1. To familiarize students with the fundamental concepts of Bioinformatics
2. To introduce the basics of Artificial Intelligence techniques
3. To acquire knowledge on different Classification and clustering techniques in implementation of Bioinformatics
4. To impart how to apply Neural networks and Genetic Algorithms in different applications related to Bioinformatics
5. To familiarize students with the concepts of future techniques in Genetic applications

Course Outcomes:

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

1. Recognize the purpose of molecular biology and challenges in the Bioinformatics
2. Analyse the importance of Artificial Intelligence and its techniques related to bioinformatics.
3. Enumerate different techniques of classification and clustering with respect to bioinformatics applications
4. Comprehend the methods related to neural network and genetic algorithms.
5. Elaborate the concepts of Genetic Programming, Cellular Automata and Hybrid methods

UNIT-I

Introduction: Introduction to the Basics of Molecular Biology: Basic cell architecture, The structure, content and scale of deoxyribonucleic acid (DNA), History of the human genome, Genes and proteins, Current knowledge and the 'central dogma', Why proteins are important, Gene and cell regulation, When cell regulation goes wrong, what is bioinformatics?

Introduction to Problems and Challenges in Bioinformatics: Introduction, Genome, Transcriptome, Proteome, Interference technology, viruses, and the immune system.

UNIT-II

Introduction to Artificial Intelligence and Computer Science: Introduction to search, Search algorithms, Heuristic search methods, Optimal search strategies, Problems with search techniques, Complexity of search, Use of graphs in bioinformatics, Grammars, languages and automata, Classes of problems.

UNIT-III

Current Techniques: Probabilistic Approaches: Introduction to probability, Bayes' Theorem, Bayesian networks, Markov networks.

Nearest Neighbour and Clustering Approaches: Introduction, Nearest neighbour method, Nearest neighbour approach for secondary structure protein folding prediction, Clustering, Advanced clustering techniques, Application guidelines.

Decision Trees: Method, Gain criterion, Over fitting and pruning, Application guidelines, Bioinformatics applications.

UNIT-IV

Neural Networks and Genetic Algorithms: Method, Application guidelines, Bioinformatics applications, Background.

Genetic Algorithms: Single-objective genetic algorithms – method and example, Multi-objective genetic algorithms – method, Application guidelines, Genetic algorithms – bioinformatics applications.

UNIT- V

Future Techniques: Genetic Programming: Method, Application guidelines, Bioinformatics applications, Background.

Cellular Automata: Method, Application guidelines, Bioinformatics applications, Background.

Hybrid Methods: Method, Neural-genetic algorithm for analysing gene expression data, Genetic algorithm, and *k* nearest neighbour hybrid for biochemistry solvation, Genetic programming neural networks for determining gene – gene interactions in epidemiology, Application guidelines, Conclusions.

Textbooks:

1. Edward Keedwell and Ajit Narayanan, "Intelligent Bioinformatics", Wiley, First Edition, 2005.
2. Gary B. Fogel, David W. Corne, Yi Pan, "Computational Intelligence in Bioinformatics", Wiley-IEEE Press, First Edition, 2010.

Suggested Reading:

1. Jin Xiong, "Essential Bioinformatics", Cambridge University Press, First Edition, 2006.
2. Supratim Choudhuri, "Bioinformatics for Beginners" Academic Press, First Edition, 2014
3. Dua, Pradeep Chowriappa, "Data Mining for Bioinformatics", CRC Press, First Edition, 2019.

Web Resource:

1. https://omicstutorials.com/introduction-to-machine-learning-bioinformatics/
2. https://www.britannica.com/science/bioinformatics
3. https://www.biotecharticles.com/Category-24/0/Bioinformatics.html

20ITE108 **RECOMMENDER SYSTEMS**

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

Course Objectives:

1. To learn basics of information retrieval and recommender systems.
2. To introduce the concepts of collaborative filtering and content based recommenders.
3. To impart knowledge on design approaches for hybrid recommendation system.
4. To evaluate the recommender systems to provide high quality recommendations.
5. To familiarise the recent developments of recommender systems

Course Outcomes:

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

1. Understand the fundamentals of information retrieval and recommender systems
2. Analyze collaborative filtering and model based recommenders.
3. Identify suitable content based recommenders and understand the concept of user profiling.
4. Design and apply hybrid recommendation system for a particular application.
5. Evaluate recommender systems by means of various measures in different application domains.

UNIT-I

Introduction: Overview of Information Retrieval, Retrieval Models, **Search and Filtering Techniques:** Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II

Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

UNIT-III

Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval.

UNIT-IV

Hybrid approaches: Opportunities for hybridization, **Monolithic hybridization design:** Feature combination, Feature augmentation, **Parallelized hybridization design:** Weighted, Switching, Mixed, **Pipelined hybridization design:** Cascade Meta-level, Limitations of hybridization strategies

UNIT- V

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations. **Recent Developments of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

Text Books:

1. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition, 2011.

Suggested Reading:

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., "Recommender Systems Handbook", Springer, 1st edition, 2011.
3. Manouselis N., Drachsler H., Verbert K., Duval E., "Recommender Systems For Learning", Springer, 1st Edition, 2013.

Web Resources:

1. Coursera recommender systems specialization, https://www.coursera.org/specializations/recommender-systems
2. A Material on recommender systems, https://cse.iitkgp.ac.in/~pawang/courses/recSys.pdf

20ITE109 **REINFORCEMENT LEARNING**

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

Course Objectives:

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, Examples.

Multi Armed Bandits: A K-armed Bandit Problem**,** Action-Value Methods, Incremental implementation, Tracking a Non-stationary problem, Optimistic initial values, UCB, GBA, Associative search.

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

UNIT-II

Dynamic Programming: Policy Evaluation (Prediction), 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, Incremental implementation.

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, Dyna: Integrated Planning, acting and learning, Prioritized Sweeping, Expected vs Sample updates, Trajectory sampling, Real-time dynamic programming, Planning at decision time, Heuristic search, Rollout algorithms, 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, Nonlinear function approximation: ANN, Least-squares TD, Memory based function approximation, Kernel-based function approximation.

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, The Bellman Error is Not Learnable, Gradient-TD Methods, Emphatic-TD Methods, Reducing Variance.

UNIT- V

Eligibility Traces: The λ -return, TD (λ), n-step truncated λ -return methods, Online λ-return algorithm, True online TD (λ), Stable off-policy methods with traces, Implementation issues.

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.

Applications and Case studies

Text Books:

1. 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 Resource:

1. Nptel Course: Reinforcement Learning: https://nptel.ac.in/courses/106/106/106106143/
2. Swayam Course: Reinforcement Learning: https://swayam.gov.in/nd1_noc19_cs55/preview

20ITE110 **GPU COMPUTING**

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

Course Objectives:

1. To provide knowledge on basics of Multi-core architectures and parallel programming models
2. To design parallel algorithms, implement them on graphics processing units (GPUs) such as OpenMP, CUDA and improve their performance by utilizing the GPU architecture effectively.
3. Use OpenGL and CUDA to create real-time visualization coupled with simulations.
4. To apply program optimizations on parallel programs and evaluate the performance using profiling tools.
5. To learn how to design and implement accelerated programs exploiting the potential of GPUs for business use cases.

Course Outcomes:

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

1. Outline the developments in the evolution of multi-core architectures and parallel programming paradigms feature vectors for the Images.
2. Comprehend the various programming languages and libraries for parallel computing platforms.
3. Use of profiling tools to analyse the performance of applications by interpreting the given data.
4. Compare and contrast the features of parallel programming languages such as OpenMP and CUDA.
5. Write parallel programs using OpenMP and CUDA.
6. Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel Application design.

UNIT-I

Introduction: History, Graphics Processors, Graphics Processing Units,GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators,Parallel programming, CUDA OpenCL / OpenACC,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs

UNIT-II

Memory: Memory hierarchy, DRAM / global, local / shared, private / local ,textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

UNIT-III

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

UNIT-IV

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects

Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.

UNIT- V

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Text Books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2nd Edition, 2015
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Suggested Reading:

1. Cheng J, Grossman M and McKercher T, Professional CUDA C Programming, Wrox Press Ltd. (2014).
2. Cook S, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, Morgan Kaufman (2012).

Web Resource:

1. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html
2. https://nptel.ac.in/courses/106/105/106105220/
3. https://developer.nvidia.com/cuda-code-samples#multiGPU
4. http://www.gpucomputing.net/

20ITE111 SCALABLE ALGORITHMS AND SYSTEMS FOR DATA ANALYSIS

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

Course Objectives:

1. To provide knowledge on scalability as a complexity notion of computation
2. To familiarize students with algorithmic techniques for the design of provably-good scalable algorithms
3. To give an overview of map reduce and link analysis for handling larger datasets.
4. To introduce Systems and approaches for large scale data-science problems.
5. To enable students with how large scale machine learning and distributed machine learning approaches work

Course Outcomes:

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

1. Outline the characteristics of massive data and primitives of scalable algorithms.
2. Apply geometric and clustering techniques for local computation of data.
3. Solve large scale data science problems related to link analysis and finding similar items.
4. Examine the need of scalable systems for large scaledata science such as web advertising and recommendation systems.
5. Determine useful information to be gained by analyzing the large-scale data that is derived from social networks.

UNIT-I

Scalable Algorithms: Challenges of Massive Data, The Scalability of Algorithms, Complexity Class S, Scalable Reduction and Algorithmic Primitives

Networks and Data: Weighted Graphs and Affinity Networks, Possible Sources of Affinities, Beyond Graph Models for Social/Information Networks, Basic Problems in Data and Network Analysis, Sparse Networks and Sparse Matrices.

Significant Nodes: Sampling - Making Data Smaller: Personalized PageRank Matrix, Multi-Precision Annealing for Significant Page Rank, Local Approximation of Personalized PageRank, Multi-Precision Sampling,Significant-PageRank Identification.

UNIT-II

Partitioning: Geometric Techniques for Data Analysis: Centerpoints andRegression Depth, Scalable Algorithms for Centerpoints,Geometric Separators,Dimension Reduction: Random vs Spectral,Scalable GeometricDivide-and-Conquer,Graph Partitioning: Vertex and Edge Separators,Multiway Partition of Network and Geometric Data,Spectral Graph Partitioning: The Geometry of a Graph.

UNIT-III

Overview of data mining: and map-reduce, Hash Functions, shingling of documents ,Similarity-Preserving Summaries of Sets, Locality-Sensitive Hashing for Documents, Distance Measures, Link-analysis Page Rank,Link Spam, Hubsand authorities. **Frequent Item sets:** Market based model, A-Priori Algorithm, Handling larger data sets in memory, Limited-pass algorithms.

UNIT-IV

Clustering : Hierarchical clustering, k-means, CURE, Clustering in Non Euclidean Spaces, Clustering for Streams and Parallelism. **Advertising on the web:** Matching problem, The ad-words problem.

Recommendation systems: Content Based Recommendations, Collaborative Filtering, Dimensionality Reduction,The NetFlix Challenge.

UNIT- V

Mining Social-Network Graphs: Social Networks as Graphs, Clustering of Social-Network Graphs ,Direct Discovery of Communities ,Partitioning of Graphs ,Finding Overlapping Communities ,Simrank , Counting Triangles ,Neighborhood Properties of Graphs.

Large-scale machine Learning: The Machine-Learning Model ,Perceptrons, Support-Vector Machines, Learning from Nearest Neighbors ,Comparison of Learning Methods.

Text Books:

1. Shang Hua Teng, Scalable algorithms for data and network analysis, FoundationTrends TheoreticalComputerScience,Firstedition,NowPublishersInc.,2016
2. NathalieJapkowicz,JerzyStefanowski,BigDataAnalysis:NewAlgorithmsforaNewSociety, Firstedition, Springer,2016
3. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, Cambridge University Press,2014

Suggested Reading:

1. Jimmy Lin and Chris Dyer, Data-Intensive Text Processing with MapReduce, First edition,Morgan and Claypool Publishers,2010
2. Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, Advanced Analytics with Spark: Patternsfor Learning from Data at Scale,Oreilly, 2015
3. Ankit Jain, Mastering Apache Storm: Processing big1 data streaming in real time, PacktPublishing,2017

Web Resource:

1. https://www.worldcat.org/title/scalable-algorithms-for-data-and-network-analysis/oclc/951566325
2. https://www.worldcat.org/title/scalable-algorithms-for-data-and-network-analysis/oclc/951566325

20ITE112 DIGITAL IMAGE PROCESSING AND ANALYSIS

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

Course Objectives:

1. To learn the fundamental concepts and applications of digital image processing and analysis, image fundamentals, intensity transformations and spatial filtering
2. To learn basics of frequency domains filtering, image restoration and reconstruction concepts
3. To learn about wavelets and other transformations, basics of colour image processing and various image compression methods
4. To learn morphological image processing concepts and various image segmentation techniques
5. To learn various feature extraction methods and image pattern classification approaches

Course Outcomes:

Upon successful compilation of the course, student will be able to

1. Explain the fundamentals of digital image processing, colour models and intensity transformations
2. Demonstrate smoothing and sharpening in both spatial and frequency domains, image restoration and reconstruction
3. Demonstrate the usage of wavelets and other image transforms
4. Compare image compression methods Huffman Coding, Arithmetic Coding, LZW Coding, Block Transform Coding
5. Recommend proper use of morphological and segmentation algorithms
6. Build an image pattern classification system using feature extraction and image pattern classification techniques

UNIT - I

Introduction and applications; **Digital Image Fundamentals**, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sampling and Quantization, Basic Concepts in Sampling and Quantization, Some Basic Relationships Between Pixels; **Intensity Transformations and Spatial Filtering**, Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, The Mechanics of Linear Spatial Filtering, Smoothing (Low pass) Spatial Filters, Sharpening (High pass) Spatial Filters;

UNIT - II

Filtering in the Frequency Domain, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of Two Variables, Some Properties of the 2-D DFT and IDFT, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Low pass Frequency Domain Filters, Image Sharpening Using High pass Filters; I**mage Restoration and Reconstruction,** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only—Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering

UNIT - III

Wavelet and other Image Transforms, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms; **Color Image Processing,** Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing; **Image Compressions,** Fundamentals, Huffman Coding, Arithmetic Coding, LZW Coding, Bit-plane Coding, Block Transform Coding

UNIT - IV

Morphological Image Processing, Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Some Basic Morphological Algorithms, **Image Segmentation,** Fundamentals, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Super pixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, The Use of Motion in Segmentation

UNIT - V

Feature Extraction, Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Some Basic Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT); **Image Pattern Classification,** Background, Patterns and Pattern Classes, Pattern Classification by Prototype Matching, Optimum (Bayes) Statistical Classifiers

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Education, Fourth Edition, 2019.

Suggested Reading:

1. Vipula Singh, “Digital Image Processing with MatLab and lab View”, Elsevier.
2. Thomas B. Moeslund, “Introduction to Video and Image Processing: Building Real Systems and Applications”, Springer, 2012.
3. Milan Sonka, Vaclav Halvac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Second Edition, Thomson Learning Publishers.
4. Kenneth R.Castleman, “Digital Image Processing”, Pearson Education, 2006.

20ITE113 **CYBER SECURITY**

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

Course Objectives:

1. To present basic concepts of Cybercrime and Cyber attacks.
2. To impart knowledge on Tools and Methods used in Cybercrime
3. To introduce Systems Vulnerability Scanning and tools
4. To familiarize about Network Defense tools.
5. To have knowledge about various Web Application Tools.

Course Outcomes:

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

1. Describe legal and global perspectives of Cybercrimes and inspect how criminals plan the attacks.
2. Examine phishing techniques ,keyloggers, spywares, password cracking methods and types of thefts used in cybercrimes.
3. Determine the challenges of various vulnerability mechanisms and Injection Tools.
4. Demonstrate how Network Defense tools is used in investigations.
5. Experiment with security tool that will test a web site for thousands of possible security issues like dangerous files, mis-configured services, vulnerable scripts and other issues.

UNIT-I

Introduction to Cybercrime: Definition and origins of the word,Cyber crime and Information security ,who are cybercriminals, Classification of Cybercrimes ,Legal Perspectives,Indian Perspective, Cybercrime and the Indian ITA 2000,A Global Perspective on Cybercrimes,Cybercrime Era.

Cyber offenses: Introduction, How Criminals plan the attacks, Social Engineering, CyberStalking,Cybercafe and Cybercrimes, Botnets, Attack vector,Cloud computing.

UNIT-II

Tools and Methods Used in Cybercrime: Introduction, Proxy servers and Anonymizers, Phishing ,Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDos Attacks, SQL Injection, Buffer Overflow, Attacks on wireless Networks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft.

UNIT-III

Systems Vulnerability Scanning Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples,Open VAS, Metasploit, Networks-Netcat, Socat,understanding Port and Services tools - Datapipe, Fpipe, WinRelay,Network Reconnaissance – Nmap, THC-Amap and System tools, Network Sniffers andInjection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet

UNIT-IV

Network Defense tools Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System.

UNIT- V

Web Application Tools Scanning for web vulnerabilities tools: Nikto, HTTP utilities - Curl, Open SSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap, Password Cracking and Brute-Force Tools – John the Ripper,L0phtcrack, Pwdump, THC-Hydra

Text Books:

1. Nina,Godbole,Sunit Belapure, "Cyber Security understanding Cyber Crimes,Computer forensics and Legal Perspectives",Wiley India Pvt.Ltd., 2013
2. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema,Fourth Edition, Publication McGraw Hill,2014.

Suggested Reading:

1. William Stallings "Cryptography and Network Security Principles and Practice, 6th Edition, Pearson 2014.
2. Dr.V.K.Jain, "Cryptography and Network Security", First Edition ,Khanna Book publishing New Delhi 2013.
3. Nina Godbole,"Information Systems Security Security Management, Metrics, Frameworks and Best Practices",Wiley ,2nd Edition,2012

Web Resource:

1.https://www.udemy.com/the-complete-cyber-security-course-end-point-protection/

20ITE114 **BIG DATA ANALYTICS**

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

Course Objectives:

1. To introduce big data and HDFS.
2. To impart knowledge on Mapper and Reducer.
3. To provide the concepts of NoSQL and MongoDB.
4. To introduce programming tools PIG and HIVE in Hadoop echo system.
5. To facilitate learning of Spark with machine learning applications.

Course Outcomes:

Upon completing this course, students will be able to:

1. Perform data analysis in Hadoop framework.
2. Build applications using MapReduce.
3. Model the data using NoSQL and MongoDB.
4. Perform analysis on large datasets using Pig and Hive.
5. Develop machine learning solutions in Spark.

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UNIT-I

Introduction to Big Data: Big Data Important, Big Data Solution, Big Data Use Cases: IT for IT Log Analytics, the Fraud Detection Pattern, Social Media Pattern.

The Hadoop Distributed Files system: The Design of HDFS, HDFS Concepts, Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems, Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow, Anatomy of a File Read, Anatomy of a File Write.

UNIT-II

MapReduce: Introduction, Architecture of map reduce, Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures, Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, The Map Side, The Reduce Side, **MapReduce Types and Formats:** MapReduce Types, The Default MapReduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output, Developing a MapReduce Application.

Hadoop Ecosystem and YARN: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT-III

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, **Working Mechanisms of Mongo DB**: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation

UNIT-IV

Pig: Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

UNIT-V

Spark: Spark and its Purpose, Components of the Spark Unified Stack, Batch and Real-Time Analytics with Apache Spark, Resilient Distributed Dataset, **Scala** (Object Oriented and Functional Programming)

Machine Learning with Spark: Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
2. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

Suggested Reading:

1. Thilinagunarathne, “Hadoop MapReduce v2 Cookbook”, Second Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, “Hadoop in Action”, Manning Publications Company, 2016.
3. Alex Holmes, “Hadoop in Practice”, Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, 2012.

Web Resources:

1. http://www.planetcassandra.org/what-is-nosql
2. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
3. https://class.coursera.org/datasci-001/lecture

20ITE115 **AUGMENTED AND VIRTUAL REALITY**

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

Course Objectives:

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: History 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 Modelling: From 2D to 3D, 3D space curves, 3D boundary representation. The Graphics Pipeline and OpenGL, Overview and Transformations, Rotation, translation, scaling, mode 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, Gestrual 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

20ITE116 **PREDICTIVE ANALYTICS WITH 'R'**

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

Course Objectives:

1. To introduce Predictive Modeling.
2. To familiarize Regression and Classification Techniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree based classifiers and ensemble methods
5. To introduce Topic modeling.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend predictive modeling and assess the performance
2. Apply regression techniques and analyse the performance
3. Demonstrate Support Vector Machines and build an efficient networking model
4. Analyze ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphic models and identify topics through topic modeling

UNIT-I

Gearing Up for Predictive Modeling: Models**, Types of models :** Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

UNIT-II

Linear Regression: Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression**.**

Logistic Regression: Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

UNIT-III

Support Vector Machines: Maximal margin classification, Support vector classification, Inner products**,** Kernels and support vector machines, Cross-validation.

Neural Networks: Stochastic gradient descent**:** Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

UNIT-IV

Tree-based Methods: The intuition for tree models, Algorithms for training decision trees-
Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees CART classification trees, C5.0, Predicting complex skill learning, Variable importance in tree models,

Ensemble Methods: Bagging - Margins and out-of-bag observations, Predicting heart disease with bagging, Limitations of bagging, **Boosting –** AdaBoost, Limitations of boosting, **Random forests-** The importance of variables in random forests

UNIT-V

Probabilistic Graphical Models: A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models- Predicting letter patterns in English words.

Topic Modeling: An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

Text Books:

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng,"R Programming for Data Science", Lean Publishing, 2015.

Suggested Reading:

1. Lantz Brett, "Machine Learning with R", 2nd Edition, Packt Publishing Limited.
2. SunilaGollapudi, "Practical Machine Learning", Packt Publishing Ltd.
3. EthemAlpaydin, "Introduction to Machine Learning", 2nd Edition, PHI, 2013.

Web Resources:

1. https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/
2. https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1
3. http://uc-r.github.io/mars

20ITE117 **NATURAL LANGUAGE PROCESSING**

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

Course Objectives:

1. To provide theoretical concepts of language processing that shows how to explore interesting bodies of text.
2. To familiarize with fundamental topics in language processing that include tagging, classification, and information extraction using tiny Python programs.
3. To facilitate understanding of formal grammar to describe the structure of an unlimited set of sentences.
4. To acquaint with methods to parse a sentence, recognize its syntactic structure and construct representations of meaning.
5. To familiarize with design of existing corpora, the typical workflow for creating a corpus and the life cycle of a corpus

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the concept of natural language processing, its challenges and applications.
2. Demonstrate skills in natural language processing using Natural Language Toolkit (NLTK).
3. Build and evaluate classifiers for textual data.
4. Analyze linguistic structure of text and build feature based grammar.
5. Determine the semantics of sentences using WordNet and Treebank.

UNIT-I

Language Processing: Computing with Language- Texts and Words, A Closer Look at Python-: Texts as Lists of Words, Computing with Language- Simple Statistics, Automatic Natural Language Understanding, **Accessing Text Corpora and Lexical Resources**: Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet

UNIT-II

Processing Raw Text: Strings- Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings

Categorizing and Tagging Words: Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging

UNIT-III

Learning to Classify Text: Supervised Classification, Evaluation, Modeling Linguistic Patterns

Extracting Information from Text: Information, Chunking, Developing and Evaluating Chunkers Recursion in Linguistic Structure

UNIT-IV

Analyzing Sentence Structure: Context-Free Grammar, Parsing with Context-Free Grammar, Dependencies and Dependency Grammar, Grammar Development.

Building Feature-Based Grammars: Grammatical Features, Processing Feature Structures, Extending a Feature-Based Grammar.

UNIT-V

Analyzing the Meaning of Sentences: Natural Language Understanding, Propositional Logic, First-Order Logic, The Semantics of English Sentences.

Managing Linguistic Data: Corpus Structure: A Case Study, The Life Cycle of a Corpus, Acquiring Data.

Text Book:

1. Steven Bird, Evan Klein and Edward Loper, “Natural Language Processing with Python”, O'Reilly Media, Inc., 2009.

Suggested Reading:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, Pearson Education, 2009.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, 2ndEdition, Chapman and Hall/CRC Press, 2010.
3. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. Nitin Hardaniya, Jacob Perkins, “Natural Language Processing: Python and NLTK”, Packt Publishers, 2016.

Web Resources:

1. https://pythonprogramming.net/tokenizing-words-sentences-nltk-tutorial/
2. http://www.nptelvideos.in/2012/11/natural-language-processing.html
3. https://github.com/keon/awesome-nlp

20ITE118 **ROBOTIC PROCESS AUTOMATION**

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

Course Objectives:

1. To give an overview of the Automation Anywhere Enterprise Platform, Architecture, and Components; and explain in detail various features and functionalities of the platform.
2. To facilitate learning on various components of client software, including Development and Control Room.
3. To make use of data manipulation concepts.
4. To create Bots using different types of Recorders.
5. To Provide an overview of MetaBots.

Course Outcomes:

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

1. Describe the Automation Anywhere Enterprise Platform, Architecture, Components and its features.
2. Demonstrate various Basic Commands to build Bots for automating simple processes.
3. Apply manipulation techniques for data extraction and integration.
4. Select the appropriate Recorders for web scrapping and capturing objects.
5. Analyze various aspects of Meta Bots in Visual captures.

UNIT-I

Introduction to Robotic Process Automation (RPA): Scope and techniques of automation, What should be automated, What can be automated, Techniques of automation, What can RPA do, Benefits of RPA, Components of RPA, RPA platforms, The future of automation Introduction to Automation Anywhere, Automation Anywhere Architecture, Automation Anywhere Editors.

UNIT-II

Control Room View, Task Editor :Features of Task Editor, Different sections in Task Editor, Automation Anywhere Commands, Keystrokes / Mouse: Insert Keystrokes, Mouse Click, Insert Mouse Move, Mouse Scroll, Programs / Files / Windows :Open Files, Folders, Window Actions, Log To File, Manage Windows Controls, Object Cloning, Conditions / Loops :If/Loop ,Pause / Delays / Wait.

UNIT-III

Data Manipulation: Variables and scope, Variable Operation, String Operation, Comment, Interactive: Prompt Message Box, Clipboard management, File operation with step-by-step example: Read cell, Write cell, Read range, Write range, Append range, CSV/Excel to data table and vice versa: Reading an Excel file and creating a data table by using data from the Excel file, Creating a data table and then writing all its data to an Excel file.

UNIT -IV

Recorders: Basic recording, Desktop recording, Web recording, Error Handling, Image Recognition, Screen Capture, Integration: Email Automation, PDF Integration, Object Cloning Command , Web Control Room : Dashboard , Activity, Bots (View Bots Uploaded and Credentials) , Devices (View Development and Runtime Clients and Device Pools),Administration (Configure Settings, Users, Roles, License and Migration).

UNIT-V

Creating a MetaBot: Using MetaBot in a TaskBot and Uploading and Downloading MetaBots, Creating a new MetaBot using 'Record', Record Screen(s) and Record Screen(s) with Logic, Adding Screens to a MetaBot using 'Add Screen', Updating MetaBots and Deleting MetaBots, Using the Logic Editor, Building Logic and Adding Commands, Using MetaBot DLLs in Task, MetaBot (Web Based), MetaBot (DLL Based), Bot Insight - Operational Analytics.

Text Books:

1. Alok Mani Tripathi “Learning Robotic Process automation” Packet publishing Ltd–Mumbai, 2018.

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

20ITE119 **DEEP LEARNING**

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

Course Objectives:

1. To introduce the concepts, architecture and limitations of neural networks
2. To provide foundational concepts of deep learning.
3. To learn the concepts convolution neural networks.
4. To familiarize with architectures of recurrent neural networks.
5. To impart the knowledge of advanced applications of deep neural networks.

Course Outcomes:

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

1. Illustrate the working principle of neural networks, deep learning and their challenges.
2. Understand training of deep feed forward network and Partially Observable Markov Decision Process.
3. Identify the challenges in Neural Network optimization and apply Convolution Neural Network.
4. Analyze the usage of Recurrent Neural Networks for sequential analysis.
5. Implement deep learning algorithms for real-world problems and evaluate their performance.

UNIT-I

The Neural Network (Deep Learning): Neurons, Linear Perceptron as Neuron, Neural Nets Architecture/ Design, Working of Neural Nets, Layers of Neural Networks and Deep learning, Activation Functions, Feed Forward Neural Networks, Limitations of Neurons, Deep Belief Networks (DBNs), Large Scale DBNs, Large Scale Convolution Neural Networks, Deep Learning for Big Data, Deep Learning from High Volumes of Data, Deep Learning from High Variety of Data, Deep Learning for High Velocity of Data, Local Minima in Deep Networks, Rearranging Neurons in a layer of a Neural Network, Spurious Local Minima in Deep Networks.

UNIT-II

Deep Feed forward Networks: Training Neurons, Common terminologies, Flowchart for Training a Deep Learning Model, Avoiding Over fitting in Deep Neural Networks, Deep Reinforcement Learning, Explore versus Exploit, Policy versus Value Learning, Q-Learning and Deep Q-Networks, POMDPS(Partially Observable Markov Decision Process), Applications of POMDPS.

UNIT-III

Deep Learning Optimization: Learning versus Pure Optimization, Challenges in Neural Network Optimization, Basic Optimization Algorithms, Parameter Initializations, Meta-algorithms, **Convolution Neural Networks:** Convolution, The Convolution Layer, The Convolution Operation, Max Pooling, Various Convolution Network Architectures.

UNIT-IV

Sequence Analysis: Variable –sized Inputs Analysis, Beam Search, Stateful Deep Learning Models, Recurrent Neural Networks (RNN), Bidirectional RNNs, Deep Recurrent Networks, Augmenting Recurrent Networks, Neural Turing Machines, Applications of Deep Learning.

UNIT- V

Deep Learning Survey: Representation Learning, Transfer Learning, Exponential Gains from Depth, Challenges of Unstructured Modeling, Using Graphs to explain Model Structure, Sampling, Advantages of Structured Modeling, Deep Learning Approach to Structured Probabilistic Models, Deep Boltzmann Machines, Directed Generative Nets, Generative Stochastic Networks.

Text Books:

1. Rajiv Chopra, "Deep Learning A Practical Approach (using python)", 2nd edition, Khanna Book Publishing Co., New Delhi, 2020.

Suggested Reading:

1. Anurag Bhardwaj, Wei Di, Jianing Wei,"Deep Learning Essentials", Packt Publishing, 2018.
2. Goodfellow, I., Bengio,Y., and Courville, A., "Deep Learning", MIT Press, 2016.
3. Raúl Rojas , "Neural Networks: Asystematic Introduction", 1996.
4. Chirstopher Bishop, "Pattern Recognition and machine Learning", Springer, 2007.

Web Resources:

1. NPTEL Deep Learning Part-1, https://nptel.ac.in/courses/106/106/106106184/#
2. Coursera Deep Learning Specialization course, https://www.coursera.org/specializations/deep-learning

20ITE120 **INTERNET OF THINGS**

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

Course Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT.
2. To explore various IoT enabling technologies, Levels and Applications.
3. To facilitate with steps in IoT design Methodology.
4. To identify the Raspberry pi and other devices and end points.
5. To introduce about the Raspberry Pi device, its interfaces and Django Framework.

Course Outcomes:

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

1. Describe the terminology, protocols, Communication models and APIs of IoT.
2. Analyze the various IoT enabling technologies, Levels,M2M and Domain specific Applications.
3. Design IoT platform and interpret the Case Studies.
4. Develop IoT applications using Raspberry Pi3.
5. Create web applications using Django frame work.

UNIT-I

Introduction: Internet of Things- Definitions & Characteristics of IoT, Physical Design of IoT-Physical Layer, Network Layer, Transport Layer, Application Layer, Things in IoT, IoT Protocols, Logical Design of IoT-IoT Functional Blocks, IoT Communication Models-Request-response, Publisher-Subscriber, Push-Pull, Exclusive Pair, IoT Communication APIs-REST API, Web socket API.

UNIT-II

IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels and Deployment Templates. M2M, Differences and similarities between IoT and M2M, SDN and NFV for IoT. Domain Specific IoT – IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

IoT Platforms Design Methodology: Introduction, IoT Design Methodology 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-IV

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi . About the Raspberry Pi board, Raspberry Pi interfaces-Serial, SPI, I2C, Other IoT Devices pcDuino, Beagle Bone Black, Cubie board.

UNIT- V

IoT Physical Servers and cloud offerings: Introduction to cloud storage models and communication APIs, WAMP, Xively cloud for IoT, Python Web Application Framework: Django Framework Django Architecture, Designing a RESTful Web API, Amazon web services for IoT. SkyNetIoT messaging platform..

Text Books:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Matt Richardson, Shawn Wallace, “Getting Started with Raspberry Pi”, O'Reilly (SPD), 2014.

Suggested Reading:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347- 4, Willy Publications.

Web Resource:

1. The Internet of Things - Article https://dl.acm.org/citation.cfm?id=1862541 2. Internet of Things - Tutorial.
2. http://archive.eurescom.eu/~pub/about-eurescom/message_2009_02/Eurescom_message_02_2009.pdf
3. Publications on the Internet of Things. http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

20ITE121 **ADVANCED ALGORITHMS**

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

Course Objectives:

1. To introduce asymptotic notation for representing Algorithmic complexity.
2. To learn algorithmic design approaches for solving problems.
3. To familiarize with advanced data structures and their applications.
4. To facilitate learning of algorithms related to network flow, text processing and computational geometry.
5. To impart knowledge about number theory and cryptography.

Course Outcomes:

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

1. Understand the basic data structures and analyze time and space complexities of algorithms.
2. Identify appropriate algorithmic strategy for solving problems and understand basics of graphs.
3. Analyse shortest path algorithms in weighted graphs and flow control techniques in Network flows.
4. Understand text processing concepts and cryptographic algorithms.
5. Formulate computational geometry solutions using Range Trees, Quad trees and Convex Hulls.

UNIT-I

Algorithm Analysis: Asymptotic Notation, Amortization, **Basic Data Structures:** Stacks and Queues, Lists, Trees, Priority Queues, Heaps. Search Trees and Skip Lists: Binary Search Trees, AVL Trees, Splay Trees, Red-Black Trees, Skip Lists.

UNIT-II

Fundamental Techniques: The Greedy Method, Divide-and-Conquer, Dynamic Programming, **Graphs:** The Graph Abstract Data Type, Data Structures for Graphs, Graph Traversal, Directed Graphs.

UNIT-III

Weighted Graphs: Single-Source Shortest Paths, All-Pairs Shortest Paths, Minimum Spanning Trees, **Network Flow and Matching:** Flows and Cuts, Maximum Flow, Maximum Bipartite Matching, Minimum-Cost Flow.

UNIT-IV

Text Processing: Strings and Pattern Matching Algorithms, Tries, Text Compression, Text Similarity Testing, **Number Theory and Cryptography:** Fundamental Algorithms involving numbers, Cryptographic Computations, Information Security Algorithms and Protocols.

UNIT- V

Computational Geometry: Range Trees, Priority Search Trees, Quad trees and kDTrees, Convex Hulls.

Text Books:

1. M T Goodrich, R Tamassia, “Algorithm Design-Foundations, Analysis, and Internet Algorithms”, John Wiley, 2002.
2. E Horowitz S Sahni, S Rajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, University Press, 2007.

Suggested Reading:

1. Aho, A V Hopcraft, Ullman J D, “The Design and Analysis of Computer Algorithms”, Pearson Ed, 2007.
2. Hari Mohan Pandy, “Design Analysis and Algorithms”, University Science Press, 2009.
3. Cormen, Lieserson, Rivest, “Introduction to Algorithms”, Second Edition, PHI, 2003.

Web Resources:

1. Algorithm Design, http://ww3.algorithmdesign.net/
2. Advanced Algorithms Material, http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-854j-advanced-algorithms-fall-2008/study-materials/

20ITE122 DIGITAL IMAGE PROCESSING AND ANALYSIS LAB

Instruction	4LHours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To learn intensity transformations
2. To learn smoothing and sharpening in both spatial and frequency domains, image restoration and reconstruction
3. To learn the usage of wavelets and other image transforms
4. To learn the image compression methods Huffman Coding, Arithmetic Coding, LZW Coding, Block Transform Coding
5. To learn the use of morphological, segmentation algorithms andimage pattern classification

Course Outcomes:

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

1. Demonstrate the gray level intensity transformations
2. Demonstrate the smoothing and sharpening operations in both the spatial and frequency domains, image restoration and reconstruction
3. Demonstrate the usage of wavelets and other image transforms
4. Compare image compression methods Huffman Coding, Arithmetic Coding, LZW Coding, Block Transform Coding
5. Evaluate the use of morphological and segmentation algorithms
6. Build an image pattern classification system

List of Programs

1. Implementation of gray level transformations
2. Implementation of histogram equalization algorithms
3. Implementation of smoothing and sharping of an image in spatial domain.
4. Implementation of smoothing and sharping of an image in frequency domain.
5. Implementation of opening and closing of the image.
6. Implementation of morpholphical image processing operations
7. Implementation of edge detection algorithms
8. Implementation of grey level slicing
9. Implementation a program to demonstrate of Noise models
10. Implementation of Segmentation Algorithms
11. Mini Project

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson Education, Fourth Edition, 2019.
2. Allen B. Downey, “Think Python How to Think Like a Computer Scientist”, Second Edition, O'Reilly, 2016.
3. Vipula Singh, “Digital Image Processing with MatLab and lab View”, Elsevier.

20ITE123 **CYBER SECURITY LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives

1. To give an overview about TCP and Port Scanning using NMAP.
2. To familiarize with the concepts of Netcat and Open VAS
3. 3.To impart knowledge on penetration testing and sql injection.
4. 4.To facilitate understanding of DAMN and Cross site scripting.
5. 5.To provide knowledge on snort tool and Net stumbler.

Course Outcomes:

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

1. Examine Port scanning to determine what services are running on the systems that have been identified.
2. Illustrate the Netcat and Open VAS and uses such as simple sniffing abilities, port redirection.
3. Demonstrate SQL injection technique often used to attack data driven applications.
4. Experiment with Cross-site Scripting (XSS) is a client-side attack that leverages the user's browser to execute malicious code.
5. Design and develop intrusion prevention system capable of real-time traffic analysis and packet logging.

List of Programs

1. Demonstrate TCP Scanning Using NMAP.
2. Illustrate Port scanning Using NMAP.
3. Implement TCP/UDP Connectivity using Netcat.
4. Examine Network Vulnerability using Open VAS.
5. Demonstrate Practice of Web Application Penetration Testing.
6. Implement SQL injection manually using Damn Vulnerable Web App.
7. Experiment on Practical Identification of SQL-Injection Vulnerabilities.
8. Implement Cross-site Scripting Techniques to check malicious code.
9. Demonstrate intrusion detection system using SNORT tool or any other sofware.
10. Perform wireless audit on an access point or a router and decrypt WEP and WPAUsing Net Stumbler.

Text Books:

1. Nina,Godbole,SunitBelapure, ”Cyber Security understanding Cyber Crimes,Computer forensics and Legal Perspectives”,Wiley India Pvt.Ltd., 2013
2. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema,Fourth Edition, Publication McGraw Hill,2014.

Suggested Reading:

1. William Stallings “Cryptography and Network Security Principles and Practice, 6th Edition, Pearson 2014.
2. Dr.V.K.Jain, ”Cryptography and Network Security”, First Edition ,Khanna Book publishing New Delhi 2013.
3. Nina Godbole,”Information Systems Security Security Management, Metrics, Frameworks and Best Practices”,Wiley ,2nd Edition,2012

Web Resources:

1. https://www.udemy.com/the-complete-cyber-security-course-end-point-protection/

20ITE124 **BIG DATA ANALYTICS LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To provide the knowledge to setup a Hadoop Cluster.
2. To impart knowledge to develop programs using MapReduce
3. To introduce Pig, PigLatin and HiveQL to process big data
4. To introduce NoSQL databases
5. To introduce the latest big data frameworks and writing applications using Spark and Scala
6. Integrate Hadoop with R (RHadoop) to process and visualize.

Course Outcomes:

After successful completion of this course student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems.
4. Write queries using Hive to analyse the datasets
5. Use Spark working environment.

List of Programs

1. Understanding and using basic HDFS commands
2. Word count application using Map Reduce on single node cluster
3. Analysis of Weather Dataset on Multi node Cluster using Hadoop
4. Real world case studies on Map Reduce applications
5. Working with Hadoop file system: Reading, Writing and Copying
6. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
7. Working with HiveQL
8. Writing User Defined Functions in Hive
9. Processing large datasets on Spark framework.
10. Integrating Hadoop with other data analytic frameworks like R

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. TanmayDeshpande, “HadoopReal-World Solutions Cookbook”, Second Edition, Packt Publishing 2016.

Suggested Reading:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.
3. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

Web Resources:

1. https://parthgoelblog.wordpress.com/tag/hadoop-installation
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com.

20ITE125 **AUGMENTED AND VIRTUAL REALITY LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

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 Unityand 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

20ITE126 **PREDICTIVE ANALYTICS WITH 'R' - LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To introduce R libraries for managing and interrogating raw and derived, observed, experimental datasets.
2. To build programs using Predictive Modeling.
3. To familiarize Regression and Classification Techniques with case studies.
4. To impart knowledge on the concepts of Neural Networks and various model Evaluation Techniques.
5. To explore time series models, Topic Modeling and Recommender Systems.

Course Outcomes:

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

1. Demonstrate the basic functions and implement R packages and commands
2. Apply regression analysis methods and infer the problems
3. Develop applications of neural networks and evaluate the techniques
4. Evaluation of ensemble methods
5. Build a system to perform topic modeling on real time datasets

List of Programs

1. Implementation of basic statistical functions of R programming
2. Demonstrate the file operations read and write, importing and exporting datasets
3. Demonstrate the regularization with the lasso in R
4. Implement the pocket perceptron algorithm for classification with neural networks
5. Solve a real-world regression problem by evaluating a neural network model to predict the energy
6. efficiency of the buildings
7. Build a neural network model that predicts a numerical digit (0-9) from *MNIST* database of handwritten digits
8. Explore the field of Banking and Finance and build a classification model which predicts credit scores
9. Design and evaluate a decision tree classifier which predicts whether a particular banknote is genuine or whether it has been forged
10. Build a model to predict heart disease based on their profile and a series of medical tests with bagging
11. Design a bagging model for predicting atmospheric gamma ray radiation
12. Predict promoters in gene sequences using Hidden Markov Model. The Data set contains a number of gene sequences from DNA belonging to the bacterium *E. Coli*
13. Implement Topic Modeling on online news stories

Text Books:

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng,"R Programming for Data Science", Lean Publishing, 2015.

Suggested Reading:

1. Lantz Brett, "Machine Learning with R", 2nd Edition, Packt Publishing Limited.
2. SunilaGollapudi, "Practical Machine Learning", Packt Publishing Ltd.
3. EthemAlpaydin, "Introduction to Machine Learning", 2nd Edition, PHI, 2013.

Datasets:

1. https://archive.ics.uci.edu/ml/index.php
2. https://www.kaggle.com/datasets
3. Energy Efficiency Data Set: http://archive.ics.uci.edu/ml/datasets/Energy+efficiency
4. MNIST dataset of handwritten digits http://yann.lecun.com/exdb/mnist/
5. German Credit Dataset: https://archive.ics.uci.edu/ml/datasets/Statlog+%28German+Credit+Data%29
6. Banknote Authentication Data Set: https://archive.ics.uci.edu/ml/datasets/banknote+authentication
7. MAGIC Gamma Telescope data set: https://archive.ics.uci.edu/ml/datasets/magic+gamma+telescope

8. Promoter Gene Sequences Data Set:https://archive.ics.uci.edu/ml/datasets/Molecular+Biology+(Promoter+Gene+Sequences)
9. http://mlg.ucd.ie/datasets/bbc.html

Web Resources:

1. https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/
2. https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1
3. http://uc-r.github.io/mars

20ITE127 **NATURAL LANGUAGE PROCESSING LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To provide practical knowledge of language processing that involves various operations that can be performed on text data.
2. To familiarize with fundamental topics in language processing that include tokenization, stemming, tagging, classification, and information extraction using Python programs.
3. To facilitate understanding of regular expressions, formal grammar that describe the structure of an unlimited set of sentences.
4. To create classifiers and choose the best classifier.
5. To perform NLP operations on existing corpora and build simple AI Applications

Course Outcomes:

Upon completing this course, students will be able to:

1. Apply the concept of natural language processing (NLP) using Natural Language Toolkit (NLTK).
2. Build text corpora with tokenization, Stemming, Lemmatization and apply visualization techniques.
3. Evaluate the classifiers and choose the best classifier.
4. Access WordNet and Treebank and apply regular expression pattern recognition methods.
5. Create Artificial Intelligence applications for text data.

List of Programs

1. i) Write a program to find the 50 most frequent words of a dataset.
   ii) Demonstrate the functions: bigram( ), upper( ), lower( ), isupper( ), islower( ), split( ), append( )
   iii) Visualize and infer the insights from datasets.
   iv) Find all the four-letter words in the Chat Corpus. With the help of a frequency distribution, show these words in decreasing order of frequency.

2. i) Write a program that performs processing of raw text.
   ii) Explore CMU Pronouncing Dictionary and Wordnet.

3. Perform Tokenization, Stemming, and Lemmatization to carry out the analysis with text corpora.

4. Describe the class of strings matched by the following regular expressions:
   a. [a-zA-Z]+
   b. [A-Z][a-z]*
   c. p[aeiou]{,2}t
   d. \d+(\.\d+)?
   e. ([^aeiou][aeiou][^aeiou])*
   f. \w+|[^\w\s]+
   g. Write a regular expression which collects organization name from the organization mail-id. (Ex: 'cbit.ac.in' from " From: xyz_it@cbit.ac.in")

5. i) Write code to access web page and forecast top temperature for today.
   ii) Explore 'punkt' package in NLTK
   iii) Develop a simple extractive summarization tool and rank the sentences according to their score.

6. i) Perform Automatic, N-gram and Transformation based Tagging for text data.
   ii) Write a program to demonstrate Mapping Words to Properties Using Python Dictionaries

7. Using any of the three classifiers, build the best name gender classifier. Begin by splitting the Names Corpus into three subsets: 500 words for the test set, 500 words for the dev-test set, and the remaining 6,900 words for the training set. Then, starting with the example name gender classifier, make

incremental improvements. Use the devtest set to check the progress. Check its final performance on the test set. Analyze the performance on the test set compare to the performance on the dev-test set.

8. Write a recursive function to traverse a tree and return the depth of the tree.

9. Perform operations on Treebank dataset

10. Build a simple Chatbot and analyze.

Text Book:

1. Steven Bird, Evan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, Inc., 2009.

Suggested Reading:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2nd Edition, Pearson Education, 2009.
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, 2ndEdition, Chapman and Hall/CRC Press, 2010.
3. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
4. Nitin Hardaniya, Jacob Perkins, "Natural Language Processing: Python and NLTK", Packt Publishers, 2016.

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resources:

1. https://pythonprogramming.net/tokenizing-words-sentences-nltk-tutorial/
2. http://www.nptelvideos.in/2012/11/natural-language-processing.html
3. https://github.com/keon/awesome-nlp

20ITE128 **ROBOTIC PROCESS AUTOMATION LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To familiarize Automation Anywhere Enterprise Platform
2. To facilitate learning of Control Room features.
3. To enhance creation of Bots using different types of Recorders and data manipulation commands.
4. To deal with exceptional test cases using exceptional handling mechanism.
5. To impart the knowledge of MetaBots and its features.

Course Outcomes:

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

1. Demonstrate the process of writing, compiling and executing task bots.
2. Implement task bots using various Basic Commands for automating simple processes.
3. Develop task bots using manipulation commands for data extraction and integration.
4. Solve real world problems using exceptional concepts.
5. Construct MetaBots using API's and Visual captures.

List of Programs

1. Installation of Client and control room of automation software.
2. Developing a Task Bot using decision / loop controls
3. Develop a Task Bot for Automating String Operations, Manipulate and Extract Strings.
4. Create a Task Bot for reading and writing data from/to notepad, csv file.
5. Use the Excel command to automate processes related to Excel Workbooks
6. Use the PDF Integration command to automate PDF-related tasks
7. Developing a Bot using Object cloning / web recording / smart recording
8. Developing a Bot using Exception Handling
9. Extract data from various invoices and store it in an excel file. After that, an email should be sent automatically to the mentioned email address
10. Create a Meta Bot using Application API's, Visual Captures and Integration Flow.

Text Books:

1. Alok Mani Tripathi "Learning Robotic Process automation" Packet publishing Ltd–Mumbai, 2018.

Datasets:

1. https://www.marketwatch.com/tools/stockresearch/globalmarkets/intindices.asp
2. https://www.overclockers.co.uk/monitors/finder/above-300-pounds
3. https://www.worldometers.info/world-population/population-by-country/

Web Resources:

1. https://www.edureka.co/blog/rpa-projects
2. https://automationedge.com/10-best-use-cases-to-automate-using-rpa-in-2019/

20ITE129 **DEEP LEARNING LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

The objectives of this course are

1. To learn integration of deep learning system with realistic environment through the use of third-party libraries.
2. To impart the capability of applying Deep Learning algorithms and perform experiments on real-world data.
3. To improve the knowledge of Deep Learning techniques in technological and industrial environments.

Course Outcomes:

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

1. Understand the concepts of feed forward and backward Neural Networks.
2. Build deep learning models using libraries such as Tensor Flow, Keras and interpret the results.
3. Understand the significance of regularization methods and apply them in training deep neural networks.
4. Build Convolution Neural Networks on applications such as image classification.
5. Implement Recurrent Neural Networks based on the application requirement.

List of Programs

1. Demonstrate normalization of input data, basic activation functions such as the softmax, sigmoid, dsigmoid, etc.
2. Build a neural network for logistic regression to minimize the cost function and update the parameters.
3. Implement backward propagation neural network for a two class classification with a single hidden layer, non-linear activation function like tanh and compute the cross entropy loss.
4. Build a deep neural network with more than one hidden layer, non-linear functions like ReLU.
5. Build deep neural network to any classification problem and compare its accuracy to logistic regression.
6. Apply Regularization techniques in deep learning model with backward propagation.
7. Implement mini batch optimization technique to improve the performance of deep learning model.
8. Demonstrate Convolutional Neural Network with various Convolution functions and Pooling functions.
9. Develop a Residual Network for image classification.
10. Build a bidirectional Recurrent Neural Network for any one application.

Text Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., "Deep Learning", MIT Press, 2016.

Suggested Reading:

1. Anurag Bhardwaj, Wei Di, Jianing Wei,"Deep Learning Essentials", Packt Publishing, 2018.
2. Raúl Rojas , "Neural Networks: Asystematic Introduction", 1996.
3. Chirstopher Bishop, "Pattern Recognition and machine Learning", Springer, 2007.

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resources:

1. NPTEL Deep Learning Part-1, https://nptel.ac.in/courses/106/106/106106184/#
2. Coursera Deep Learning Specialization course, https://www.coursera.org/specializations/deep-learning

20ITE130 **INTERNET OF THINGS LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To familiarize with Raspberry Pi Device.
2. To impart knowledge about Python Programming.
3. To provide an overview of IoT applications using Raspberry pi3.
4. To deal with Sensors and its applications
5. To facilitate understanding of different IoT applications.

Course Outcomes:

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

1. Implement Python programming on Raspbian platform.
2. Demonstrate IoT applications using LEDs and Switches on Raspberry Pi3.
3. Experiment with various Sensors on Raspberry Pi3.
4. Design IoT based systems using Raspberry Pi3.
5. Develop cloud based IoT Applications.

List of Programs

Following are some of the programs that a student should be able to write and test on Raspberry Pi3, but not limited to this only.

1. Switching LED on/off from Raspberry Pi3 Console.
2. Interfacing an LED and Switch with Raspberry Pi3.
3. Interfacing a Light Sensor with Raspberry Pi3.
4. Interfacing Rain Sensing Automatic Wiper System.
5. Interfacing to identify accident and send alert messages.
6. Interfacing smoke sensor to give alert message to fire department.
7. Implementation of Traffic Light System based on density.
8. Design and develop IoT Solar Power Monitoring System.
9. Design and develop Patient health monitoring system cloud Module.
10. Implementation of Home Automation System using cloud Module.

Text Books:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press 2014.
2. Matt Richardson, Shawn Wallace, “Getting Started with Raspberry Pi”, O'Reilly (SPD), 2014.

Suggested Reading:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Web Resources:

1. https://nptel.ac.in/courses/106/105/106105166
2. https://swayam.gov.in/nd1_noc19_cs65
3. http://www.circuitbasics.com/raspberry-pi-ds18b20-temperature-sensor-tutorial/.
4. https://raspberrypihq.com/making-a-led-blink-using-the-raspberry-pi-and-python/.https://archive.ics.uci.edu/ml/index.php

20ITE131 **ADVANCED ALGORITHMS LAB**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

The objectives of this course are

1. To impart knowledge of fundamental design and implementation of Advanced Algorithms.
2. To introduce different algorithmic design paradigms to solve problems.
3. To familiarise the advanced concepts of tree data structures and graphs.
4. To introduce Pattern Matching Algorithms and Tries.
5. To learn the implementation of cryptographic algorithms.

Course Outcomes:

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

1. Understand the implementation of basic data structures like stacks, queues, search trees and balanced trees.
2. Identify appropriate algorithmic paradigm to find the optimal solution.
3. Analyze the algorithms to find the shortest path in weighted graphs.
4. Apply appropriate string pattern matching technique and flow control techniques.
5. Implement Cryptographic techniques to ensure security.

List of Programs

1. Implement stacks, queues and analyze the time complexity of stacks and queues.
2. Demonstrate the working of tree data structure and implement Binary Search Tree, AVL, Splay and Red Black trees.
3. Demonstrate the greedy, divide & conquer and dynamic programming paradigms.
4. Implement the graph traversal techniques like Breadth First Traversal and Depth First Traversal.
5. Demonstrate the shortest path techniques for weighted graphs.
6. Implement Minimum spanning trees for weighted graphs.
7. Implement algorithms to find the maximum flow and minimum cost in network flows.
8. Implement string pattern matching techniques and tries.
9. Implement information security algorithms like RSA.
10. Demonstrate the usage of Range Trees and Priority Search Trees

Text Books:

1. M T Goodrich, R Tamassia, “Algorithm Design-Foundations, Analysis, and Internet Algorithms”, John Wiley, 2002.
2. E Horowitz S Sahni, S Rajasekaran, “Fundamentals of Computer Algorithms”, Second Edition, University Press, 2007.

Suggested Reading:

1. Aho, A V Hopcraft, Ullman J D, “The Design and Analysis of Computer Algorithms”, Pearson Ed, 2007.
2. Hari Mohan Pandy, “Design Analysis and Algorithms”, University Science Press, 2009.
3. Cormen, Lieserson, Rivest, “Introduction to Algorithms”, Second Edition, PHI, 2003.

Web Resources:

1. Algorithm Design, http://ww3.algorithmdesign.net/
2. Advanced Algorithms Material, http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-854j-advanced-algorithms-fall-2008/study-materials/

20ITC107 **MINI PROJECT WITH SEMINAR**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Outcomes:

Upon completing this course, students will be able to:

1. Formulate a specific problem and give 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 programme each students 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 modelling based/Experimental investigations or Numerical modelling.
- 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 Review 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

20EG A101 ENGLISH FOR RESEARCH PAPER WRITING
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To enable the students to produce original research papers without plagiarism.

Course Outcomes:

Upon completing this course, students will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT -I

Academic Writing: Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT- II

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

UNIT –III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT- IV

Process of Writing a research paper: 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.

UNIT- V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Book:

1. C. R Kothari, Gaurav, Garg, **Research Methodology Methods and Techniques,** New Age International Publishers. 4th Edition.

Suggested Reading:

1. Day R (2006) "How to Write and Publish a Scientific Paper**",** Cambridge University Press
2. MLA **"**Hand book for writers of Research Papers**"**, East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers**"**, Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

20CEA101 **DISASTER MITIGATION AND MANAGEMENT**
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

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 in 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:

Upon completing this course, students will be able to:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Ability to understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Ability to understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. To 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 man-made; 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 to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT- IV

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, 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 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 institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes 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.

Suggested Reading:

1. Ministry of Home Affairs, Government of India, "National disaster management plan, Part I and II",
2. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

20EEA101 SANSKRIT FOR TECHNICAL KNOWLEDGE
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

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 Indian literature

Course Outcomes:

Upon completing 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- significance of Amarakosa-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: Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba_sutram or baudhayana theorem (origination of pythogorous 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-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-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-kosthi yanthram-

Text Books:

1. M Krishnamachariar, “History of Classical Sanskrit Literature”, TTD Press, 1937.
2. M.R. Kale, “A Higher Sanskrit Grammar: For the Use of School and College Students”, Motilal Banarsidass Publishers, ISBN-13: 978-8120801783, 2015
3. Kapail Kapoor, “Language, Linguistics and Literature: The Indian Perspective”, ISBN-10: 8171880649, 1994.
4. “Pride of India”, Samskrita Bharati Publisher, ISBN: 81-87276-27-4, 2007
2. Shri RamaVerma, “Vedas the source of ultimate science”, Nag publishers, ISBN:81-7081-618-1, 2005

20EC A101 **VALUE EDUCATION**
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes:

Upon completing this course, students will be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day to day professional life.
3. Appreciate the need and importance of interpersonal skills for successful career and social life
4. Emphasize the role of personal and social responsibility of an individual for all-round growth.
5. Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

UNIT I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, 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, 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 labour, True friendship, Universal brotherhood and religious tolerance.

UNIT IV

Values in Holy Books : Self-management and Good health; **and internal & external Cleanliness,** Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT V

Dharma, Karma and Guna: 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 Tamasicgunas.

Suggested Reading:

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.

20EGA102 INDIAN CONSTITUTION AND FUNDAMENTAL RIGHTS
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

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 completing 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, ayor and role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, PRI: Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: 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**.**

Suggested Reading:

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

Web Resource:

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

20IT A101 **PEDAGOGY STUDIES**
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
Credits	0

Course Objectives:

1. To present the basic concepts of design and policies of pedagogy studies.
2. To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. To familiarize various theories of learning and their connection to teaching practice.
4. To create awareness about the practices followed by DFID, other agencies and other researchers.
5. To provide understanding of critical evidence gaps that guides the professional development.

Course Outcomes:

Upon completing this course, students will be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

UNIT-I

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

UNIT-II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT-III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT-IV

Professional Development: alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT-V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

Text Books:

1. Ackers J, Hardman F, "Classroom Interaction in Kenyan Primary Schools, Compare", 31 (2): 245 – 261, 2001.
2. Agarwal M, "Curricular Reform in Schools: The importance of evaluation", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

Suggested Reading:

1. Akyeampong K, "Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)", Country Report 1.London: DFID, 2003.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?, International Journal Educational Development, 33 (3): 272- 282, 2013.
3. Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education", Oxford and Boston: Blackwell, 2001.
4. Chavan M, "Read India: A mass scale, rapid, 'learning to read' campaign", 2003.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview
2. www.pratham.org/images/resources%20working%20paper%202.pdf.

20EGA103 **STRESS MANAGEMENT BY YOGA**
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

1. Creating awareness about different types of stress and the role of yoga in the management of stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by yoga practice.

Course Outcomes:

Upon completing this course, students will be able to:

1. To 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)

Suggested Reading:

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

Online Resources:

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

20EGA104 PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS (AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom among themselves.

Course Outcomes:

Upon completing 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. To 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 BhagawadGeeta: 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.

Suggested Reading:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Web Resource:

1. NTPEL: http://nptel.ac.in/downloads/109104115/

20CSO101 **BUSINESS ANALYTICS**
(OPEN ELECTIVE)

Instruction	3 hrs per week
Duration of End examination	3 hrs
Semester end examinations	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

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:

Upon completing this course, students will be able to:

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with 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

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

Text Books:

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 Reading:

1. 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/

20MEO102 INTRODUCTION TO OPTIMIZATION TECHNIQUES
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Objectives: The students will

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

Outcomes:

Upon completing 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. Pannerselvam, "Operations Research", Prentice Hall of India 2010
3. Harvey M Wagner, "Principles of Operations Research", Prentice Hall of India 2010

20CE O101 COST MANAGEMENT OF ENGINEERING PROJECTS
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

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. 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:

Upon completing this course, students will be able to:

1. Acquire in-depth knowledge about the concepts of project management and understand the principles of project management.
2. Determine the critical path of a typical project using CPM and PERT techniques.
3. Prepare a work break down plan and perform linear scheduling using various methods.
4. Solve problems of resource scheduling and levelling 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 managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT- II

Project Planning and Scheduling: Introduction for project planning, defining activities and their interdependency, time and resource estimation. Work break down 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 levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis

Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing 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)
4. K. K Chitkara, "Construction Project Management: Planning, scheduling and controlling", Tata McGraw-Hill Education. (2004).
5. Kumar Neeraj Jha "Construction Project Management Theory and Practice", Pearson Education India; 2 edition (2015)

20MEO101 **INDUSTRIAL SAFETY**
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Causes for industrial accidents and preventive steps to be taken.
2. Fundamental concepts of Maintenance Engineering.
3. About wear and corrosion along with preventive steps to be taken
4. The basic concepts and importance of fault tracing.
5. The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

Course Outcomes:

Upon completing 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 equipments 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, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT – II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and 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 equipment's 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 (DG) 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 Reading:

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

20MEO103 **COMPOSITE MATERIALS**
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: To make the students to learn the
1. Composite materials and their constituents.
2. Classification of the reinforcements and evaluate the behaviour of composites.
3. Fabrication methods of metal matrix composites.
4. Manufacturing of Polymer matrix composites.
5. Failure mechanisms in composite materials.

Course Outcomes:
Upon completing 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, 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. R.W.Cahn – VCH , “Material Science and Technology”, (Vol 13) Composites , West Germany.
2. WD Callister, Jr., Adapted by R. Balasubramaniam, “Materials Science and Engineering, An introduction”., John Wiley & Sons, NY, Indian edition, 2007.

Suggested Reading:
1. Ed-Lubin, “Hand Book of Composite Materials”
2. K.K.Chawla, “Composite Materials”.
3. Deborah D.L. Chung, “Composite Materials Science and Applications”
4. Daniel Gay, Suong V. Hoa, and Stephen W. Tsai, “Composite Materials Design and Applications”

20EE O101 **WASTE TO ENERGY**
(OPEN ELECTIVE)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course objectives:
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:
Upon completing this course, students will be able to:
1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Chose 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, digestors

UNIT-II
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – 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, Design, construction and operation - Operation of all the above biomass combustors.

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

Text Books:
1. Non Conventional Energy, 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 Reading:
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.

20ITC108 **DISSERTATION PHASE- I**

Instruction	20 Hours 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 journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of 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 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 : Department committee has to assess the progress of the student for every two weeks.

20ITC109 **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/equipments 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 III semester.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be submitted in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of the solution and results with analysis.
- 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 Chair Person), supervisor/co-supervisor.
- The candidate has to be in regular contact with his/her supervisor/co-supervisor.

Guidelines for awarding marks in CIE:		**Max. Marks: 100**
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)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s)	20	Power Point 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