SCHEME OF INSTRUCTION AND SYLLABI

For

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Master of Technology

A TWO YEAR PG Program

in

M.TECH (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)
(AICTE Model Curriculum with effect from AY 2023-24)

(R–23 Regulation)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous Institution under UGC, Affiliated to Osmania University)
Department of Electronics and Communication Engineering
Accredited by NBA and NAAC-UGC
Chaitanya Bharathi (Post), Gandipet, Hyderabad–500075

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

OUR MOTTO: SWAYAM TEJASWIN BHAVA

VISION and MISSION of the INSTITUTE

Vision

To be a centre of excellence in technical education and research.

Mission

To address the emerging needs through quality technical education and advanced research.

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.

Program Outcomes:

At the end of the program, students will be able to:

PO1: Independently carry out research/investigation and development work to solve practical problems.

PO2: Write and present a substantial technical report/document.

PO3: Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2023-24)

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	23MTC101	Mathematical Foundations for Data Science	3	-	3	40	60	3
2	23ADC101	Artificial Intelligence	3	-	3	40	60	3
3		Program Elective-1	3	-	3	40	60	3
4		Program Elective-2	3	-	3	40	60	3
5	23MEM103	Research Methodology and IPR	2	-	3	40	60	2
6		Audit Course-1	2	-	2	-	50	Non-Credit
PRACTICALS								
7	23MTC102	Mathematical Foundations of Data Science Lab	-	2	-	50	-	1
8	23ADC105	Artificial Intelligence Lab	-	2	-	50	-	1
9		Laboratory-3 **(Based on Elective-2)**	-	2	-	50	-	1
TOTAL			**14**	**06**	**17**	**350**	**350**	**17**

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 2023-24)

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	23ADC102	Introduction to Data Science	3	-	3	40	60	3
2	23ADC103	Machine Learning	3	-	3	40	60	3
3	23ADC104	Deep Learning	3	-	3	40	60	3
4		Program Elective-3	3	-	3	40	60	3
5		Program Elective-4	3	-	3	40	60	3
PRACTICALS								
6	23ADC106	Introduction to Data Science Lab	-	2	-	50	-	1
7	23ADC107	Machine Learning Lab	-	2	-	50	-	1
8		Laboratory-6 **(Based on Elective-4)**	-	2	-	50	-	1
9	23ADC109	Mini Project with Seminar	-	4	-	50	-	2
TOTAL			**15**	**10**	**15**	**400**	**300**	**19**

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

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2023-24)

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
3		Audit Course-2	2	-	2	-	50	Non-Credit
PRACTICALS								
3	23ADC110	Dissertation/Phase-I	-	20	-	100	-	10
TOTAL			8	20	8	180	170	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	23ADC111	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
Mandatory Courses			
1.	23MEM103	Research Methodology and IPR	2
Program Elective-1, Elective-3 and Elective-5 Courses (without Lab)			
2.	23ADE101	Soft Computing	3
3.	23ADE102	Cloud Computing	3
4.	23ADE103	Information Retrieval Systems	3
5.	23ADE104	Time Series Analysis & Forecasting	3
6.	23ADE105	Social Network Analytics	3
7.	23ADE106	Block Chain Technology	3
8.	23ADE107	Intelligent Bio Informatics	3
9.	23ADE108	Recommender Systems	3
10.	23ADE109	Reinforcement Learning	3
11.	23ADE110	GPU Computing	3
12.	23ADE111	Scalable Algorithms and Systems for Data Analysis	3
13.	23ADE112	Cyber Physical Systems	3
14.	23ADE113	Explainable AI	3
15.	23ADE114	Advanced Data Structures	3
16.	23ADE115	High Performance Computing	3
17.	23ADE116	Ethics in AI	3
Program Elective-2 and Elective-4 Courses (with Lab)			
18.	23ADE117	Digital Image Processing and Analysis	3
19.	23ADE118	Cyber Security	3
20.	23ADE119	Big Data Analytics	3
21.	23ADE120	Augmented and Virtual Reality	3
22.	23ADE121	Predictive Analytics with R	3
23.	23ADE122	Natural Language Processing	3
24.	23ADE123	Robotic Process Automation	3
25.	23ADE124	Federated Machine Learning	3
26.	23ADE125	Internet of Things	3
27.	23ADE126	Advanced Algorithms	3
Audit Course – 1 and 2			
28.	23EGA101	English for Research Paper Writing	0
29.	23CEA101	Disaster Mitigation and Management	0
30.	23EEA101	Sanskrit for Technical Knowledge	0
31.	23ECA101	Value Education	0
32.	23EGA102	Indian Constitution and Fundamental Rights	0
33.	23ADA101	Pedagogy Studies	0
34.	23EGA103	Stress Management by Yoga	0
35.	23EGA104	Personality Development Through Life's Enlightenment Skills	0
Open Elective Courses			
36.	23CS0101	Business Analytics	3
37.	23MEO102	Introduction to Optimization Techniques	3
38.	23CEO101	Cost Management of Engineering Projects	3
39.	23MEO101	Industrial Safety	3
40.	23MEO103	Composite Materials	3
41.	23EEO101	Waste to Energy	3
Labs, Seminars & Projects			
Laboratory-2 and Laboratory-4 (Based on Elective-2 and Elective-4 Courses) *			

42.	23ADE127	Digital Image Processing and Analysis Lab	1
43.	23ADE128	Cyber Security Lab	1
44.	23ADE129	Big Data Analytics Lab	1
45.	23ADE130	Augmented and Virtual Reality Lab	1
46.	23ADE131	Predictive Analytics in R Lab	1
47.	23ADE132	Natural Language Processing Lab	1
48.	23ADE133	Robotic Process Automation Lab	1
49.	23ADE134	Federated Machine Learning Lab	1
50.	23ADE135	Internet of Things Lab	1
51.	23ADE136	Advanced Algorithms Lab	1
Seminar and Projects			
52.	23ADC109	Mini Project with Seminar	2
53.	23ADC110	Dissertation Phase-I	10
54.	23ADC111	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.**

23MTC101

MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

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

Course Objectives:

This course aims to:

1. Discuss vector space and subspace.
2. Understand the linear transformation.
3. Explore the stochastic processes.
4. Explain different estimates.
5. Fit the curve to the data using the least squares approximation.

Course Outcomes:

Upon successful completion of 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 Parameters.
5. Apply the appropriate model for Regression diagnostic of the raw data.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	1	2	1
CO2	2	-	1	2	1
CO3	3	-	1	3	2
CO4	3	-	2	3	2
CO5	3	-	1	3	2

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 (Weibull and Exponential), Computation of Mean Time to Failure. Stochastic Process: Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process and the 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.

23ADC101

ARTIFICIAL INTELLIGENCE

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

Course Objectives:

This course aims to:

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

Course Outcomes:

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

1. Understand the basics of AI and concept of Intelligent Agent.
2. Compare the advanced Searching techniques.
3. Understand and apply the first-order and second-order predicate Logic to infer the knowledge
4. Analyse classical and real-world planning approaches
5. Understand the uncertainty and apply the probabilistic reasoning models

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	3
CO3	3	1	2	2	2
CO4	2	1	3	2	3
CO5	2	1	3	2	2

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, Multi agent 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

23ADC102

INTRODUCTION TO DATA SCIENCE

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

Course Objectives:
This course aims to:
1. Introduce the fundamentals of Data Science.
2. Familiarise with Numpy, Pandas and handle large data.
3. Facilitate learning of data pre-processing.
4. Introduce plotting and visualisation.
5. Present grouping and aggregate operations

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Comprehend the process of Data Science and handle large unstructured data.
2. Use the packages Numpy, Pandas and interact with Web API and databases.
3. Choose suitable pre-processing techniques to process raw data.
4. Interpret the data from visualisations.
5. Apply appropriate group and aggregation operations.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	2	3
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	2	3
CO5	3	2	3	2	3

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~~,~~ 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: The modeling process, Types of machine learning, Semi-supervised learning, **Handling large data on a single computer:** The problems ~~you face when~~ in 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 nd-array, Universal Functions: Fast Element-Wise Array Functions, **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 sea born, **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.linkedin.com/in/randylaosat
4. https://www.programmer-books.com/introducing-data-science-pdf/
5. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
6. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
7. https://www.edx.org/course/python-basics-for-data-science
8. https://www.edx.org/course/analyzing-data-with-python
9. https://www.coursera.org/learn/python-plotting?specialization=data-science-python

23ADC103

MACHINE LEARNING

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

Course Objectives:
This course aims to:

1. Impart knowledge on the basic concepts underlying machine learning.
2. Acquaint with the process of selecting features for model construction.
3. Familiarize different types of machine learning techniques.
4. Facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. Provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes:
Upon successful completion of this course, students 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. Understand reinforcement learning and choose the best learning mechanism to the problem.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	3	2	2
CO2	2	2	3	3	3
CO3	2	-	3	2	2
CO4	2	1	3	3	3
CO5	1	1	2	1	1

UNIT-I

Introduction to Machine Learning: Classic and adaptive machines, Descriptive analysis, Predictive analysis, Supervised learning, Unsupervised learning, Semi-supervised learning, Reinforcement learning, Computational neuroscience, Elements in Machine Learning: Data formats, Multiclass strategies, Learnability, Under fitting and overfitting, Error measures and cost functions, statistical learning concepts, Maximum likelihood learning, Class balancing, Elements of information theory.

UNIT-II

Principal Component Analysis, Non-Negative Matrix Factorization, Sparse PCA, Kernal PCA, Regression Algorithms: Linear models for regression, R2 score, Explained variance, Ridge, Lasso, and Elastic Net, Robust regression, RANSAC, Huber Regression, Bayesian regression, Polynomial regression, Isotonic regression, Linear Classification Algorithms: Linear classification, Logistic regression, Stochastic gradient descent algorithms, Passive-aggressive regression, Classification metrics: Confusion Matrix, Accuracy, Recall, Precision, RoC.

UNIT-III

Naive Bayes and Discriminant Analysis: Bayes' theorem, Naive Bayes classifiers, Multinomial Naive Bayes classifiers Gaussian Naive Bayes, Discriminant analysis, Support Vector Machines: Linear SVM, Kernel-based

classification, Radial Basis Function, Polynomial kernel, Sigmoid kernel, Custom kernels Support Vector Regression, semi-supervised Support Vector Machines, Artificial Neural Networks, Back Propagation Algorithm.

UNIT-IV

Decision Trees and Ensemble Learning: Binary Decision Trees, Impurity measures, Gini impurity index, Cross-entropy impurity index, Misclassification impurity index, Feature importance, Decision Tree regression, Ensemble Learning, Random Forests, Feature importance in Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier. Optimization techniques: Gradient Descent, Momentum, Genetic Algorithm.

UNIT-V

Clustering Fundamentals: Clustering basics, k-NN, Gaussian mixture, Finding the optimal number of components, K-means, Finding the optimal number of clusters, Optimizing the inertia, Silhouette score. Calinski-Harabasz index, Cluster instability, Homogeneity, Completeness, DBSCAN, Spectral Clustering. Mini-batch K-means, BIRCH, Biclustering Agglomerative Clustering, Connectivity constraints, Reinforcement Learning fundamentals.

Text Books:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms Second Edition, 2018, Packt Publishing.
2. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow”- Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd edition, O’Reilly,2019

Suggested Reading:

1. Tom Mitchel, “Machine Learning”, Tata McGraW Hill, 2017.
2. Stephen Marshland, “Machine Learning: An Algorithmic Perspective”, CRC Press Taylor & Francis, 2nd Edition, 2015

Web Resources:

1. https://www.coursera.org/specializations/machine-learning

23ADC104

DEEP LEARNING

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

Course Objectives:

This course aims to:

1. Introduce the concepts, architecture and limitations of neural networks
2. Provide foundational concepts of deep learning
3. Understand the concepts convolution neural networks
4. Familiarize with architectures of recurrent neural networks
5. Impart the knowledge of advanced applications of deep neural networks.

Course Outcomes:

Upon successful completion of this course, students 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. Analyse the usage of Recurrent Neural Networks for sequential analysis
5. Implement deep learning algorithms for real-world problems and evaluate their performance.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	2	1	3	3	2
CO3	2	1	2	2	3
CO4	2	1	2	3	3
CO5	1	1	3	3	3

UNIT-I

Introduction of Perceptron, Fully Connected Layer, Neural Network, Optimization, Activation functions, Design of Output Layer, Error Calculation, Mean Square Error Function, Cross-Entropy Error Function, Convolutional Neural Network, Recurrent Neural Network, Attention Mechanism Network, Graph Convolutional Neural Network, Backward Propagation Algorithm: Derivatives and Gradients, Common Properties of Derivatives, Derivative of Activation Functions, Gradient of Loss Function, Gradient of Fully Connected Layer, Chain Rule, Back Propagation Algorithm.

UNIT-II

Model Capacity, Overfitting and Under fitting, Validation Set and Hyper parameters, Early Stopping, Model Design Regularization, Dropout, Data Augmentation, Convolutional Neural Networks: Problems with Fully Connected N, Local Correlation, Weight Sharing, Convolution Operation, Single-Channel Input and Single Convolution Kernel, Multi-channel Input and Single Convolution Kernel, Multi-channel Input and Multi-convolution Kernel, Stride Size, Padding, LeNet-5.

UNIT-III

Representation Learning, Gradient Propagation, Pooling Layer, Batch Norm Layer, Forward Propagation, Backward Propagation, AlexNet, VGG Series, GoogLeNet, Convolutional Layer Variants: Dilated/Atrous Convolution, Transposed Convolution, Separate Convolution, Deep Residual Network, DenseNet.

UNIT-IV

Recurrent Neural Network: Sequence Representation Method, Embedding Layer, Pre-trained Word Vectors, Recurrent Neural Network, Is a Fully Connected Layer Feasible?, Shared Weight, Global Semantics, Gradient Propagation, How to Use RNN Layers Simple RNN Cell, RNN Sentiment Classification, Gradient Vanishing and Gradient Exploding, Gradient Clipping, RNN Short-Term Memory, LSTM Principle, Forget Gate, Input Gate, Update Memory, Output Gate, GRU Introduction, Reset Door, Pre-trained Word Vectors, fundamentals of Sentiment Analysis.

UNIT-V

Autoencoder: Principle of Autoencoder, Encoder, Decoder, Autoencoder, Image Reconstruction, Autoencoder Variants Dropout Autoencoder, Adversarial Autoencoder, Variational Autoencoder, Principle of VAE, Reparameterization Trick, Generative Adversarial Networks: GAN Principle, Network Structure, Network Training, Unified Objective Function, Generator, GAN Variants, DCGAN, InfoGAN, CycleGAN, WGAN, Self-Attention GAN, BigGAN, Nash Equilibrium, Discriminator State, Generator State, GAN Training Difficulty: Hyperparameter Sensitivity, Model Collapse, WGAN Principle, Reinforcement Analysis

Text Books:

1. Liangqu Long Xiangming Zeng, “Beginning Deep Learning with TensorFlow, First edition, Appress, 2022
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, “Dive into Deep Learning, Release 0.16.6, 2018.

Suggested Reading:

1. Levitin A, “Introduction to the Design And Analysis of Algorithms”, Pearson Education, 2008.
2. Ian Goodfellow,Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016
3. Indra den Bakker, “Python Deep Learning Cookbook”, Packt publisher, 2017
4. Wei Di, Anurag Bhardwaj, Jianing Wei, “Deep Learning Essentials” , Packt publishers, 2018

Web Resources:

1. http://nptel.ac.in/course

23ADE101

SOFT COMPUTING

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. 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:

Upon successful completion of this course, students 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

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	3	2
CO2	3	2	2	2	2
CO3	3	3	2	3	3
CO4	3	3	2	3	3
CO5	3	3	3	3	3

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 behaviour 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

23ADE102

CLOUD COMPUTING

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon successful completion of 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

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, and 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.
5. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016. 3 Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra,

Web Resources:

1. https://nptel.ac.in/courses/106105167/1
2. https://www.manning.com/books/exploring-cloud-computing (e-book)
3. https://www.coursera.org/specializations/cloud-computing

23ADE103

INFORMATION RETRIEVAL SYSTEMS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Familiarize with different Information Retrieval models.
2. Learn query languages for data retrieval.
3. Introduce various methods for efficient retrieval of information.
4. Impart knowledge on text operations.
5. Introduce Parallel and Distributed IR models.

Course Outcomes:

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

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

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	2	2
CO2	3	-	2	3	3
CO3	2	-	2	2	2
CO4	3	1	3	3	2
CO5	3	1	3	3	3

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, and Query Protocols

UNIT-III

Query operations: Introduction, User Relevance Feedback, Automatic Local Analysis, and Automatic Global Analysis

Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Mark-up Languages, Multimedia

UNIT-IV

Text Operations: Introduction, Document Pre-processing, 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, “re”, Pearson Education, 2008.

Suggested Reading:
1. Christopher D. Manning, Prabhakar Raghavan, 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

23ADE104

TIME SERIES ANALYSIS AND FORECASTING

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

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

Course Outcomes:

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

1. Understand the time series and non-time series data and choose the right approach to solve a given problem.
2. Apply advanced Pre-processing and visualization techniques on time series data.
3. Analyze the various smoothing methods such as first, second and higher-ordered exponentials.
4. Understand the auto-regressive models.
5. Develop forecasting models for time series data using different RNNs such as Vanilla RNN, Gated Recurrent Units, and Long Short-Term Memory units.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	3	2	3
CO2	3	1	2	2	3
CO3	1	2	1	-	3
CO4	3	-	2	2	3
CO5	3	-	2	-	3

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, and 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”, Packt Publishing, 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

23ADE105

SOCIAL NETWORK ANALYTICS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Design modelling, aggregating and knowledge representation of semantic web
2. Describe Association rule mining algorithms
3. To know the applications in real time systems.

Course Outcomes:

Upon successful completion of this course, students 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	1	1	1	1
CO2	2	1	-	2	2
CO3	3	2	2	3	2
CO4	2	2	1	2	2
CO5	3	3	3	3	3

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: Ontolog-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.

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

23ADE106

BLOCK CHAIN TECHNOLOGY

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:
This course aims to:

1. Facilitate understanding of Bitcoin and working with consensus in Bitcoin.
2. Impart knowledge about designing and building Permissioned block chains.
3. Introduce the concepts of Cryptocurrency, Ethereum virtual machine, cryptocurrency regulation, and Hyper ledger Fabric.

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

1. Demonstrate the concepts of block chain technology.
2. Understand Bitcoin, working with consensus in Bitcoin.
3. Design Permissioned Block chains.
4. Illustrate the concepts of Cryptocurrency, Ethereum virtual machine, and cryptocurrency regulations.
5. Design smart contracts using Hyper ledger Fabric frameworks.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	1	2	2	2
CO2	3	2	3	2	2
CO3	3	3	3	3	2
CO4	3	3	3	3	3
CO5	3	3	3	3	3

UNIT-I
Introduction: Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Blockchain, Understanding Cryptocurrency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain 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 Blockchain: 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 a 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

Cryptocurrency: History, Distributed Ledger, Mining strategy and rewards, Ethereum- Construction, Ethereum Virtual Machine (EVM)-Wallets for Ethereum, Decentralized Autonomous Organization, Smart Contract, Vulnerability Attacks. Cryptocurrency Regulation: Stakeholders, 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 contracts using Hyperledger Fabric, Writing smart contracts 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 Cryptocurrency 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

23ADE107

INTELLIGENT BIO INFORMATICS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Familiarize students with the fundamental concepts of Bioinformatics
2. Acquire knowledge on different Classification and clustering techniques in the implementation of Bioinformatics
3. Impart how to apply Neural networks and Genetic Algorithms in different applications related to Bioinformatics

Course Outcomes:

Upon successful completion of this course, students 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 networks and genetic algorithms.
5. Elaborate the concepts of Genetic Programming, Cellular Automata and Hybrid methods

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	2	2
CO2	2	2	3	3	3
CO3	3	2	3	3	2
CO4	3	3	3	3	3
CO5	3	3	3	3	3

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, grammar, 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, Overfitting 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.

Text books:

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

23ADE108

RECOMMENDER SYSTEMS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Learn basics of information retrieval and recommender systems.
2. Introduce the concepts of collaborative filtering and content-based recommenders.
3. Impart knowledge on design approaches for hybrid recommendation system.
4. Evaluate the recommender systems to provide high quality recommendations.
5. Familiarise the recent developments of recommender systems

Course Outcomes:

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

1. Understand the fundamentals of information retrieval and recommender systems.
2. Analyse collaborative filtering and model-based recommenders.
3. Examine the suitable content-based recommenders for real time applications.
4. Design hybrid recommendation system for a particular application.
5. Evaluate recommender systems by means of various measures in different application domains.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	3	2	3
CO2	2	1	2	2	3
CO3	3	2	2	1	3
CO4	3	-	2	2	3
CO5	3	-	2	2	3

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

23ADE109

REINFORCEMENT LEARNING

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Learn the concepts of reinforcement learning, Multi Armed bandits problem, and Finite Markov Decision Process.
2. Introduce Dynamic programming, Monte Carlo methods and Temporal-Difference Learning.
3. Excel with Tabular Methods and Prediction with Approximation.
4. Provide approximate solutions methods for Reinforcement learning.
5. Familiarize with applications and case studies of reinforcement learning.

Course Outcomes:

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

1. Understand the Reinforcement Learning, Multi Armed Bandits and Finite Markov Decision process.
2. Apply Monte Carlo, Temporal Difference methods for policy evaluation and prediction.
3. Analyse 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	1	3
CO2	1	1	2	2	3
CO3	2	-	1	1	2
CO4	3	-	1	2	3
CO5	3	-	2	2	3

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

23ADE110

GPU COMPUTING

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

1. Provide knowledge on basics of Multi-core architectures and parallel programming models
2. 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. Apply program optimizations on parallel programs and evaluate the performance using profiling tools.
5. Learn how to design and implement accelerated programs exploiting the potential of GPUs for business use cases.

Course Outcomes:

Upon successful completion of this course, students 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 memory hierarchy for parallel computing platforms.
3. Compare and contrast the features of parallel programming languages such as OpenMP and CUDA.
4. Write parallel programs using OpenMP and CUDA.
5. Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel Application design.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	2	2
CO2	3	-	2	3	3
CO3	1	-	2	2	2
CO4	3	2	3	3	3
CO5	3	1	3	3	3

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/

23ADE111

SCALABLE ALGORITHMS AND SYSTEMS FOR DATA ANALYSIS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon successful completion of this course, students 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 scale data 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	3	3	2	2	2
CO4	2	2	2	3	3
CO5	2	2	3	3	3

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 and Regression Depth, Scalable Algorithms for Center points, Geometric Separators , Dimension Reduction: Random vs Spectral, Scalable Geometric Divide-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 Graph, 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, Foundation Trends Theoretical Computer Science, Firstedition, Now Publishers Inc.,2016
2. Nathalie Japkowicz, Jerzy Stefanowski, Big Data Analysis: New Algorithms for a NewSociety, 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

23ADE112

CYBER PHYSICAL SYSTEMS

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives

This course aims to:

1. Introduce basics of cyber-physical system and Industrial revolution 4.0 concepts
2. Design CPS requirements based on operating system and hardware architecture constraints.
3. Understand the concepts involved in Cyber Physical Systems Security.

Course Outcomes

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

1. Understand the basics of cyber-physical system and Industrial revolution 4.0 concepts
2. Understand the Cyber Physical System Hardware Platform
3. Analyse the working of Sensors, Actuators and Sensor Networks
4. Analyse the concepts involved in Cyber Physical Systems Security
5. Design CPS requirements based on operating system and hardware architecture constraints.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	2	2
CO2	2	2	2	3	3
CO3	2	2	1	3	2
CO4	2	2	1	2	2
CO5	3	3	1	3	3

UNIT - I

INTRODUCTION TO INDUSTRY 4.0 & CYBER PHYSICAL SYSTEM: Industry 4.0 - Globalization and Emerging Issues, The Fourth Revolution - Smart and Connected Business Perspective, Basics of Industrial IoT - Industrial Processes - Industrial Sensing & Actuation, Industrial Internet Systems - Basic principles of design and validation of CPS, Cyber-Physical Systems (CPS) in the real world, Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT - II

EMBEDDED SYSTEMS MODELING AND DESIGN AND CPS: Platform components, Embedded Systems definition, specification, and languages. Concepts, requirements, examples. Embedded system models at different abstraction levels. Test benches, design under test, Intellectual Property components. Discrete event simulation, semantics, algorithms. Design, and analysis techniques for decentralized computer architectures, communication, and hardware-software systems. Cyber Physical System Hardware Platform, Processors, Sensors, Actuators, Network, Wireless Hart, CAN, Automotive Ethernet, Software stack, Real-Time Operating system (RTOS) - Scheduling Real-Time control tasks.

UNIT – III

SENSORS, ACTUATORS AND SENSOR NETWORKS: Sensors, Actuators and Sensor Networks & Real-Time and Distributed Systems - Fundamental principles and applications of sensors, actuators. Smart sensors and micro sensor/micro actuator array devices. Introduction to signal processing and sensor/actuator networks, deployment and architecture, wireless communication, multiple access control layer, data gathering, routing and querying, collaborating signal processing, Time dependent systems, clock synchronization, real-time communication protocols, specification of requirements, task scheduling. Validation of timelines, real-time configuration management. Middleware architecture for distributed real-time and secure services.

UNIT – IV

SECURITY OF CYBER PHYSICAL SYSTEMS: Security of Cyber Physical Systems, Embedded and CPS security attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter-measures, security protocols. Privacy issues vehicular devices and smart metering. Applications of public key and symmetric cryptography, digital certificates, credentials. Security and vulnerability of cyber-physical infrastructure networks, Mobile and wireless network security, Robust wireless infrastructure, Cloud computing and data security, Event Awareness and System Monitoring for Cyber Physical Infrastructure.

UNIT – V

CYBER-PHYSICAL SYSTEMS CASE STUDIES AND PROJECTS: Cyber Physical Systems Case Studies and Projects, Automotive: SW controllers for Antilock braking system, Adaptive Cruise Control, Lane Departure Warning, Suspension Control, Healthcare: Artificial Pancreas/Infusion Pump/Pacemaker, Green Buildings: automated lighting, AC control, power distribution grid, robotics, civil infrastructure, avionics Transportation.

Text / Reference books:

1. "Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist (Apress)
2. "Industrial Internet of Things: Cyber manufacturing Systems" Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer)
3. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, http://LeeSeshia.org, ISBN 978-1-312-42740-2, 2015.
4. Rajeev Alur. Principles of Cyber-Physical Systems. MIT Press. 2015.
5. K. J. Astrom and R. M. Murray. Feedback Systems: An Introduction for Scientists and Engineers. Princeton University Press, 2009. http://www.cds.caltech.edu/~murray/amwiki/index.php/Main_Page.
6. Sajal Das, Krishna Kant, and Nan Zhang, Securing Cyber-Physical Critical Infrastructure – Foundations & Challenges, Morgan Kaufmann, 2012.

23ADE113

EXPLAINABLE ARTIFICIAL INTELLIGENCE (EAI)
(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives:

1. To Understand the concepts within Explainable AI and interpretable machine learning
2. To Summarize, visualize, and explore the data using graphical and non-graphical techniques
3. To know the Importance of XAI in modern world
4. To Categorize XAI on the basis of their scope, agnosticity, data types and explanation techniques
5. To know the working principles and mathematical modelling of XAI techniques

Course Outcomes:

Upon completing this course, students will be able to:

1. Describe the machine learning application's context and why explain ability might help.
2. Understand the concepts of model validation, evaluation, and performance visualization for both supervised and unsupervised learning.
3. Demonstrate post hoc explain ability techniques through a self-chosen set of programming platforms.
4. Illustrate the results from Explainable deep learning techniques and suggest how it helps the problem context.
5. Describe the comprehension of challenges and future related to Explainable AI

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	2	3	3
CO2	3	-	2	2	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

UNIT-I

Introduction: Black-Box problem, Goals, Brief History, Purpose, Societal Impact, Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques

Pre-model Interpretability and Explain ability: Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering

UNIT-II

Model Visualization Techniques and Traditional Interpretable Algorithms: Model Validation, Evaluation, and Hyper parameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms

UNIT-III

Model Interpretability: Advances in Interpretable Machine Learning: Interpretable vs. Explainable Algorithms, Tools and Libraries, Ensemble-Based, Decision Tree-Based, Rule-Based Techniques, Scoring System

Post-Hoc Interpretability and Explanations: Tools and Libraries, Visual Explanation, Feature Importance, Example-Based

UNIT-IV

Explainable Deep Learning: Applications, Tools and Libraries, Intrinsic, Perturbation, Gradient / Backpropagation

UNIT-V

Explain ability: Time Series Forecasting, Natural Language Processing, and Computer Vision

XAI: Challenges: Properties of Explanation, Categories of Explanation, Taxonomy of Explanation Evaluation

XAI: Future: Formalization of Explanation Techniques and Evaluations, Adoption of Interpretable Techniques, Human-Machine Collaboration, Collective Intelligence from Multiple Disciplines, Responsible AI (RAI), XAI and Security, Causality and XAI

Text Books:

1. Uday Kamath and John Liu "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer Cham, First Edition, 2021.

Suggested Reading:

1. Leonida Gianfagna and Antonio Di Cecco, "Explainable AI with Python", Springer International Publishing, First Edition, 2021.
2. Denis Rothman, "Hands-On Explainable AI (XAI) with Python", Packt Publishing, First Edition, 2020

Web Resources:

1. https://www.ibm.com/in-en/watson/explainable-ai
2. https://sites.google.com/view/explainable-ai-tutorial
3. https://cloud.google.com/explainable-ai

23ADE114

ADVANCED DATA STRUCTURES

(Program Elective-1, Elective-3 and Elective-5 Courses)

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

Course Objectives

This course aims to:

1. Understand the different mathematical abstractions and recurrences to solve problems
2. Become acquainted with different types of sorting and their complexity.
3. Familiarize with advanced data structures such as hash tables, B Trees, disjoint set union
4. Acquire knowledge on the various hierarchical data structures.
5. Understand graph algorithms such as shortest path, and minimum spanning tree.

Course Outcomes

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

1. Analyze the time complexity and performance of different algorithms.
2. Compare and contrast the different sorting algorithms based on time complexity
3. Select suitable data structures and algorithms, and use it to design algorithms for a specific problem.
4. Comprehend and analyze the different graph algorithms and apply graphs to model engineering problems.
5. Apply suitable algorithm design techniques to solve real-world problems.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	3
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	1	3
CO5	3	2	3	3	3

UNIT I

ASYMPTOTIC NOTATIONS AND RECURRENCES

Growth of functions – Asymptotic notations - Mathematical Induction - Solving Recurrences – Substitution Method – Recursion Tree Method – Master Method - Probabilistic Analysis and Randomized algorithms.

UNIT II

SORTING

Heaps – Heap sort Algorithm – Quick Sort –Randomized version of Quick sort – Sorting in linear time – Radix Sort – Bucket Sort – Topological Sorting – Medians.

UNIT III

HIERARCHICAL DATA STRUCTURES

Hash tables – Hash functions- B-trees-Fibonacci Heaps- Red Black Trees –AVL trees – Splay Trees-Data Structures for Disjoint sets.

UNIT IV
GRAPH ALGORITHMS
Representation of Graphs-Breadth First Search – Depth First Search – Minimum Spanning Trees – Single Source Shortest Paths – Maximum Flow – FordFulkerson, Edmonds-Karp algorithm - Maximum Bipartite Matching-Pattern Matching Algorithms.

UNIT V
ALGORITHMIC TECHNIQUES
Divide and Conquer -Dynamic Programming – Optimal Binary Search Trees – Greedy Algorithms – Huffman Codes – Amortized Analysis – NP completeness - Approximation Algorithms

TEXT BOOKS :

1. Thomas H Cormen, Charles. E.Leiserson, Ronald L.Rivest, and Clifford.Stein, Introduction to Algorithms", Third Edition MIT Press, ISBN: 978-0262033848, 2009.
2. 2. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Addison Wesley, ISBN-13: 978-0321573513, 2011.

REFERENCES :

1. Alfred V Aho, John E Hopcrof," The Design and Analysis of Computer Algorithms", Pearson Education, Fourth Edition ISBN: 978813170205, 2009.
2. Mark Allen Weiss," Data Structures and Algorithm Analysis in C++", Addison-Wesley, Third edition, ISBN: 978-0132847377, 2013.

23ADE115

HIGH PERFORMANCE COMPUTING

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives

This course aims to:

1. Understand the concepts of advanced processors
2. Learn the core of high end computers, components and their capacities
3. Understand the need for parallel algorithms
4. Build applications using parallel programming paradigm
5. Build solutions using programming model

Course Outcomes

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

1. Elucidate on advanced processors
2. Analyze the working of cluster and sky computing
3. Apply Parallel Algorithmic concepts to solve problems
4. Develop applications using Open MP and MPI
5. Develop applications using Open MP and MPI

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	1	2	2
CO2	1	-	1	2	2
CO3	1	1	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

Unit-I

Fundamentals of parallel processors Stored Program Computer Architecture- General purpose cache- based microprocessor-Performance based metrics and benchmarks- Moore's Law- Pipelining- Superscalarity- SIMD- Memory Hierarchies Cache- mapping- prefetch- Multicore processors- Mutithreaded processors- Vector Processors- Design Principles- Maximum performance estimatesProgramming for vector architecture – Data flow computers and VLSI Computations – Need for Migrating to Nanoscale Processors – Design of Quantum Processors and Quantum Logic gates with Qubits Processing.

Unit-II

Performance Enhancement Computing Cluster Computing and Sky Computing Introduction to Cluster Computing- Scalable Parallel Computer Architectures- Cluster Computer and its ArchitectureClassifications, Components for Clusters- Cluster Middleware and Single System Image- Resource Management and Scheduling, Programming Environments and Tools, Applications, Representative Cluster Systems, Heterogeneous Clusters, Security, Resource Sharing, Locality, Dependability, Cluster Architectures, Detecting and Masking Faults, Recovering from Faults, Condor, Evolution of Metacomputing. Virtualised Architecture for Cloud Computing Storage, Hypervisor usage and Integration of Cloud Computing for Sky Computing Model.

Unit-III

Perspective of Parallel Algorithms

Principles of parallel algorithm design - Data Parllel, Task graph, Work pool, master- slave, pipeline, Hybrid – Non – numerical algorithms, sorting, graph algorithms, search algorithms for discrete optimization problems, Dynamic programming – Numerical algorithms, Dense matrix algorithms, fast Fourier transforms.

Unit-IV

Constructs of Parallel Programming

Introduction to parallel computing – parallel programming platforms – Basic communication operations – Programming using message passing paradigm , MPI– Programming shared address space platforms, POSIX threads , open MP.

Unit-V

GPU ARCHITECTURE AND PROGRAMMING

Hardware Architecture – Integrated GPUs –Multi GPUs – GPU Architecture - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory. Introduction to CUDA C , parallel programming in CUDA C , Thread cooperation- Shared Memory and Synchronization.

Text Books:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman & Hall / CRC Computational Science series, 2011.
2. Parag K. Lala “Quantum Computing: A Beginners Introduction”, Mc Graw Hill, 2020.
3. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson Education, 2008.
4. Introduction to Parallel Computing , Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, 2003.
5. Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming‖, Addison - Wesley, 2013.
6. Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming‖, Addison - Wesley, 2010. https://link.springer.com/article/10.1007/s10586-017-0727-5 http://www.nvidia.com/object/cuda_home_new.html

23ADE116

ETHICS AND AI

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives

This course aims to:

1. Study the morality and ethics in AI
2. Learn about the Ethical initiatives in the field of artificial intelligence
3. Study about AI standards and Regulations
4. Study about social and ethical issues of Robot Ethics
5. Study about AI and Ethics- challenges and opportunities

Course Outcomes

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

1. Learn about morality and ethics in AI
2. Acquire the knowledge of real time application ethics, issues and its challenges.
3. Understand the ethical harms and ethical initiatives in AI
4. Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
5. Understand the concepts of Roboethics and Morality with professional responsibilities.
6. Learn about the societal issues in AI with National and International Strategies on AI

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	2	-	1	1
CO2	1	2	-	1	1
CO3	1	2	-	1	1
CO4	1	2	-	1	1
CO5	1	2	-	1	1
CO6	1	2	-	1	1

UNIT I

INTRODUCTION

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.

UNIT II

ETHICAL INITIATIVES IN AI

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

UNIT III

AI STANDARDS AND REGULATION

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT IV

ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility Roboethics Taxonomy.

UNIT V

AI AND ETHICS- CHALLENGES AND OPPORTUNITIES

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

TEXT BOOKS:

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, "The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

WEB LINK:

1. https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
2. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteenchallenges-and-opportunities/
3. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
4. https://sci-hub.mksa.top/10.1159/000492428

23ADE117

DIGITAL IMAGE PROCESSING AND ANALYSIS

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Learn the fundamental concepts and applications of digital image processing and analysis, image restoration and reconstruction concepts
2. Understand about wavelets and other transformations, morphological image processing concepts and various image segmentation techniques
3. Learn various feature extraction methods and image pattern classification approaches

Course Outcomes:

Upon successful compilation of the course, students 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 and Build an image pattern classification system using feature extraction and image pattern classification techniques

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	1	3	3
CO2	2	2	2	3	2
CO3	2	3	3	3	3
CO4	3	2	2	2	2
CO5	3	2	3	2	2

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 (Lowpass) Spatial Filters, Sharpening (Highpass) 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 Lowpass Frequency Domain Filters, Image Sharpening Using Highpass 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 Pre-processing, 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.

23ADE118

CYBER SECURITY

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Present basic concepts of Cybercrime and Cyber-attacks and Tools and Methods used in Cybercrime
2. Introduce Systems Vulnerability Scanning and tools
3. Familiarize with Network Defense tools and Web Application Tools.

Course Outcomes:

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

1. Infer legal and global perspectives of Cybercrimes.
2. Examine cybercrime methods, tools, attacks, and thefts.
3. Explore the vulnerability mechanisms and Injection Tools.
4. Demonstrate Network Défense tools used in investigations.
5. Explore web security tools

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	3	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	2	3	3	3
CO5	3	3	3	3	3

UNIT-I

Introduction to Cybercrime: Definition and origins of the word, Cybercrime and Information security, who are cyber criminals, 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, Viruses 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 and Injection 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 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

23ADE119

BIG DATA ANALYTICS

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Introduce to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Pig and Hive
2. Provide Large scale data storage technologies such as NoSQL distributed databases with MongoDB
3. Facilitate learning of Spark and GraphX with machine learning applications

Course Outcomes:

Upon completing this course, students will be able to:

1. Design of Hadoop Distributed Files system and build applications using MapReduce
2. Perform analysis on large datasets using Pig and Hive
3. Model the data using NoSQL and MongoDB
4. Develop applications of Parallel programming with Spark and Spark SQL
5. Develop machine learning solutions using Spark and Spark GraphX.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	3	3
CO2	3	2	2	3	2
CO3	3	1	1	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2

UNIT-I

Introduction to Big Data: Introduction, Big Data Enabling Technologies, Hadoop Stack for Big Data

The Hadoop Distributed Files system: Overview, The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems.

MapReduce: Overview, Developing a MapReduce Application, How MapReduce works, MapReduce Types and Formats, MapReduce Features, MapReduce Examples.

UNIT-II

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-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

Parallel programming with Spark: Overview of Spark, Fundamentals of Scala and functional programming, Spark concepts - Resilient Distributed Datasets (RDD), creating RDDs, Basic Transformations, Basic Actions, Word Count example; Spark operations, Job execution, Spark Applications – Cluster computing with working sets.

Spark SQL: What is SQL, Big Data and SQL – Spark SQL, How to Run Spark SQL Queries, Tables, Views, Databases, Select Statements.

UNIT-V

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.

Spark GraphX & Graph Analytics: *GraphX* – Introduction, Graphs in Machine Learning Landscape, Graph-structured data, PageRank, *Graph Analytics* – Property Graphs, Graph Operators, Distributed Graphs, GraphX – Unified Analytics; *Case Study*: Flight Data Analysis using Spark GraphX

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers & Matei Zaharia, “Spark: The Definitive Guide”, O'Reilly Media Inc, 2018.
3. 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. https://nptel.ac.in/courses/106104189
2. http://www.planetcassandra.org/what-is-nosql
3. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
4. https://class.coursera.org/datasci-001/lecture

23ADE120

AUGMENTED AND VIRTUAL REALITY

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Familiarize the students with the fundamentals of Virtual Reality, deal with the Development Tools and Frameworks in Virtual Reality.
2. Impart the knowledge of 3D orientation for understanding the behaviour of VR system with the environment.
3. Introduce the applications of Virtual Reality Systems, technology and features of augmented reality.

Course Outcomes:

Upon successful completion of this course, students 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. Analyse Development Tools and Frameworks in Virtual Reality.
4. Develop a Virtual Reality application.
5. Evaluate Augmented Reality Systems

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	2	3	3
CO2	2	2	2	3	2
CO3	2	3	3	3	3
CO4	3	2	2	2	2
CO5	3	2	3	2	2

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 Way finding, Types of Centred-Way finding Support, Evaluating Way finding Aids, System Control, Classification, Graphical Menus, Voice Commands, Gestural Commands, Tools, Muti-modal System Control Techniques, Case Study: Mixing System Control Methods, Symbolic Input Tasks.

UNIT-III

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

UNIT-IV

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

UNIT- V

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

Text Books:

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

Suggested Reading:

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

Web Resource:

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

23ADE121

PREDICTIVE ANALYTICS WITH 'R'

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Introduce Predictive Modeling.
2. Familiarize Regression and Classification Techniques.
3. Impart knowledge on the concepts of Support vector machines and Neural Networks.
4. Explore tree based classifiers and ensemble methods
5. Introduce Topic modeling.

Course Outcomes:

Upon successful completion of 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. Analyse ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphic models and identify topics through topic modelling

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	2	3
CO2	3	2	3	2	3
CO3	3	2	3	2	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

UNIT-I

Gearing Up for Predictive Modeling: 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, Pre-processing 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

23ADE122

NATURAL LANGUAGE PROCESSING

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon successful completion of 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. Analyse linguistic structure of text and build feature-based grammar.
5. Determine the semantics of sentences using WordNet and Treebank.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	-	-	3	-	3
CO2	3	-	-	2	3
CO3	3	-	1	-	3
CO4	3	--	2	2	3
CO5	-	-	2	-	3

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, Modelling 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, 2nd Edition, 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

23ADE123

ROBOTIC PROCESS AUTOMATION

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Give an overview of the Automation Anywhere Enterprise Platform, Architecture, and Components; and explain in detail various features and functionalities of the platform.
2. Make use of data manipulation concepts.
3. Create Bots using different types of Recorders and provide an overview of MetaBots.

Course Outcomes:

Upon successful completion of this course, students 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. Analyse various aspects of Meta Bots in Visual captures.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	2	2	3
CO2	2	1	-	2	2
CO3	3	2	1	3	3
CO4	2	1	2	2	2
CO5	3	2	1	3	2

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

23ADE124

FEDERATED MACHINE LEARNING

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Understand the key concepts and issues behind Federated Learning
2. Get familiar with key theoretical results of Federated Learning
3. Understand the key concepts of reinforcement Learning

Course Outcomes:

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

1. Knowledge of the basic concepts, architecture, and applications of FL.
2. Understanding of new research and application trends in FL.
3. Analyze distributed Machine Learning
4. Analyze horizontal federated learning
5. Understand the significance of Federated Learning for Vision, Language, and Recommendation

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	1	1	1	1
CO2	2	2	1	2	3
CO3	2	2	1	3	3
CO4	1	2	-	2	2
CO5	2	3	2	2	2

UNIT - I

Introduction: Motivation, Federated Learning as a Solution, The Definition of Federated Learning, Categories of Federated Learning, Current Development in Federated Learning, Research Issues in Federated Learning, Open-Source Projects, Standardization Efforts, The Federated AI Ecosystem Background: Privacy-Preserving Machine Learning, PPML and Secure ML, Threat and Security Models, Privacy Threat Models, Adversary and Security Models, Privacy Preservation Techniques, Secure Multi- Party Computation, Homomorphic Encryption, Differential Privacy.

UNIT - II

Distributed Machine Learning: Introduction to DML, The Definition of DML, DML Platforms, Scalability-Motivated DML, Large-Scale Machine Learning, Scalability-Oriented DML Schemes, Privacy-Motivated DML, Privacy-Preserving Decision Trees, Privacy-Preserving Techniques, Privacy-Preserving DML Schemes, Privacy-Preserving Gradient Descent, Vanilla Federated Learning, Privacy-Preserving Methods.

UNIT - III

Horizontal Federated Learning: The Definition of HFL, Architecture of HFL, The Client- Server Architecture, The Peer-to-Peer Architecture, Global Model Evaluation, The Federated Averaging Algorithm, Federated Optimization, The FedAvg Algorithm, The Secured FedAvg Algorithm, Improvement of the FedAvg Algorithm, Communication Efficiency, Client Selection Vertical Federated Learning: The Definition of VFL, Architecture of VFL, Algorithms of VFL, Secure Federated Linear Regression, Secure Federated Tree-Boosting.

UNIT - IV

Federated Transfer Learning: Heterogeneous Federated Learning, Federated Transfer Learning, The FTL Framework, Additively Homomorphic Encryption, The FTL Training Process, The FTL Prediction Process, Security Analysis, Secret Sharing-Based FTL Incentive Mechanism Design for Federated Learning: Paying for Contributions, Profit- Sharing Games, Reverse Auctions, A Fairness-Aware Profit Sharing Framework, Modeling Contribution, Modeling Cost, Modeling Regret, Modeling Temporal Regret, The Policy Orchestrator, Computing Payoff Weightage.

UNIT - V

Federated Learning for Vision, Language, and Recommendation: Federated Learning for Computer Vision, Federated CV, Federated Learning for NLP, Federated NLP, Federated Learning for Recommendation Systems, Recommendation Model, Federated Recommendation System Federated Reinforcement Learning: Introduction to Reinforcement Learning, Policy, Reward, Value Function, Model of the Environment, RL Background Example, Reinforcement Learning Algorithms, Distributed Reinforcement Learning, Asynchronous Distributed Reinforcement Learning, Synchronous Distributed Reinforcement Learning, Federated Reinforcement Learning, Background and Categorization.

TEXT BOOK:

1. Federated Learning, Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and HanYu - Synthesis Lectures on Artificial Intelligence and Machine Learning 2019.

23ADE125

INTERNET OF THINGS

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Provide an overview of Internet of Things, building blocks of IoT.
2. Explore various IoT enabling technologies, Levels and Applications.
3. Facilitate with steps in IoT design Methodology.
4. Identify the Raspberry pi and other devices and end points.
5. Introduce about the Raspberry Pi device, its interfaces and Django Framework.

Course Outcomes:

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

1. Describe the terminology, protocols, Communication models and APIs of IoT.
2. Analyse 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	3	2
CO2	2	-	3	3	3
CO3	3	3	3	3	3
CO4	2	2	3	3	3
CO5	3	2	3	3	3

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

23ADE126

ADVANCED ALGORITHMS

(Program Elective-2 and Elective-4 Courses)

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

Course Objectives:

This course aims to:

1. Learn algorithmic design approaches and learn the basic data structures for solving problems.
2. Facilitate learning of algorithms related to network flow, text processing and computational geometry.
3. Impart knowledge about number theory and cryptography.

Course Outcomes:

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

1. Understand the basic data structures and analyse 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	1	1	1	1
CO2	2	2	2	3	3
CO3	2	2	-	3	2
CO4	1	-	1	2	1
CO5	2	3	2	2	2

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/

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING
(**Audit Course – 1 and 2**)

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

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

Course Objectives:
This course aims to:

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

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

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

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PSO1	PSO2
CO 1	1	2	1	1	1
CO 2	1	1	1	1	1
CO 3	1	2	2	1	1
CO 4	1	2	1	1	1
CO 5	2	3	1	1	1

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

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

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

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

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

Text Books:

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

***Suggested Reading**:*

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Hand book for writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

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

Writing Tools:

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

23CEA101

DISASTER MITIGATION AND MANAGEMENT
(Audit Course – 1 and 2)

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

Course Objectives:

The objectives of this course are

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human-induced factors and associated impacts and mitigation measures of the various natural disasters with appropriate disaster management plan.
2. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc. and to understand participatory role of engineers in disaster management.
3. 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 successful completion of this course, students will be able to:

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

CO-PO Articulation Matrix

COs	PO1	PO2	PO3	PO4
CO1	2	2		1
CO2	1	2		1
CO3	1	1		1
CO4	1	2		1
CO5	1	2		1

UNIT- I:

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

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

UNIT- III:
Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related 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 responsewater, 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

References:

1. Pradeep Sahni," Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh," Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.
3. Ministry of Home Affairs". Government of India, "National disaster management plan, Part I and II",
4. K. K. Ghosh," Disaster Management", APH Publishing Corporation, 2006.
5. http://www.indiaenvironmentportal.org.in/files/file/ disaster_management_india1.pdf
6. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
7. Hazards, Disasters and your community: A booklet for students and the community, Ministry of home affairs.

23EEA101

SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course – 1 and 2)

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

Prerequisite: None

Course Objectives:

This course aims to:

1. Get a working knowledge in illustrious Sanskrit, the scientific language in the world.
2. Make the novice Learn the Sanskrit develop the logic in mathematics, science & other subjects.
3. Explore the huge knowledge from ancient literature.

Course Outcomes:

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

1. Develop passion towards Sanskrit language.
2. Decipher the latent engineering principles from Sanskrit literature.
3. Correlates the technological concepts with ancient Sanskrit history.
4. Develop knowledge for technological progress.
5. Explore the avenue for research in engineering with the aid of Sanskrit.

CO-PO Articulation Matrix

PO / CO	PO 1	PO 2	PO 3	PO 4
CO 1	-	1	1	1
CO 2	2	1	1	1
CO 3	2	1	1	1
CO 4	2	1	1	1
CO 5	2	1	1	1

UNIT -I

Introduction 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-Madhavas sine and cosine theory (origination of Taylors 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 (Biotechnology 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

Textbooks:

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

Suggested Reading:

1. “The Wonder that is Sanskrit”, Auro Publications, ISBN: 978-8170601821, 2017.
2. “Science in Sanskrit”, Samskrita Bharti Publisher, ISBN-13: 978-8187276333, 2007
3. “A Treasury of Indian Wisdom: An Anthology of Spiritual Learn”, ISBN: 978-0143426158, 2016.

23EC A101

VALUE EDUCATION
(Audit Course – 1 and 2)

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

Prerequisite: Knowledge about universal human values.

Course Objectives: This course aims to:
1. Understand Value Education, self-development and National development.
2. Imbibe good human values and Morals in students.
3. Let them should know about the importance of character.

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

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5
CO 1	1	1	1	1	3
CO 2	1	1	1	1	3
CO 3	1	1	1	1	3
CO 4	1	1	1	1	3
CO 5	1	1	1	1	3

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Human Values, Indian concept of humanism, Values for self-development, Social values, Individual attitudes, Work ethics, Moral and non- moral behavior, Standards and Principles based on religion, Culture and Tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior Development, Scientific attitude and Spiritual (soul) outlook, Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, Forgiveness, Dignity of labor, True friendship, Universal brotherhood and religious tolerance., Happiness Vs Suffering, Love for truth, Aware of self-destructive habits, Appreciation and co-operation.

UNIT-IV

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

UNIT-V

All religions and same message: Mind your mind, Self-control**,** Concept of soul;, Science of Reincarnation, Character and Conduct, Concept of Dharma, Cause and Effect based Karma Theory;, The qualities of Devine and Devilish;,Satwic, Rajasic and Tamasic gunas.

Text Book:

1. Chakroborty, S.K. "Values & Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1998.

Suggested Reading:

1. Jaya DayalGoyandaka, "Srimad Bhagavad Gita", with Sanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

23EGA103

STRESS MANAGEMENT BY YOGA
(**Audit Course – 1 and 2**)

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

Prerequisite: Knowledge on Yoga Practices.

Course Objectives:

This course aims to:

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

Course Outcomes:

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

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas
5. Improve work performance and efficiency

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PSO1	PSO2
CO 1	1	1	-	-	1
CO 2	1	1	-	-	1
CO 3	1	1	-	-	1
CO 4	1	1	-	-	1
CO 5	1	1	-	-	1

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT – IV

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

UNIT – V

Pranayama- Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Text Books:

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

Online Resources:

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

23EGA104

PERSONALITY DEVELOPMENT THROUGH LIFE'S ENLIGHTENMENT SKILLS
(Audit Course – 1 and 2)

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

Prerequisite: Awareness on Personality Development.

Course Objectives:

This course aims to:

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

Course Outcomes:

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

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO 1	1	1	-	1	1
CO 2	1	1	-	1	1
CO 3	1	1	-	1	1
CO 4	1	1	-	1	1
CO 5	1	1	-	1	1

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

Text Books:

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

Online Resources:

6. http://nptel.ac.in/downloads/109104115/

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23CSO101

BUSINESS ANALYTICS
(Open Elective)

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

Course Objectives:

The objectives of this course are

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

Course Outcomes:

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Textbooks:

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

Suggested Readings:

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

Online Resources::

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

23MEO102

INTRODUCTION TO OPTIMIZATION TECHNIQUES
(Open Elective)

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

Course Objectives:

The objectives of this course are

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

Course Outcomes:

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

1. Formulate a linear programming problems (LPP)
2. Build and solve Transportation Models and Assignment Models.
3. Apply project management techniques like CPM and PERT to plan and execute project successfully
4. Apply queuing and inventory concepts in industrial applications
5. Apply sequencing models in industries

CO-PO Articulation Matrix

CO \ PO	PO1	PO2	PO3
CO1	3	1	3
CO2	3	1	3
CO3	1	1	3
CO4	2	1	3
CO5	2	1	3

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

23CEO101

COST MANAGEMENT OF ENGINEERING PROJECTS
(OPEN ELECTIVE– Common to All Branches)

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

Course Objectives:

The objectives of this course are

1. To enable students to understand the concepts of project management, project planning, and scheduling.
2. To provide knowledge of project monitoring and cost management.
3. To understand the concepts of budgetary control and Quantitative techniques for cost management.

Course Outcomes:

Upon successful completion of 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.

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4
CO1	2	1	-	3
CO2	2	1	-	-
CO3	2	2	-	-
CO4	2	2	1	1

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, and responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT-II:

Project Planning and Scheduling: Introduction for project planning, defining activities and their 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: praetor 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.

References:

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 NeerajJha "Construction Project Management Theory and Practice",Pearson Education India; 2 edition (2015)

23MEO101

INDUSTRIAL SAFETY
(Open Elective)

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

Course Objectives:

The objectives of this course are

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 equipment used in industry

Course Outcomes:

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

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

CO-PO Articulation Matrix

PO / CO	PO1	PO2	PO3
CO1	3	3	3
CO2	3	3	3
CO3	3	1	3
CO4	3	1	3
CO5	3	2	3

UNIT - I

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

UNIT – II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, 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 sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance, Repair cycle concept and importance

Text Books:

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

Suggested Readings:

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

23MEO103

COMPOSITE MATERIALS

(Open Elective)

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

Objectives: Student will understand

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.

Outcomes: At the end of the course, student 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.

CO-PO Articulation Matrix

PO / CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3
CO5	2	1	3

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

Suggested Readings:

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

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23EEO101

WASTE TO ENERGY
(Open Elective)

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

Prerequisite: Students should have prior knowledge of Energy Conversions.

Course Objectives:

The objectives of this course are

1. Know the various forms of waste.
2. Extraction of Energy from Waste.
3. Infer the Global and national scenario.

Course Outcomes:

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

1. Understand the concept of waste energy.
2. Explore the various Energy extraction options.
3. Describe the Energy Production methodology.
4. Explicate the Environmental implications.
5. Compare and contrast waste energy productions by case studies.

CO-PO Articulation Matrix

CO \ PO	PO 1	PO 2	PO 3
CO 1	PO1	PO2	PO3
CO 2	2	1	1
CO 3	2	1	1
CO 4	2	1	1
CO 5	-	-	1

UNIT -I

Introduction: The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source. Waste Sources & Characterization Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

UNIT -II

Energy Extraction Options: Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and

Industrial boilers. Conversion of wastes fuel resources for other useful energy applications Energy from Plastic Wastes: Non-recyclable plastic wastes for energy recovery. Energy Recovery from waste and optimization of its use, benchmarking and standardization. Energy Analysis

UNIT -III

Energy production Methodologies: Collection, segregation, transportation and storage requirements. Location and Siting of 'Waste Energy' plants. Industry Specific Applications: In-house use: sugar, distillery, pharmaceuticals, Pulp and paper, refinery and petrochemical industry and any other industry. Centralized and Decentralized Energy production, distribution and use. Comparison of Centralized and decentralized systems and its operations

UNIT -IV

Environmental Implications: Environmental standards for Waste Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms

UNIT -V

Case Studies: Success/failures of waste energy Global Best Practices in Waste energy production distribution and use. Indian Scenario on Waste Energy production distribution and use in India. Success and Failures of Indian Waste Energy plants. Role of the Government in promoting 'Waste Energy.'

Textbooks:

1. "Industrial and Urban Waste Management in India", TERI Press.
2. Banwari Lal and Patwardhan, "Wealth from Waste: Trends and Technologies" TERI Press.
3. S.N Mukhopadhyay, "Fundamentals of waste and Environmental Engineering", TERIPress.
4. "Waste-to-Energy in Austria – White Book – Figures, Data Facts", 2nd edition, May 2010.

Suggested Reading:

1. CPCB Guidelines for Co-processing in Cement/Power/Steel Industry
2. Report of the task Force on Waste Energy, Niti Ayog (Formerly Planning Commission) 2014.
3. Municipal Solid Waste Management Manual, CPHEEO, 2016
4. Gazette Notification on Waste Management Rules 2016.

23MTC102

MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. To learn techniques for finding Eigen values and Eigen vectors.
2. To learn about reliability for probability function.
3. To learn about Estimating the parameter using LR test.
4. To learn about Hypothesis Testing for generalized linear model.
5. To learn about Prediction and Analysis of Variance.

Course Outcomes:

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

1. Construct Eigen vectors for the nth order transformation.
2. Test the reliability for the probability function.
3. Estimate the parameter using the LR test.
4. Identify the significance level for the generalized linear model.
5. Predict the values of generalized linear models using Analysis of Variance.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3		2	2	1
CO2	3		2	2	1
CO3	3		2	2	1
CO4	3		2	2	1
CO5	3		2	2	1

LIST OF PROGRAMS:

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

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.

23ADC105

ARTIFICIAL INTELLIGENCE LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. Familiarize with search and game playing strategies.
2. Introduce logic programming concepts through Prolog
3. Learn probabilistic reasoning on uncertain data.
4. Learn knowledge representation and inference
5. Learn building AI Systems

Course Outcomes:

Upon successful completion of the course the 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	2
CO3	2	1	3	2	2
CO4	2	-	3	3	3
CO5	2	1	3	2	1

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 Book:

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 Resource:

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

23ADC106

INTRODUCTION TO DATA SCIENCE LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:
This course aims to:
1. Introduce data structures in Python.
2. Familiarise with data types and file formats.
3. Gain knowledge on data pre-processing and data visualization.
4. Acquaint with supervised and unsupervised learning algorithms.
5. Explore various case studies.

Course Outcomes:
Upon successful completion of 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	3	2	3
CO2	2	2	3	2	3
CO3	2	2	3	2	3
CO4	2	2	3	2	3
CO5	2	2	3	2	3

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

EBOOKS:

1. https://www.programmer-books.com/introducing-data-science-pdf/
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf

Web Resources:

1. https://www.kaggle.com/getting-started
2. https://www.edx.org/course/python-basics-for-data-science
3. https://www.edx.org/course/analyzing-data-with-python
4. https://www.coursera.org/learn/python-plotting?specialization=data-science-python

23ADC107

MACHINE LEARNING LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. Impart knowledge of dimensionality reduction and clustering techniques.
2. Introduce the concept of decision tree for supervised learning.
3. Familiarize with Bayesian decision theory and probabilistic methods.
4. Introduce the concept of SVM.
5. Familiarize with ensemble methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Perform dimensionality reduction of a dataset.
2. Build decision trees for classification.
3. Design solutions using SVM, KNN, Regression algorithms.
4. Perform clustering of data.
5. Use principle Component Analysis for feature Extraction.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	2	1	3	3	3
CO3	3	1	3	3	2
CO4	2	1	3	3	2
CO5	3	1	3	2	2

LIST OF PROGRAMS:

1. Vectors, Matrices, and Arrays representation, Loading of different types of data
2. Data Wrangling, Handling Numerical, Categorical and Image Data
3. Dimensionality Reduction Using Feature Extraction, Feature Selection
4. Linear Regression, Nonlinear Regression, Ridge Regression, Esso Regression, Logistic Regression
5. Semi-Supervised Training-Self-Training, Co-Training
6. Decision Trees and Random Forest
7. K-Nearest Neighbor Classifiers with different similarity Measures
8. Support Vector Machines for Classification and Regression
9. Naive Bayes classifier for continuous and discrete datasets
10. Principle Component Analysis for data reduction
11. Clustering using K-Means, DBSCAN
12. Model Selection, Saving and Loading Trained Models.

Text Book:

1. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow”,
2. Giuseppe Bonaccorso, Machine Learning Algorithms, PACKT, Second Edition, 2017.
3. Chris Albon, “Python Machine Learning Cook Book”. Orielly, Ist Edition, 2018

Suggested Reading:

1. Tom Mitchel, “Machine Learning”, Tata McGraW Hill, 2017.
2. Stephen Marshland, “Machine Learning: An Algorithmic Perspective”, CRC Press Taylor & Francis, 2nd Edition, 2015

Datasets:

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

Web Resource:

1. https://www.coursera.org/specializations/machine-learning

23ADE127

DIGITAL IMAGE PROCESSING AND ANALYSIS LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. Learn intensity transformations, smoothing and sharpening image restoration and reconstruction.
2. Learn the usage of wavelets and other image transforms, image compression methods Huffman Coding, Arithmetic Coding, LZW Coding, Block Transform Coding
3. Learn the use of morphological, segmentation algorithms and image 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 and Build an image pattern classification system

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	2	2	2
CO2	2	2	2	3	2
CO3	2	3	3	3	3
CO4	3	2	2	2	2
CO5	3	2	3	2	2

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 Books:

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.

23ADE128

CYBER SECURITY LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. To give an overview about TCP and Port Scanning using NMAP.
2. To familiarize with the concepts of Netcat and Open VAS
3. To facilitate understanding of DAMN and Cross-site scripting, snort tool, and Net stumbler.

Course Outcomes:

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

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

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	3	2
CO2	2	2	3	3	2
CO3	3	2	3	3	2
CO4	3	3	3	3	3
CO5	3	3	3	3	3

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 WPA Using 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/

23ADE129

BIG DATA ANALYTICS LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. To provide the knowledge to setup a Hadoop Cluster and to develop programs using MapReduce
2. To introduce Pig, PigLatin and HiveQL and NoSQL to process big data
3. To introduce the latest big data frameworks and writing applications using Spark and Scala

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 using MapReduce
3. Write scripts using Pig to solve real world problems.
4. Write queries using Hive to analyse the datasets
5. Use Spark working environment to solve real world problems.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2	3	2
CO2	3	2	2	3	2
CO3	3	1	2	3	2
CO4	3	1	2	3	2
CO5	3	1	2	3	3

LIST OF PROGRAMS:

1. Demonstrate the following using HDFS
    a. Basic HDFS commands
    b. Working with Hadoop file system: Reading, Writing and Copying
2. Develop the following applications using MapReduce
    a. Word count application using Map Reduce on single node cluster
    b. Analysis of Weather Dataset on Multi node Cluster using Hadoop
    c. Real world case studies on Map Reduce applications
3. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
4. Working with Hive on the following
    a. HiveQL
    b. Writing User Defined Functions in Hive
5. Demonstrate the working of NoSQL database MongoDB
6. Implement the following on Spark
    a. Processing large datasets on Spark framework
    b. Word count application
7. Build a Clustering Model with Spark
8. Implement the case study “Flight Data Analysis” using Spark GraphX

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.

23ADE130

AUGMENTED AND VIRTUAL REALITY LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

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

Course Outcomes:

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

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

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	3	2	3
CO2	3	2	2	3	2
CO3	3	3	3	3	3
CO4	2	2	2	2	2
CO5	2	3	3	2	2

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 AukstakalnisPractical 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

23ADE131

PREDICTIVE ANALYTICS WITH 'R' LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon successful completion of this course, students 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

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

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
14.

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.
4. Hadley Wickham, Garrett Grolemund," R for Data Science, OREILLY Publication, 2017

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
4. https://online-learning.harvard.edu/subject/r
5. https://www.udemy.com/course/r-basics/
6. https://www.datacamp.com/courses/free-introduction-to-r
7. https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf

23ADE132

NATURAL LANGUAGE PROCESSING LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon successful completion of 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	-	2	3	-	3
CO2	3	-	-	2	3
CO3	3	2	-	-	3
CO4	3	-1	2	2	3
CO5	1	-	2	-	3

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 Readings:

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

23ADE133

ROBOTIC PROCESS AUTOMATION LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

1. To familiarize Automation Anywhere Enterprise Platform
2. To enhance creation of Bots using different types of Recorders and data manipulation commands.
3. To impart the knowledge of MetaBots and its features.

Course Outcomes:

Upon successful completion of this course, students 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	3	1	2	2
CO2	1	1	-	1	1
CO3	2	2	1	2	2
CO4	3	2	1	3	3
CO5	2	3	1	3	2

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/

23ADE134

FEDERATED MACHINE LEARNING LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

The students will be able to

1. Develop a foundational understanding of federated learning concepts, including decentralized training, privacy preservation, and model aggregation.
2. Learn how to set up federated learning environments using popular Python libraries like PySyft, TensorFlow Federated, or PyTorch, allowing for decentralized model training.
3. Explore and implement privacy preservation techniques such as differential privacy and homomorphic encryption to protect individual data privacy within federated learning setups.
4. Dive deep into advanced federated learning algorithms like FedProx, FedAvg-M, or FedAdapt, understanding their principles and practical applications.
5. Apply federated learning to real-world datasets and use cases, like healthcare, finance, or IoT data, and analyze the challenges and complexities involved in practical deployments.

Course Outcomes:

1. Create federated learning environments using Python libraries like PySyft, TensorFlow Federated, or PyTorch, allowing for decentralized model training.
2. Practical experience in integrating privacy preservation mechanisms like differential privacy and homomorphic encryption into federated learning, ensuring data privacy.
3. Deep understanding of advanced federated learning algorithms (e.g., FedProx, FedAvg-M, FedAdapt) and their applications in solving complex machine learning problems.
4. Apply federated learning to real-world datasets and use cases, demonstrating their ability to address practical challenges in various domains.
5. Develop problem-solving skills and adaptability, enabling them to design fault-tolerant mechanisms, explore model compression techniques, and handle heterogeneity in federated learning scenarios.

LIST OF EXPERIMENTS

1. Create a federated learning environment using Python libraries like PySyft, TensorFlow Federated, or PyTorch.
2. Implement federated averaging to train a simple model on decentralized nodes.
3. Integrate differential privacy mechanisms (e.g., Laplace noise) into federated learning to protect individual data privacy.
4. Experiment with homomorphic encryption libraries (e.g., PySEAL) to secure model updates during federated learning.
5. Implement secure aggregation protocols (e.g., Secure Multi-Party Computation) for aggregating model updates securely.
6. Create a federated learning scenario with heterogeneous devices (e.g., different types of smartphones) and analyze the challenges.
7. Generate synthetic non-IID data and observe how it affects federated learning model performance.
8. Explore advanced federated learning algorithms like FedProx, FedAvg-M, or FedAdapt.
9. Experiment with model compression techniques (e.g., quantization, pruning) in the context of federated learning to reduce communication overhead.
10. Introduce node failures or adversarial nodes and implement fault-tolerant mechanisms to ensure robustness in federated learning.
11. Apply federated learning to real-world datasets and use cases, such as healthcare, finance, or IoT data.

Text Books:

1. Nakayama, Kiyoshi, and George Jeno. Federated Learning with Python. 1st ed. Packt Publishing, 2022.
2. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, and Han Yu, Federated Learning, - Synthesis Lectures , on Artificial Intelligence and Machine Learning, Morgan & Claypool Publishers, 2019.

Suggested Reading:

1. Kairouz, Peter, and McMahan, H. Brendan, Advances and Open Problems in Federated Learning. United States, Now Publishers, 2021.
2. Heiko Ludwig, Nathalie Baracaldo, Federated Learning: A Comprehensive Overview of Methods and Applications. Poland, Springer International Publishing, 2022.
3. Verma, Dinesh C. Federated AI for Real-World Business Scenarios. United States, CRC Press, 2021.
4. Lam M. Nguyen, Pin-Yu Chen, Trong Nghia Hoang, Federated Learning: Theory and Practice. United Kingdom, Elsevier Science, 2024.
5. A. Jose Anand, R. Kavitha, R. Srinivasan, S. Suresh, Saravanan Krishnan, Handbook on Federated Learning: Advances, Applications and Opportunities. N.p., Taylor & Francis Group, 2024.
6. Chaoqun You, Gang Feng, Lei Zhang, Yao Sun, Federated Learning for Future Intelligent Wireless Networks. United Kingdom, Wiley, 2023.

Web Links:

1. https://www.tensorflow.org/federated
2. https://openmined.github.io/PySyft/index.html
3. https://opendp.org/

23ADE135

INTERNET OF THINGS LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

This course aims to:

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

Course Outcomes:

Upon completing this course, students will be able to:

1. Develop interfacing techniques with Raspberry Pi
2. Implement Python scripts that run on Raspberry Pi/Arduino.
3. Build IoT Applications using sensors.
4. Demonstrate Read and write cloud data using Thing speak.
5. Interpret the Case studies in different domains.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	1	2	3	3
CO2	2	1	3	3	3
CO3	2	1	3	3	3
CO4	2	1	2	3	3
CO5	2	1	3	3	2

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. Study and Configure Raspberry Pi.
2. Write programs using Raspberry Pi to blink LED. a)Using loops b)Using conditional & control statements.
3. Write program using Raspberry Pi to interface LEDs, Switch and Buzzer.
4. Write a program to send an e-mail using switch.
5. Write a program to blink LED for quiz questions.
6. Implementation of Traffic Light System
7. Interface different Sensors using Raspberry Pi.
   a) Temperature & Humidity b) PIR c) GAS d) LDR d) Rain e) Soil moisture.
8. Write a program to monitor temperature and humidity using DHT (Digital Humidity andTemperature) sensor using Raspberry Pi / Arduino.
9. Uploading and reading the Cloud data using Thing speak platform.

Text Books:

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

Suggested Reading:

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

Web Resources:

1. http://www.circuitbasics.com/raspberry-pi-ds18b20-temperature-sensor-tutorial/.
2. https://raspberrypihq.com/making-a-led-blink-using-the-raspberry-pi-and-python/.
3. https://raspi.tv/wp-content/uploads/2017/11/Raindrop-sensor-experiment_bb_1000_01.jpg
4. https://www.instructables.com/Soil-Moisture-Sensor-Raspberry-Pi/?amp_page=true
5. https://www.electronicshub.org/raspberry-pi-dht11-humidity-temperature-sensor-interface/
6. https://maker.pro/raspberry-pi/tutorial/how-to-interface-a-pir-motion-sensor-with-raspberry-pi-gpio

23ADE136

ADVANCED ALGORITHMS LAB

(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

The objectives of this course are

1. Impart the different algorithmic design paradigms to solve problems.
2. Familiarise the advanced concepts of tree data structures and graphs.
3. Learn the implementation of cryptographic algorithms.

Course Outcomes:

Upon successful completion of this course, students 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. Analyse 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.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	1	2	2	2	2
CO2	3	2	2	3	3
CO3	2	2	-	3	2
CO4	1	1	1	2	2
CO5	3	3	3	3	2

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/