DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Scheme of Instruction
and
Syllabi of

M.TECH. (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

AICTE Model Curriculum

2021-2022

UNIVERSITY COLLEGE OF ENGINEERING

(AUTONOMOUS)
OSMANIA UNIVERSITY
HYDERABAD – 500 007, TELANGANA

SCHEME OF INSTRUCTION
M.TECH. (COMPUTER SCIENCE AND ENGINEERING)

S.No	Type of Course	Course Code	Course Name	Contact hours per Week			Scheme of Examination		Credits
				L	T	P	CIE	SEE	
SEMESTER-I									
1	Core-I	CS101	Mathematical foundations of Computer Science	3	0	0	30	70	3
2	Core-II	CS301	Machine Learning	3	0	0	30	70	3
3	Professional Elective-I	CS121	Natural Language Processing	3	0	0	30	70	3
		CS311	Machine Vision						
		CS312	Data Mining						
		CS114	Advanced Operating Systems						
		CS102	Advanced Data Structures						
4	Professional Elective-II	CS321	Reinforcement Learning	3	0	0	30	70	3
		CS322	Data Engineering & Databases for Data science						
		CS122	Information Retrieval Systems						
		CS125	Object Oriented Software Engineering						
		CS323	Web Engineering						
5	Mandatory Course	CS100	Research Methodology in Computer Science	3	0	0	30	70	3
6	Audit Course- I	AC031	English for Research Paper Writing	2	0	0	30	70	0
		AC032	Disaster Management						
		AC033	Sanskrit for Technical Knowledge						
		AC034	Value Education						
7	Core Lab-I	CS 351	Machine Learning Lab	0	0	3	50	0	1.5
8	Elective Lab-I	CS xxx	Elective Lab-I	0	0	3	50	0	1.5
			TOTAL	**17**	**0**	**6**	**280**	**420**	**18**

SEMESTER – II

S.No	Type of Course	Course Code	Course Name	Contact hours per Week			Scheme of Examination		Credits
				L	T	P	CIE	SEE	
1	Core-III	CS104	Artificial Intelligence	3	0	0	30	70	3
2	Core-IV	CS302	Deep Learning	3	0	0	30	70	3
3	Professional Elective-III	CS331	Statistical Machine Translation	3	0	0	30	70	3
		CS332	Sentiment Analysis						
		CS333	Advanced Visual Recognition						
		CS131	Image Processing						
		CS213	Multimedia Technologies						
4	Professional Elective-IV	CS341	Distributed databases	3	0	0	30	70	3
		CS342	Scalable architectures for ML Applications						
		CS103	Advanced Algorithms						
		CS343	Web Mining						
		CS216	Soft Computing						
		CS144	Artificial Neural Networks						
5	Audit Course-II	AC035	Constitution of India	2	0	0	30	70	0
		AC036	Pedagogy Studies						
		AC037	Stress Management by Yoga						
		AC038	Personality Development through Life Enlighten Skills						
6		CS 070	Mini Project	0	0	6	50*	0	3
7	Core Lab-II	CS xxx	Artificial Intelligence Lab	0	0	3	50	0	1.5
8	Elective Lab-II	CS xxx	Elective Lab-II	0	0	3	50	0	1.5
TOTAL				**14**	**0**	**12**	**300**	**350**	**18**

SEMESTER-III									
1	Profession Elective-V	CS351	Automatic Speech Recognition	3	0	0	30	70	3
		CS352	Deep Multitasking with Meta Learning						
		CS353	Programming for Big Data Systems						
		CS218	Scripting Languages For Design Automation						
		CS151	Simulation & Modelling						
		CS354	Human Compute Interaction						
		CS153	Secure Coding Principles						
2	Open Elective	OE941	Business Analytics	3	0	0	30	70	3
		OE942	Industrial Safety						
		OE943	Operations Research						
		OE944	Cost Management of Engineering Projects						
		OE945	Composite Materials						
		OE946	Waste to Energy						
		OE947	Cyber Security						
		OE948	Internet of Things (IoT)						
3	Dissertation	CS181	Major Project Phase-I	0	0	20	100**		10
TOTAL				**6**	**0**	**20**	**160**	**140**	**16**
SEMESTER-IV									
1	Dissertation	CS182	Major Project Phase-II	0	0	32	0	200	16
TOTAL				**0**	**0**	**32**	**0**	**200**	**16**
GRAND TOTAL									68

*** Major Project Phase I Evaluation: 50 marks to be awarded by Supervisor and 50 marks to be awarded by Viva-Voce committee comprising Head, Supervisor and an Examiner.*

L: Lecture T: Tutorial P: Practical

CIE: Continuous Internal Evaluation SEE: Semester End Examination

CS 101

MATHEMATICALFOUNDATIONS OF COMPUTER SCIENCE

Instruction: (3L) hrs per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

COURSE OBJECTIVES:

- To understand the mathematical fundamentals that are pre requisite for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
- To develop the understanding of the mathematical and logical basis of various modern techniques in information technology like machine learning, programming language design, and concurrency.
- To study various sampling and classification problems.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Understand the basic notions of discrete and continuous probability.
2. Apply the methods of statistical inference, and learn application of sampling distributions in Data mining and Machine Learning.
3. Apply statistical analysis to algorithmic problems of simple to moderate complexity in different domains.
4. Model different applications of Computer science as graph theory problems

UNIT-I

Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

UNIT-II

Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**.**

UNIT-III

Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal component analysis**,** The problem of over fitting model assessment.

UNIT-IV

Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

UNIT-V

Number Theory: Elementary number theory, fundamental theorem of arithmetic, gcd, unique factorization, Euler's function, modular arithmetic, Fermat's little theorem, Chinese remainder theorem, modular exponentiation, RSA public key encryption.

Suggested Readings

1. John Vince, Foundation Mathematics for Computer Science, Springer, 2015.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley, 2001.
3. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis, 2005.
4. Alan Tucker, Applied Combinatorics, Wiley, 2012**.**

CS 301

MACHINE LEARNING

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course objectives:

- To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
- To introduce the concepts of instance based learning and decision tree induction
- To introduce the concepts of linear separability ,Perceptron and SVM
- To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes:

Student will be able to:

1. Students will be able to explain strengths and weakness of different machine learning techniques
2. Select suitable model parameter for different machine learning technique
3. Design & implement various machine learning algorithms to a wide range of real world applications
4. Students will be able to evaluate available learning methods to develop the research based solutions in different domains.

UNIT-I

Introduction: Learning, Types of Machine Learning, Machine Learning Examples , Decision Tree Learning
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Decision Tree Learning, the Big Picture
Linear Discriminants: Learning Linear Separators , The Perceptron Algorithm , Margins

UNIT-II

Estimating Probabilities from Data, Bayes Rule, MLE, MAP
Naive Bayes: Conditional Independence, Naive Bayes: Why and How, Bag of Words
Logistic Regression : Maximizing Conditional likelihood , Gradient Descent
Kernels: Kernalization Algorithm, Kernalizing Perceptoron,
Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation.

UNIT-III

Support Vector Machines: Geometric margins, Primal and Dual Forms, Kernalizing SVM
Generalization & Overfitting: Sample Complexity, Finite Hypothesis classes, VC Dimension Based Bounds

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Tradeoff Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier.
Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT-IV
Model Selection & Regularization: Structural Risk Minimization, Regularization, k-Fold Cross validation
Linear Regression: Linear regression, minimizing squared error and maximizing data Likelihood
Neural Networks: Back Propagation,
Deep Neural Networks: Convolution, Convolution Neural Networks, LeNet-5 architecture
Boosting: Boosting Accuracy, Ada Boosting, Bagging

UNIT-V
Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison.
Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis
Interactive Learning: Active Learning, Active Learning, Common heuristics, Sampling bias , Safe Disagreement Based Active Learning Schemes
Semi-Supervised Learning: Semi-supervised Learning, Transductive SVM, Co-training
Reinforcement Learning: Markov Decision Processes, Value Iteration, Q-Learning

References:
1. Tom M. Mitchell, *Machine Learning*, Mc Graw Hill, 1997
2. Chistopher Bishop, Pattern recognition & Machine Learning, Springer 2006.
3. Stephen Marsland, *Machine Learning - An Algorithmic Perspective*, CRC Press, 2009
4. Margaret H Dunham, *Data Mining*, Pearson Edition., 2003.
5. Galit Shmueli, Nitin R Patel, Peter C Bruce, *Data Mining for Business Intelligence*, Wiley India Edition, 2007
6. Rajjan Shinghal, *Pattern Recognition*, Oxford University Press, 2006.
7. Jerry Zhu, *Encyclopedia of Machine Learning*,

CS 121

NATURAL LANGUAGE PROCESSING

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives:

- Students able to gain knowledge on NLP.
- Understand deals with morphological processing.
- To familiarize students syntactic parsing, information extraction, probabilistic NLP.
- Be capable of performing classification of text using Python's NLTK Library.

Course Outcomes:

At the end of the course the student will be able to

1. Write Python programs to manipulate and analyze language data
2. Understand key concepts from NLP and linguistics to describe and analyze language
3. Understand the data structures and algorithms that are used in NLP
4. Classify texts using machine learning and deep learning

UNIT-I

Language Processing and Python: Computing with Language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics, Back to Python: Making Decisions and Taking Control, Automatic Natural Language Understanding

Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet

UNIT-II

Processing Raw Text: Accessing Text from the Web and from Disk, 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: Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word

UNIT-III

Learning to Classify Text: Supervised Classification, Evaluation, Naive Bayes Classifiers

Deep Learning for NLP: Introduction to Deep Learning, Convolutional Neural Networks, Recurrent Neural Networks, Classifying Text with Deep Learning.

UNIT-IV

Extracting Information from Text

Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction.

Analyzing Sentence Structure

Some Grammatical Dilemmas, What's the Use of Syntax. Context-Free Grammar, Parsing with Context-Free Grammar.

UNIT-V

NLP applications : Topic modeling, Text classification, Sentiment analysis , Word sense disambiguation, Speech recognition and speech to text, Text to speech, Language detection and translation.

References:

1. Natural Language Processing with Python. Steven Bird, Ewan Klein, and Edward Lope, O'Reily, 2009
2. Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning using Python. Akshay Kulkarni, AdarshaShivananda, Apress, 2019
3. Allen James, Natural Language Understanding, Benjamin/Cumming,1995.
   Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.

CS 311

MACHINE VISION

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives:

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks

Course Outcomes:

1. Developed the practical skills necessary to build computer vision applications.
2. To have gained exposure to object and scene recognition and categorization from images.

UNIT I

Overview, computer imaging systems, lenses, Image formation and sensing,
Image analysis, pre-processing and Binary image analysis

UNIT II

Edge detection, Edge detection performance, Hough transform, corner detection
Segmentation, Morphological filtering, Fourier transform

UNIT III

Feature extraction, shape, histogram, colour, spectral, texture, using CV/ IP tools,
Feature analysis, feature vectors, distance /similarity measures, data preprocessing

UNIT IV

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians
Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised
Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA,
ICA, and Non-parametric methods, Pattern Recognition: Statistical, Structural, Neural and Hybrid Techniques, Training and Classification, Document Analysis and Optical Charecter Recognition. Object Recognition.

UNIT V

Recent trends in Activity Recognition, computational photography, Biometrics, Object recognition, Scene Matching and Analysis, Robotic Vision.

References:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Deep Learning, by Goodfellow, Bengio, and Courville.
3. Dictionary of Computer Vision and Image Processing, by Fisher et al.

CS 312

DATA MINING

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

COURSE OBJECTIVES:

- To introduce the basic concepts of data Mining and its applications.
- To understand different data mining concepts like classification, clustering and Frequent Pattern mining.
- To introduce current trends in data mining.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Explain different data mining tasks and the algorithms.
2. Evaluate models/algorithms with respect to their accuracy.
3. Conceptualize a data mining solution to a practical problem
4. Develop hypotheses based on the analysis of the results obtained and test them.

UNIT-I

Introduction: Why Data Mining? What is Data Mining? What kinds of data can be mined? What kinds of patterns can be mined? Which technologies are used? Which kinds of applications are targeted? Major issues in Data Mining. Getting to know your data: Data objects and attributed types. Basic statistical descriptions of data. Data visualization, Measuring data similarity and dissimilarity.

UNIT-II

Mining frequent patterns, Associations and correlations, Basic concepts and methods, Basic concepts, Frequent Item set Mining Methods, Which patterns are interesting? Pattern evaluation methods.

UNIT-III

Classification: Basic concepts, Decision tree induction, Bayes classification methods,
Classification: Advance methods, Bayesian Belief Network, Classification by back propagation, Support vector machine,

UNIT-IV

Cluster Analysis: Concepts and Methods: Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of clustering.

UNIT-V

Data Mining Trends and Research Frontiers, Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.

References:

1. Jiawei Han, Micheline Kamber, Jin Pei, *Data Mining: Concepts & Techniques*, 3rd Edition.,MorgonKoffman ,2011
2. Vikram PudiP.Radha Krishna, *Data Mining*, Oxford University Press, 1st Edition, 2009.
3. Pang-Ning Tan, Michael Steinbach, Vipin kumar, *Introduction to Data Mining*, Pearson Education, 2008.

CS114

ADVANCED OPERATING SYSTEMS

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives:

- The aim of this course is to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open-source operating systems); Hardware and software features that support these systems.

Course Outcomes:

1. The student will be able to understand the concept behind a distributed system, the challenges in its design and use the solutions suggested to design Operating System necessary in building adistributed system.
2. Students will be able to understand the necessary structures, Different algorithmic solutions and alternative approaches to design solutions.
3. To familiarize students with advanced paradigms, architectures & protocols necessary in solve the challenges in design of advanced operating systems.
4. Student will be able to come up with analysis of efficiency and proofs of correctness for multiple aspects in design of Advanced Operating Systems

UNIT I

Architecture of Distributed Systems: Types, Distributed Operating System, Issues in Distributed Operating Systems, Theoretical Foundations: Global Clock, Lamport's Logical Clock, Vector Clocks, Global State, and Termination Detection.

UNIT II

Distributed Mutual Exclusion: Classification, requirement, performance, non-token-based algorithms, Lamport's algorithm, the Richart-Agarwala algorithm, token-based algorithm-Suzuki liasamil's broadcast algorithm, Singhals heuristic algorithm.

Deadlock Detection: Resource Vs Communication deadlock, A graph- theoretic model, prevention, avoidance, detection, control organization, centralized deadlock-detection algorithm, the completely centralized algorithm, the HO-Ramamoorthy algorithm. Distributed deadlock detection algorithm - path - pushing, edge-chasing, hierarchical deadlock detection algorithm, menace-muntz and Ho-Ramamoorthy algorithm. Agreement Protocols: The system model, the Byzantine agreement, and the consensus problem.

UNIT III

Distributed File System: Mechanisms, Design Issues.

Case Studies: Sun NFS, Sprite File System, DOMAIN, Coda File System.

Distributed Shared Memory: Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, and Design Issues.

Case Studies: IVY, Mirage, Clouds.

Distributed Scheduling: Issues in Load Distribution, Components of Algorithm, Stability Load Distributing Algorithm, Performance.

UNIT IV

Failure Recovery: Backward, Forward Error Recovery in Concurrent Systems, Consistent Set of Check Points, Synchronous and Asynchronous Check Pointing and Recovery.
Fault Tolerance: Commit Protocols, Non-Blocking Commit Protocols, Voting Protocols.
Protection and Security: Access Matrix, Private Key, Public key, and Kerberos System.

UNIT V

Multiprocessor Operating Systems: Motivation, Basic Multiprocessor System Architecture, Interconnection Networks for Multiprocessor Systems, Caching, Hypercube Architecture. Threads, Process Synchronization, Processor Scheduling, and Memory Management.
Database Operating System: Concurrence Control, Distributed Databases, and Concurrency Control Algorithms.

Suggested Readings:

1. Singhal M, Shivaratri N.G, *Advanced Concepts in Operating Systems*, McGraw-Hill Intl., 1994.

2. Pradeep K Sinha, Distributed *Operating Systems Concepts and Design*, PHI, First Edition, 2002.

3 Andrew S. Tanenbaum, *Distributed Operating Systems*, Pearson Education India, First Edition, 2011.

CS 102

ADVANCED DATA STRUCTURES

Instruction : 3L hrs per week *Duration of SEE : 3 hours*
CIE : 30 Marks *SEE : 70 Marks*
Credits: 3

Course Objectives:

- Understand the ADT/libraries and choose appropriate data structures to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- To familiarize students with advanced problem-solving paradigms and data structure used to solve algorithmic problems.
- Analysis of efficiency and proofs of correctness.

Course Outcomes:

After Completion of the course Students will be able to:

1. Understand the implementation of symbol table using hashing techniques.
2. Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
3. Develop algorithms for text processing applications.
4. Identify suitable data structures and develop algorithms for computational geometry problems.

UNIT-1

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function , Collision Resolution Techniques in Hashing , Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT-1I

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of SkipLists, Deterministic Skip Lists.

UNIT-III

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3Trees, B-Trees, Splay Trees

UNIT-IV

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT-V

Computational Geometry: One Dimensional Range Searching, Two-Dimensional Range Searching, constructing Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the ew evolving problem.

References:

1. Mark Allen Weiss, *Data Structures and Algorithm Analysis in C++*, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, *Algorithm Design*, John Wiley, 2002.

CS 321

REINFORECEMENT LEARNING

Instruction : 3L hrs per week *Duration of SEE : 3 hours*
CIE : 30 Marks *SEE : 70 Marks*
Credits: 3

Course Objectives:

Student able to learn a

- Understand the Collection of machine learning techniques which solve sequential decision making problems using a process of trial-and-error.
- Understand the Foundational models and algorithms used in RL,
- To familiarize students with advanced topics such as scalable function approximation using neural network representations
- Be able to Concurrent interactive learning of multiple RL agents.

Course Outcomes:

On completion of this course, the student will be able to:

- Knowledge of basic and advanced reinforcement learning techniques.
- Identification of suitable learning tasks to which these learning techniques can be applied.
- Appreciation of some of the current limitations of reinforcement learning techniques.
- Formulation of decision problems set up and run computational experiments, evaluation of results from experiments.

UNIT I

Introduction: Course logistics and overview. Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning.

Probability Primer: Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence

UNIT II

Markov Decision Process: Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations

Prediction and Control by Dynamic Programming: Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions.

UNIT III

Monte Carlo Methods for Model Free Prediction and Control: Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling

TD Methods: Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.

UNIT IV

Function Approximation Methods: Getting started with the function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, Eligibility trace for function approximation, After states, Control with function approximation, Least squares, Experience replay in deep Q-Networks.

UNIT V

Policy Gradients: Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy gradient estimates, baselines, advantage function, actor-critic methods

References:

1. "Reinforcement Learning: An Introduction", Richard S. Sutton and Andrew G. Barto, 2nd Edition
2. "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition, Alberto Leon-Garcia
   "Machine Learning: A Probabilistic Perspective", Kevin P. Murphy

CS322

DATA ENGINEERING AND DATABASES FOR DATA SCIENCE

Instruction : 3L hrs per week Duration of SEE : 3 hours
CIE : 30 Marks SEE : 70 Marks
Credits: 3

Course Objectives:

- Understand the all aspects of computing and information access across multiple processing elements connected by any form of communication network, either local area, or wide area
- Understand the steady growth in the development of contemporary applications that demonstrate their efficacy by connecting millions of users/applications/machines across the globe without relying on a traditional client-server approach.
- To familiarize students with leverage shared resources and massive amounts of data over the Internet. This course aims to provide an understanding of theory and systems aspects of distributed

Course Outcomes

Student will be able to

1. Describe the features added to modern database systems to distinguish them from standard relational systems.
2. Understand different algorithms used in the implementation of query evaluation engine
3. Understand the different concurrency control and commit protocols in distributed databases
4. Demonstrate an understanding of the role and the concepts involved in special purpose databases such as Temporal, Spatial, Mobile and other similar database types

UNIT-I

Distributed Data Storage Technology : Server-centric IT architecture and its limitations , Storage-centric IT architecture and its advantages , Architecture of intelligent disk subsystems, Hard disks and internal i/o channels and JBOD, Storage virtualization using RAID, Introduction to NAS, SAN and DAS

Distributed File Systems & Security: File Models & Accessing models , File sharing Semantics, File Caching, File Replication, Fault Tolerance, File System Security

UNIT - II

Distributed Databases: Distributed DBMS, Architectural Models for DDBS, Distributed DBMS Architecture, Distributed Data Sources

Distributed Database Design Issues &Integration : Framework of Distribution , Distributed Design Issues, Top-Down Design Process , Fragmentation, Allocation , Bottom-Up Design Methodology, Schema Matching , Schema Integration , Schema Mapping, Data Cleaning

UNIT –III

Data and Access Control : Database Security, Discretionary Access Control, Multilevel Access Control, Distributed Access Control, View Management, Views in Centralized DBMSs, Views in Distributed DBMSs , Maintenance of Materialized Views

Data Replication: Consistency of Replicated Databases, Update Management Strategies, Replication Protocols, Replication and failures , Replication Mediator Service .

Parallel Database Systems: Parallel Database System Architectures, Parallel Data Placement, Load Balancing, Database Clusters

UNIT – IV

Web Data Management : Web Graph Management, Web Search, Web Crawling , Indexing, Ranking and Link Analysis , Keyword Search, Web Querying, Semi-structured Data Approach, Web Query Language Approach, Question Answering, Searching and Querying the Hidden Web

Hadoop & Big Data: Introduction, Hadoop Architecture, HDFS Operations, HDFS Commands, Big Data Overview, Multi Node Cluster, Map Reduce

UNIT - V

Advanced Application Development: Performance Tuning, Performance BenchmarksOther Issues in Application Development, Standardization.

Spatial and Temporal Data and Mobility: Motivation, Time in Databases, Spatial andGeographic Data, Multimedia Databases, Mobility and Personal Databases.

References:

1. M. Tamer Özsu • Patrick Valduriez Principles of Distributed Database Systems Third Edition
2. Distributed Operating Systems: Concepts And Design By Pradeep K. Sinha
3. "Storage Networks Explained" – by Ulf Troppens, Wolfgang Muller-Freidt, Rainer Wolafka, IBM Storage Software Development, Germany. Publishers: Wiley
4. Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGrawHill International Edition, 6th Edition, 2010.
5. Elmasri Navathe, Somayajulu, Gupta , Fundamentals of Database Systems, Pearson Education, 4th Edition, 2006.
6. CJ Date, A Kannan, S Swamynathan, An Introduction to Database Systems, Pearson Education, 8th Edition, 2006.
7. Raghu Ramakrishnan, and Johannes Gehrke, Database Management Systems, McGraw-Hill International Edition, 3rd Edition, 2002

CS 122

INFORMATION RETRIEVAL SYSTEM

Instruction : 3L hrs per week Duration of SEE : 3 hours
CIE : 30 Marks SEE : 70 Marks
Credits: 3

COURSE OBJECTIVES:

- To understand indexing and querying in information retrieval systems.
- To learn the different models for information retrieval.
- To expose the students to text classification and clustering.
- To learn about web searching.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Understand the algorithms and techniques for information retrieval (document indexing and retrieval, query processing).
2. Quantitatively evaluate information retrieval systems.
3. Classify and cluster documents.
4. Understand the practical aspects of information retrieval such as those in web search engines.

UNIT- I

Boolean Retrieval: example information, Building an inverted index, processing Boolean queries, the extended Boolean model versus ranked retrieval.
The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms, faster postings list intersection via skip pointers, Positional postings, and Phrase queries.
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, spelling correction.
Index Construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, dynamic indexing, Other types of indexes.

UNIT-II

Index Compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.
Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, and Variant tf-idf functions.
Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.
Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

UNIT-III

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

XML retrieval: Basic XML concepts, Challenges in XML retrieval, a vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Probabilistic information retrieval: Basic probability theory, The Probability Ranking Principle, The Binary Independence Model.

Language models for information retrieval: Language models, the query likelihood model.

UNIT-IV

Text classification and Naive Bayes: The text classification problem, Naive Bayes text classification, The Bernoulli model, Properties of Naive Bayes, and Feature selection.

Vector space classification: Document representations and measures of relatedness in vector spaces, Rocchio classification, k- nearest neighbour, Linear versus nonlinear classifiers.

Flat clustering: Clustering in information retrieval, Problem statement, Evaluation of clustering, k-means.

Hierarchical clustering: Hierarchical agglomerative clustering, Single-link and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Divisive clustering.

UNIT-V

Matrix decompositions and latent semantic indexing: Linear algebra review, Term-document matrices and singular value decompositions, Low-rank approximations, Latent semantic indexing.

Web search basics: Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling.

Web crawling and Indexes: Overview, Crawling, Distributing indexes, Connectivity servers.

Link analysis: The Web as a graph, Page Rank, Hubs and Authorities.

References:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, *An Introduction to Information Retrieval*, Cambridge University Press, Cambridge, England, 2008
2. David A. Grossman, Ophir Frieder, *Information Retrieval – Algorithms and Heuristics*, Springer, 2nd Edition (Distributed by Universities Press), 2004.
3. Gerald J Kowalski, Mark T Maybury. *Information Storage and Retrieval Systems*, Springer, 2000
4. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann Publishers, 2002.

CS 125

OBJECT ORIENTED SOFTWARE ENGINEERING

Instruction : 3L hrs per week Duration of SEE : 3 hours
CIE : 30 Marks SEE : 70 Marks
Credits: 3

COURSE OBJECTIVES:

- To know basic concepts for developing a system.
- Analyze different models and diagrams.
- To understand specific operations which are involved in designing a model.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Describe the concepts involved in object-oriented modeling and their benefits.
2. Demonstrate the concepts of use-case model, sequence model, state chart model for a given problem.
3. Translate the requirements into object-oriented design for implementation.
4. Choose an appropriate design pattern to facilitate system development.

UNIT-I

Information Systems: Problems in Information systems Development, Project life cycles, Managing Information System Development, User Involvement and Methodological Approaches, Basic Concepts and Origins of Object Orientation Modelling Concepts.

UNIT-II

Requirement Capture, User Requirements, Requirements Capture and Modelling, Requirement Analysis, Use Case Realization, the Class Diagram, Assembling the Analysis Class Diagram, Refining the Requirement Models, Component-based Development, Software Development Patterns, Object Interaction, Object Interaction and Collaboration, Interaction Sequence Diagrams, Collaboration Diagrams, Model Consistency

UNIT-III

Specifying Operations, The Role of Operation Specifications, Contracts, Describing Operation Logic, Object Constraint Language, Creating an Operation Specification, Specifying Control, States and Events, Basic Notation, Further Notation, Preparing a Statechart, Consistency Checking, Quality Guidelines, Moving Into Design, Logical and Physical Design, System Design and Detailed Design, Qualities and Objectives of Analysis and Design, Measurable Objectives in Design, Planning for Design, System Design, The Major Elements of System Design, Software Architecture, Concurrency, Processor Allocation, Data Management Issues, Development Standards, Prioritizing Design Trade-offs, Design for Implementation

UNIT-IV

Object design, Class Specification, Interfaces, Criteria for Good Design, Designing Associations, Integrity Constraints, Designing Operations, Normalization, Design Patterns, Software Development Patterns, Documenting Patterns-Pattern Templates, Design Patterns, How to use Design Patterns, Benefits and Dangers of Using Patterns, Human Computer Interaction, The User Interface, Approaches to User Interface Design, Standards and Legal Requirements, Designing Boundary Classes, The Architecture of the Presentation Layer, Prototyping the User Interface,

Designing Classes, Designing Interaction with Sequence Diagrams, The Class Diagram Revisited, User Interface Design Patterns, Modelling the Interface Using Statecharts.

UNIT-V

Data Management Design, Persistence, File Systems, Database Management Systems, Designing for Relational Database Management Systems, Designing for Object Database Management Systems, Distributed Databases, Designing Data Management Classes, Implementation, Software Implementation, Component Diagrams, Deployment Diagrams, Software Testing, Data Conversion, User Documentation and Training, Implementation Strategies, Review and Maintenance, Reusable Components, Planning a Strategy for Reuse, Commercially Available Componentware, Managing Object Oriented Projects, Resource Allocation and Planning, Managing Iteration, Dynamic Systems Development Method, Extreme Programming, Software Metrics, Process Patterns, Legacy Systems, System Development Methodologies, 'Method' and 'Methodology', A Brief Historical Review, The Unified Software Development Process, Participative Design Approaches, Issues in Choosing a Methodology, Hard versus Soft Methodologies.

References:

1. Simon Benett, Steve McRobb and Ray Farmer, Object *Oriented System Analysis and Design using UML*, McGraw-Hill Education, 2010.
2. Grady Booch, James Rumbaugh, Ivar Jacobson, *The Unified Modeling language-User guide*, Pearson Education India, 2nd Edition, 2005.
3. Subhash Mehta, Suresh K. Basandra, *Object Oriented Software Engineering*, Galgotia, 2004.

CS 323

WEB ENGINEERING

Instruction : 3L hrs per week
Duration of SEE : 3 hours
CIE : 30 Marks
SEE : 70 Marks
Credits: 3

COURSE OBJECTIVES:

- To introduce web application development methodologies.
- To introduce architectural metrics for E-commerce sites.
- To introduce models of web content management.
- To introduce concepts of web systems maintenance.
- To introduce concepts of data mining techniques to customize web applications.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Define different classes of web applications.
2. Describe Web lifecycle process model and Modified Prototyping Method (MPM) for Web application development.
3. Understand the technology and management requirements trade-offs in the Web application development.
4. Use Relationship Analysis (RA) to find relationships in application domain.
5. Describe modular approach for building evolvable location-based services.

UNIT-I

Web Engineering: Concepts and Reference Model, Introduction and Perspectives, Web Engineering Resources Portal (WEP): A Reference Model and Guide.

UNIT-II

Web Application Development: Methodologies and Techniques, Web Application Development Methodologies, Relationship Analysis: A Technique to Enhance Systems Analysis for Web Development, Engineering Location-Based Services in the Web.

UNIT-III

Web Metrics and Quality: Models and Methods, **Architectural Metrics for E-Commerce:** A Balance between Rigor and Relevance, The Equal Approach to the Assessment of E-Commerce Quality: A Longitudinal Study of Internet Bookstores, Web Cost Estimation: An Introduction.

UNIT-IV

Web Resource Management: Models and Techniques, Ontology Supported Web Content Management, Design Principles and Applications of XRML.

UNIT-V

Web Maintenance and Evolution: Techniques and Methodologies, Program Transformations for Web Application Restructuring, the Requirements of Methodologies for Developing Web Applications. A Customer Analysis-Based Methodology for Improving Web Business Systems.
Web Intelligence: Techniques and Applications, Analysis and Customization of Web-Based Electronic Catalogs, Data Mining using Qualitative Information on the Web.

References:

1. Woojong Suh, *Web Engineering Principles and Techniques*, Idea Group Publications 2005.

CS 100

RESEARCH METHODOLOGIES IN COMPUTER SCIENCE

Instruction : 3L hrs per week | Duration of SEE : 3 hours
CIE : 30 Marks | SEE : 70 Marks
Credits: 3

Course Objectives:

- To understand the research process
- To solve unfamiliar problems using scientific procedures
- To pursue ethical research
- To use appropriate tools for documentation and analysis of data

Course Outcomes:

5. Understand research problem formulation
6. Design experiments
7. Analyze research related information
8. Write papers and thesis, Follow research ethics
9. Use tools for analysis and thesis writing

UNIT-I

Research Process: Meaning of Research, Objectives and Motivation of Research, Technological Innovation, Types of Research, Research Vs Scientific method, Research Methodology vs Research Methods, Research process.

Research Problem Formulation: Problem solving in Engineering, Identification of Research Topic, Problem Definition, Literature Survey, Literature Review.

Research Design: Research Design: What it is?, Why we need Research Design? Terminology and Basic Concepts, Different Research Designs, Experimental Designs, Important Experimental Designs, Design of Experimental Setup, Use of Standards and Codes.

UNIT-II

Mathematical Modelling: Models in General, Mathematical Model, Model Classification, Modelling of Engineering Systems.

Probability and Distributions: Importance of Statistics to Researchers, Probability Concepts, Probability Distributions, Popular Probability Distributions, Sampling Distributions.

Sample Design And Sampling: Sample design, Types of sample designs, The Standard Error, Sample Size for Experiments, Prior Determination Approach, Use of Automatic Stopping Rule.

Hypothesis Testing and ANOVA: Formulation of Hypothesis, Testing of Hypothesis, Analysis of Variance.

UNIT-III

Design of Experiments and Regression Analysis: Design of Experiments, Planning of Experiments, Multivariate Analysis, Simple Regression and Correlation, Multiple Regression and Correlation

Analysis and Interpretation of Data: Introduction, Data Checking, Data Analysis, Interpretation of Results, Guidelines in Interpretations.

Accuracy, Precision and Error Analysis: Introduction, Repeatability and Reproducibility, Error Definition and Classification, Analysis of Errors, Statistical Analysis of Errors, Identification of Limitations

UNIT-IV

Writing of Papers and Synopsis: Introduction, Audience Analysis,, Preparing Papers for Journals, Preparation of Synopsis of Research Work

Thesis Writing Mechanics: Introduction, Audience for Thesis Report, Steps in Writing the report, Mechanics of Writing, Presentation of graphs, figures and tables.

Structure of Thesis Report: Suggested Framework of the Report, Preliminary Pages, Main Body of Thesis, Summary, Appendices, References, Glossary.

UNIT-V

Ethics in Research: Importance of Ethics in Research, Integrity in Research, Scientific Misconduct and Consequences.

Spreadsheet tool: Introduction, Quantitative Data Analysis Tools, Entering and preparing your data, Using statistical functions, Loading and using Data Analysis Tool Pack *[Tools: Microsoft Excel / Open office]*

Thesis writing & scientific editing tool[Tool: Latex]: Introduction, Document Structure, Typesetting Text, Tables, Figures, Equations, Inserting References.

References:

1. R.Ganesan; Research Methodology for Engineers; MJP Publishers; Chennai, 2011.
2. Paul R Cohen. Empirical Methods in AI. PHI, New Delhi, 2004
3. C.R.Kothari, Research Methodology, Methods & Technique; New age International Publishers, 2004
4. Kumar, Ranjit. Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education, 2005
5. LaTEX for Beginners, Workbook, Edition 5, March 2014.

AC 031

ENGLISH FOR ACADEMIC AND RESEARCH WRITING

Instruction: 2 periods per week
CIE: 30 marks
Credits: 0

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives: To expose the students to

- Features of Academic writing; different kinds of Academic writing
- Some academic writing skills; the research process; the structure of a research document

Course Outcomes: At the end of the course, the students would be equipped with knowledge and skills related to

1. Academic writing features; Academic writing kinds; Important academic writing skills
2. The process of research; general research document structure

UNIT I: Features of Academic Writing
Language: Clear, Correct, Concise, Inclusive; **Tone**: Formal, Objective, Cautious;
Style: Appropriate, Accurate, Organized; **Ethics**: Honesty, Integrity, Responsibility, Accountability

UNIT II: Kinds of Academic Writing
Essays, Reports, Reviews, Abstracts, Proposals

UNIT III: Academic Writing Skills
Paraphrasing; Summarizing; Quoting; Rewriting; Expansion

UNIT IV: **Research Process**
Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data

UNIT V: Structure of a Research Document
Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results, Conclusion, Documenting Sources (IEEE style)

Suggested Reading

1. Bailey, S. (2014). Academic writing: A handbook for international students, Routledge.
2. Gillett, A., Hammond, A., & Martala, M. (2009). Inside track: Successful academic writing. Essex: Pearson Education Limited.
3. Griffin, G. (2006). Research methods for English studies. Edinburgh: Edinburgh University Press.
4. Silyn-Roberts, Heather. (2013). Writing for Science and Engineering: Papers, Presentations and Reports(2nd ed.). Elsevier.
5. Lipson, Charles (2011). Cite right: A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more (2nd ed.). Chicago [u.a.]: University of Chicago Press.

AC032

DISASTER MANAGEMENT

Instruction: 2 periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 0

Course Objectives:

- To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
- To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
- To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

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

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction
2. Humanitarian response
3. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
4. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

UNIT-I

Introduction

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

UNIT-II

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

UNIT-III

Disaster Prone Areas in India

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

UNIT-IV

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-V

Risk Assessment

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

UNIT-VI

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

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L. Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

AC 033

SANSKRIT FOR TECHNICAL KNOWLEDGE

Instruction: 2 periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 0

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

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

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

UNIT-I

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

UNIT-II

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT-III

- Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading:

1. "Abhyas pustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumb shastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.

3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

AC 034

VALUE EDUCATION

Instruction: 2 periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 0

Course Objectives
Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course Outcomes:
Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT-I

- Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgments

UNIT-II

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature, Discipline

UNIT-III

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.

UNIT-IV

- Doing best for saving nature
- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.

- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested Reading:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University, Press, New Delhi

CS 351

MACHINE LEARNING LAB

Instruction**:** 3 hrs per week CIE**:** 50 marks
Credits: 1.5

Course objectives:

This course will enable students to

- Make use of Data sets in implementing the machine learning algorithms.
- Implement the machine learning concepts and algorithms in any suitable language of choice.

Course outcomes:

The students should be able to:

1. Understand the implementation procedures for the machine learning algorithms.
2. Design Java/Python programs for various Learning algorithms.
3. Applyappropriate data sets to the Machine Learning algorithms.
4. Identify and apply Machine Learning algorithms to solve real world problems.

Description (If any):

1. The programs can be implemented in either JAVA or Python.
2. For Problems 1 to 6 and 10, programs are to be developed without using the built in classes or APIs of Java/Python.
3. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

1. Implement and demonstrate the FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge toclassify a new sample.

4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct aBayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

CS xxx

NATURAL LANGUAGE PROCESSING LAB
(Elective Lab)

Instruction**:** 3 hrs per week CIE**:** 50 marks
Credits: 1.5

1. Write a program to display the following words in a given text book
   a) Anagram,
   b) Isogram,
   c) Pangram,
   d) Semordnilap,
   e) Polindrome,
   f) Lipogram,
   g) Tautonym,
   h) Antigram,
   i) Ambigram

2. Write a Python Program to demonstrate match (), search () and sub () functions of Regular Expressions.
3. Write a Python program to demonstrate Stemmer (Porterand Lancaster) and Lemmatizer.
4. Python program to demonstrate PO Stagging of words in the given text using NLTKin python
5. Write a program to classify the names in Name Corpus into male and female classes. Also calculate the accuracy.
6. Implement Naïve Bayes Classifier
7. Implement confusion matrix program for the following input and calculate Accuracy, Precision, Recall, F-Measure

	Actual NN	Actual JJ	Actual VB
Predicted NN	7	8	9
Predicted JJ	1	2	3
Predicted VB	3	2	1

8. Implement Chunking and Chinking for NER.
9. Write the Python code to store the following relation information and also to perform a query("What is the national animal of India?"):
   "National Animal of Australia is Kangaroo"
   "National Animal of India is Tiger"
   "National Animal of Morocco is Lion"
   "National Animal of Nepal is Cow"
   "National Animal of Poland is Bison"
   "National Animal of Russiais Bear"
10. Implement all the steps of NLP pipe line using a) NLTK and b)SPACY

SEMESTER – II

S.No	Type of Course	Course Code	Course Name	Contact hours per Week			Scheme of Examination		Credits
				L	T	P	CIE	SEE	
1	Core-III	CS104	Artificial Intelligence	3	0	0	30	70	3
2	Core-IV	CS302	Deep Learning	3	0	0	30	70	3
3	Professional Elective-III	CS331	Statistical Machine Translation	3	0	0	30	70	3
		CS332	Sentiment Analysis.						
		CS333	Advanced Visual Recognition						
		CS131	Image Processing						
		CS213	Multimedia Technologies						
4	Professional Elective-IV	CS341	Distributed databases	3	0	0	30	70	3
		CS342	Scalable architectures for ML Applications						
		CS103	Advanced Algorithms						
		CS343	Web Mining						
		CS216	Soft Computing						
		CS144	Artificial Neural Networks						
5	Audit Course-II	AC035	Constitution of India	2	0	0	30	70	0
		AC036	Pedagogy Studies						
		AC037	Stress Management by Yoga						
		AC038	Personality Development through Life Enlighten Skills						
6		CS 070	Mini Project	0	0	6	50*	0	3
7	Core Lab-II	CS xxx	Artificial Intelligence Lab	0	0	3	50	0	1.5
8	Elective Lab-II	CS xxx	Elective Lab-II	0	0	3	50	0	1.5
TOTAL				**14**	**0**	**12**	**300**	**350**	**18**

CS 104

ARTIFICIAL INTELLIGENCE

Instruction**:** (3L) hrs per week
CIE**:** 30 marks
Credits: 3

Duration of SEE**:** 3 hours
SEE**:** 70 marks

Course Objectives:

- To familiarize the principles of Artificial Intelligence
- To study the techniques for knowledge representation and inference
- To learn the techniques involved in the creation of intelligent systems
- To study different applications like Game Playing Expert Systems, machine learning and natural language processing

Course Outcomes:

1. Use different logical systems for inference over formal domain representations, and trace how a particular inference algorithm works on a given problem specification
2. Understand the conceptual and computational trade-offs between the expressiveness of different formal representations.
3. Formalise a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, etc).
4. Design and perform an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

UNIT – I

Overview of Artificial Intelligence: Introduction. The Turing Test, Strong AI versus Weak AI, Heuristics, Identifying Problems Suitable for AI, Applications and Methods, Early History of AI, Recent History of AI to the Present, AI in the New Millennium

Uninformed Search: Introduction: Search in Intelligent Systems, State-Space Graphs, Generate-and-Test Paradigm, Blind Search Algorithms, Implementing and Comparing Blind Search Algorithms

Informed Search: Introduction, Heuristics, Informed Search Algorithms – Finding Any Solution, The Best-First Search, The Beam Search, Additional Metrics for Search Algorithms, Informed Search – Finding An Optimal Solution, Informed Search – Advanced Search Algorithms

UNIT-II

Search Using Games: Introduction, Game Trees and Minimax Evaluation, Minimax with Alpha-Beta Pruning, Variations and Improvements To Minimax, Games of Chance and the Expect minimax Algorithm, Game Theory

Logic in Artificial Intelligence: Introduction, Logic and Representation, Propositional Logic, Predicate Logic – Introduction, Several Other Logics

Knowledge Representation: Introduction, Graphical Sketches and the Human Window, Graphs and the Bridges of Königsberg Problem, Search Trees, Representational Choices, Production Systems, Object Orientation, Frames, Scripts and the Conceptual Dependency System, Semantic Networks, Associations, More Recent Approaches, Agents: Intelligent or Otherwise

UNIT-III

Production Systems: Introduction, Background, Basic Examples, Production Systems and Inference Methods, Production Systems and Cellular Automata, Stochastic Processes and Markov Chains

Uncertainty in AI: Introduction, Fuzzy Sets, Fuzzy Logic, Fuzzy Inferences, Probability Theory and Uncertainty

Expert Systems: Introduction, Background, Characteristics of Expert Systems, Knowledge Engineering, Knowledge Acquisition, Case-Based Reasoning, More Recent Expert Systems

UNIT-IV

Machine Learning : Introduction, Machine Learning: A Brief Overview, The Role of Feedback in Machine Learning Systems, Inductive Learning, Learning With Decision Trees, Problems Suitable for Decision Trees, Entropy, Constructing A Decision Tree With ID3, Issues Remaining

Machine Learning : Neural NetworksIntroduction, Rudiments of Artificial Neural Networks, McCulloch-Pitts Network, The Perceptron Learning Rule, The Delta Rule, Backpropagation, Implementation Concerns, Discrete Hopfield Networks, Application Areas

UNIT-V

Natural Language Understanding: Introduction, History of Natural Language Processing, Syntax and Formal Grammars, Semantic Analysis and Extended Grammars, Statistical Methods in NLP, Probabilistic Models for Statistical NLP, Linguistic Data Collections for Statistical NLP

Reference:

1. Stephen Lucci, Danny Kopec. Artificial Intelligence in the 21st Century. A Living Introduction. Mercury Learning and Information. 2nd Edition. 2016
2. Russell, Norvig: Artificial Intelligence, A Modern Approach, Pearson Education, Second Edition. 2004
3. Rich, Knight, Nair: Artificial Intelligence, Tata McGraw Hill, Third Edition 2009
4. Saroj Kaushik. Artificial Intelligence. Cengage Learning. 2011

CS 302

DEEP LEARNING

Instruction**:** (3L) hrs per week
CIE**:** 30 marks
Credits: 3

Duration of SEE**:** 3 hours
SEE**:** 70 marks

Course Objectives

By the end of the course, students will be able to

- Understand complexity of Deep Learning algorithms and their limitations
- Understand modern notions in data analysis oriented computing;
- Be capable of confidently applying common Deep Learning algorithms in practice and implementing their own
- Be capable of performing distributed computations;
- Be capable of performing experiments in Deep Learning using real-world data.

Course Outcomes

By the end of this deep learning course with TensorFlow, the student will be able to

1. Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
2. Implement deep learning algorithms, understand neural networks and traverse the layers of data abstraction which will empower the student to understand data more precisely.
3. Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
4. Build deep learning models in TensorFlow and interpret the results
5. Understand the language and fundamental concepts of artificial neural networks

UNIT I

Artificial Neural Networks: Introduction, Perceptron, XOR Gate, Perceptron Training Rule, Activation Functions

Linear Neural Networks: Linear Regression, Implementation of Linear Regression, Softmax Regression, The Image Classification Dataset , Implementation of Softmax Regression

UNIT II

Multilayer Perceptrons: Multilayer Perceptrons, Implementation of Multilayer Perceptrons , Model Selection, Underfitting and Overfitting, Weight Decay, Dropout, Forward Propagation, Backward Propagation, and Computational Graphs, Numerical Stability and Initialization, Considering the Environment, Predicting House Prices.

Optimization Algorithms: Optimization and Deep Learning, Convexity, Gradient Descent, Stochastic Gradient Descet, Minibatch Stochastic Gradient Descent, Momentum, Adagrad, RMSProp, Adadelta, Adam, Learning Rate Scheduling

UNIT III

Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters,

Modern Convolutional Neural Networks: Deep Convolutional Neural Networks (AlexNet), Networks Using Blocks (VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet)

UNIT IV

Recurrent Neural Networks: Sequence Models, Text Preprocessing, Language Models and the Dataset, Recurrent Neural Networks, Implementation of Recurrent Neural Networks from Scratch, Concise Implementation of Recurrent Neural Networks, Back propagation Through Time

Modern Recurrent Neural Networks: Gated Recurrent Units (GRU),Long Short Term Memory (LST), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, Encoder-Decoder Architecture, Sequence to Sequence, Beam Search

UNIT V

Auto encoders: Types of Auto Encoders and its applications

Generative Adversarial Networks: Generative Adversarial Network, Deep Convolutional Generative Adversarial Networks

References:

1 Goodfellow, I., Bengio,Y., and Courville, A., *Deep Learning*, MIT Press, 2016. Link:https://www.deeplearningbook.org

2 Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, *Dive into Deep Learning,* 2020

link: Dive into Deep Learning — Dive into Deep Learning 0.16.6 documentation (d2l.ai)

CS331

STATISTICAL MACHINE TRANSLATION

Instruction**:** (3L) hrs per week Duration of SEE**:** 3 hours
CIE**:** 30 marks SEE**:** 70 marks
Credits: 3

Course Objectives:

- Introduce the field of machine translation (systems that translate speech or text from one human language to another), with a focus on statistical approaches.
- Three major paradigms will be covered: word-based translation, phrase-based translation, and syntax-based translation.
- Students will gain hands-on experience with building translation systems and working with real-world data, and they will learn how to formulate and investigate research questions in machine translation.

Course Outcomes

On completion of the course, to earn the grade Pass the student should at least be able to:

1. describe and critically discuss the architecture of machine translation systems;
2. handle basic tools for training and applying machine translation systems;
3. compare different types of machine translation strategies, such as rule-based, statistical and neural machine translation;
4. evaluate machine translation output using automatic and manual methods and explain possible causes of translation errors;
5. critically read and summarise a scientific works in the field of machine translation

UNIT I

Overview of machine translation,the statistical approach to MT

Word-based alignment and translation: IBM word alignment models, n-gram language models. Absolute discounting and KneserNey smoothing., n-gram language models continued, Very large language models.

UNIT II

Phrase based translation and discriminative training: Phrase-based MT, Why do we need phrases, Relationship to EBMT, Phrase extraction, Estimating phrase translation probabilities and the problem of over fitting, From the noisy channel to linear models, Phrase features, Phrase reordering models, Phrase based decoding, K- best lists.

UNIT III

Maximum entropy, Minimum error-rate training, Perceptron, max-margin methods, System combination.

Interlude: Subword translation, Transliteration. Integrating traditional translation rules, Integrating morphology into translation, Decoding with lattices for morphology and word segmentation.

UNIT IV

Syntax based translation, Hierarchical and syntax based MT , Why do we need syntax, Synchronous context-free grammars and TSGs, Extracting synchronous CFGs and TSGs from parallel data, Estimating rule probabilities and the problem of overfitting, Extracting synchronous TSGs from tree-tree data and the problem of non-isomorphism.

UNIT V

CKY decoding, CKY with an n-gram language model,

More CKY decoding: Binarization. k-best lists. Decoding with lattices, Source-side tree decoding. Target-side left-to-right decoding, Syntax-based language models, Beyond synchronous CFGs and TSG, Towards semantics based translation.

References:

1.Statistical Machine Translation, P. Koehn, Cambridge Unv. Press, 2010
2.Hybrid Approaches to Machine Translation, M.R.Costa-jussa, et al. (eds.), Springer, 2016
3.Machine Translation, Pushpak Bhattacharyya, CRC Press, 2015
4.Handbook of Natural Language Processing and Machine Translation, J.Olive, C.Christianson, J.McCary (eds.), Springer, 2011

CS332

SENTIMENT ANALYSIS

Instruction**:** (3L) hrs per week Duration of SEE**:** 3 hours
CIE**:** 30 marks SEE**:** 70 marks
Credits: 3

Course Objectives:

- Understandthe introducing real time problems related to sentiment extraction with an aim to bridge the gap between unstructured and structured data
- To facilitate qualitative and quantitative analysis of opinions
- To discuss the existing techniques for solving real time sentiment extraction problems.

Course Outcomes:

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

1. Take up advanced research in the field with subsequent qualitative and quantitative analysis
2. Fully understand the whole range of issues and pitfalls and determine what tasks can be automated and what tasks need human intervention

UNIT – I

Introduction: Sentiment Analysis Applications, Sentiment Analysis Research, Sentiment Analysis as mini NLP.

The Problem of Sentiment Analysis: Definition of Opinion, Opinion Summarization, Affect, Emotion and Mood, Different Types of Opinions.

Document Sentiment Classification: Supervised Sentiment Classification, Unsupervised Sentiment Classification, Sentiment Rating Prediction

UNIT-II

Document Sentiment Classification: Cross-Domain Sentiment Classification, Cross-Language Sentiment Classification, Emotion classification of Documents.

Sentence Subjectivity and Sentiment Classification: Subjectivity, Sentence Sentiment Classification, Dealing with Conditional Sentences, Dealing with Sarcastic Sentences, Cross-language Subjectivity and Sentiment Classification, Using Discourse Information for Sentiment Classification, Emotion classification of sentences.

UNIT-III

Aspect-based Sentiment Analysis: Aspect Sentiment Classification, Rules of sentiment Composition, Negation and Sentiment

Aspect and Entity Extraction: Aspect Extraction, Entity, Opinion Holder and Time Extraction, Coreference Resolution and Word Sense Disambiguation.

UNIT-IV

Sentiment Lexicon Generation: Dictionary-based Approach, Corpus-based Approach, Desirable and Undesirable Facts.

Analysis of Comparative Opinions: Problem Definitions, Identifying the Preferred Entity Set, Entity and Aspect Extraction.

Opinion Summarization and Search: Aspect based opinion summarization, Contrastive view summarization.

UNIT-V

Opinion Summarization and Search: Summarization of Comparative Opinions, Opinion Search, Existing Opinion retrieval Techniques.

Mining Intentions: Problem of Intention Mining, Intention Classification, Fine-Grained Mining of Intentions.

Opinion Spam Detection: Types of Spam and Spamming, Supervised Spam Detection, Unsupervised Spam Detection, Group Spam Detection.

References:

1. Sentiment Analysis – Mining Opinions, Sentiments, and Emotions in Text, Bing Liu, Cambridge University Press, 2015.
2. Sentiment Analysis and Opinion Mining, Bing Liu, Morgan and Claypool Publishers, 2012.
3. Sentiment Analysis in Social Networks by Federico Alberto Pozzi, Elisabetta Fersini, Enza Messina, Bing Liu, Morgan Kaufmann publications, 2017.
4. Foundations of Statistical Natural Language Processing 1st Edition, by Christopher D. Manning, Hinrich Schütze, The MIT Press Cambridge, Massachusetts London, England, 1999
5. Natural Language Processing with Python, by Steven Bird, Ewan Klein and Edward Loper.

CS333

ADVANCED VISUAL RECOGNITION

Instruction**:** (3L) hrs per week Duration of SEE**:** 3 hours
CIE**:** 30 marks SEE**:** 70 marks
Credits: 3

Course Objectives:

- Students will be able to learn Convolutional Neural Networks, RNN.
- Understand the students with architecture can apply to visual recognition with different Dimensions.

Course Outcomes:

At the end of the course, students can able to

1. Understand machine vision principles
2. Be able to acquire and process raw image data .
3. Be able to relate image data to 3D scene structures.
4. Know the concepts behind and how to use several model-based object representations, and to critically compare them.
5. Could able to make comparable analysis with different algorithms.

UNIT I

Convolutional Neural Networks: History, Convolution and pooling, ConvNets outside vision
Training Neural Networks, part I: Activation functions, data processing, Batch Normalization, Transfer learning.
Training Neural Networks, part II: Update rules, hyper parameter tuning, Learning rate scheduling, data augmentation.
Intro to Pytorch , Colab and Tensorflow.

UNIT II

CNN Architectures: AlexNet, VGG, GoogLeNet, ResNet, etc.
Recurrent Neural Networks: RNN, LSTM, Language modeling, Image captioning, Vision + Language , Attention.

UNIT III

Generative Models: Pixel RNN/Pixel CNN, Variational auto-encoders, Generative adversarial networks
Detection and Segmentation: Semantic segmentation, Object detection, Instance segmentation.

UNIT IV

Visualizing and Understanding: Feature visualization and inversion, Adversarial examples, DeepDream and style transfer, Learning on Videos, 3D Deep Learning

UNIT V

Deep Reinforcement Learning: Policy gradients, hard attention, Q-Learning, Actor-Critic
Scene Graphs: Visual Relationships, Graph Neural Networks.

References:

1. Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari , Publisher: Packt Publishing , *Release Date: February 2018*

2. Hands-On Computer Vision with Tensor Flow 2: Leverage deep learning to create powerful image processing apps with Tensor Flow 2.0 and Keras 1st Edition, by Benjamin Planche, Eliot Andres

CS131

IMAGE PROCESSING

Instruction**:** (3L) hrs per week
CIE**:** 30 marks
Credits: 3

Duration of SEE**:** 3 hours
SEE**:** 70 marks

COURSE OBJECTIVES:

- To introduce the basics of Image processing, intensity transformations and spatial filtering.
- To Study Filtering in the frequency domain, image restoration, Colour Image Processing and wavelets.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Analyze images in the frequency domain using various transforms.
2. Design and implement algorithms that perform image processing operations such as histogram equalization, enhancement, restoration, filtering and denoising.
3. Explain color spaces, restoration and enhancement of color images.
4. Develop simple object recognition systems.

UNIT I

Image Processing: Introduction, Examples, Fundamental steps, Components, Elements of visual perception, Light and Electromagnetic Spectrum, Image sensing and Acquisition, Image Sampling and Quantization, Basic relationships between pixels.

Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining Spatial Enhancement Methods.

UNIT II

Filtering in the Frequency Domain: Background, Preliminary concepts, Sampling and Fourier Transform of Sampled Functions, Discrete Fourier Transform (DFT) of one variable, Extension to functions of two variables, Some Properties of the 2-D Discrete Fourier Transform, Basics of Filtering in the Frequency Domain, Image Smoothing, Image Sharpening, Homomorphic Filtering.

Image Restoration: Noise Models, Restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering.

Linear Degradation, Position-invariant Degradation, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error Filtering, Constrained Least Squares Filtering, Geometric Mean Filter.

UNIT III

Colour Image Processing: Colour fundamentals, Colour models, Pseudocolour Image Processing, Basics of Full-colour Image Processing, Colour Transformations, Smoothing and Sharpening, Colour-based Image Segmentation, Noise in Colour Images, Colour Image Compression.

Wavelets and Multi resolution Processing: Background, Multiresolution Expansions, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions, Wavelet Packets.

UNIT IV

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error- free Compression, Lossy Compression, Image Compression Standards, Some Basic Compression Methods.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms, Some Basic Gray-Scale Morphological Algorithms.

UNIT V

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-based Segmentation, Segmentation using Morphological Watersheds, The use of Motion in Segmentation.

Object Recognition: Patterns and Pattern Classes, Recognition based on Decision-theoretic Methods, Structural Methods.

References:

1. Rafael C. Gonzalez and Richard E. Woods, Digital *Image Processing*, PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. William K. Pratt, *Digital Image Processing*, John Wiley & Sons, Inc., 3rd Edition, 2001.

CS213

MULTIMEDIA TECHNOLOGIES

Instruction**:** (3L) hrs per week Duration of SEE**:** 3 hours
CIE**:** 30 marks SEE**:** 70 marks
Credits: 3

COURSE OBJECTIVES:

- To learn the properties of multimedia systems, supporting devices and digital representation of analog data.
- To understand the concepts of digital image recognition and transmission techniques.
- To learn data compression techniques and optical storage device standards.
- To explore the issues of QOS and synchronization in multimedia communication and storage systems.
- To understand the concepts of multimedia application development.

COURSE OUTCOMES:

After Completion of the course Students will be able to:

1. Describe the media and supporting devices commonly associated with multimedia systems.
2. Explain in general terms how analog signals can be reasonably represented by discrete samples.
3. Explain and compare media file formats including lossy vs. lossless compression.
4. Use the basic features of animation languages.
5. Describe mechanisms for providing QoS guarantees in Multimedia communication system.

UNIT-I

Media and Data Streams: Properties of multimedia systems, Data streams characteristics: Digital representation of audio, numeric instruments digital interface Bark concepts, Devices, Messages, Timing Standards Speech generation, analysis and transmission.

UNIT-II

Digital Image: Analysis, recognition, transmission, **Video**: Representation, Digitalization transmission **Animations**: Basic concepts, animation languages, animations control transmission

UNIT-III

Data Compression Standards: JPEG, H-261, MPEG DVI
Optical storage devices and Standards: WORHS, CDDA, CDROM, CDWO, CDMO.
Real Time Multimedia, Multimedia file System.

UNIT-IV

Multimedia Communication System: Collaborative computing session management, transport subsystem, QOS, resource management.

Multimedia Databases: Characteristics, data structures, operation, integration in a database model.
A Synchronization: Issues, presentation requirements, reference to multimedia synchronization, MHEG

UNIT-V
Multimedia Application: Media preparation, Composition, integration communication, consumption, entertainment.

References:

1. Ralf Steninmetz, Klara Hahrstedt, *Multimedia: Computing, Communication and Applications*, PHI PTR Innovative Technology Series, 2004.
2. John F.Koegel Bufford, *Multimedia System*, Addison Wesley, 1994.
3. Mark Elsom – Cook, *Principles of InteractiveMultimedia*, Tata Mc-Graw Hill, 2001.
4. Judith Jefcoate, *Multimedia in Practice: Technology and Application*, PHI 1998.

CS 341

DISTRIBUTED DATABASES

Instruction : 3L hrs per week
Duration of SEE : 3 hours
CIE : 30 Marks
SEE : 70 Marks
Credits: 3

Course Objectives:
With this course Students will be able to:

- Understand the abstraction and details of file systems.
- Impact the contemporary knowledge in parallel and distributed computing along with Query Processing.
- Analyze the performance and flexibility issues related to systems design decisions.
- Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs

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

1. Understand the concepts and issues related to distributed systems.
2. Design and develop the programs for distributed environment.
3. Manage performance, reliability and other issues while designing in distributed environment.

UNIT I
Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS.

UNIT II
Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control.

UNIT III
Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing. Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.

UNIT IV

Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.

UNIT V

Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing, Transaction management. Database Interoperability: Database Integration, Query processing.

References:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGrawHill.

CS 342

SCALABLE ARCHITECTURES FOR ML APPLICATIONS

Instruction : 3L hrs per week Duration of SEE : 3 hours
CIE : 30 Marks SEE : 70 Marks
Credits: 3

Course Objectives:

- Students will be able to learn application and building Scalable Machine Learning
- Understand the students with Hadoop, SMACK Stack and also Message Services.
- Be able to select the appropriate architecture for enterprise architectures based on the size, scale and applications used in the enterprise.

Course Outcomes:

At the end of the course, students will gain knowledge

1. Understand the basic concepts of Scalable Machine Learning
2. To become a data scientist work in some development environment tailored for statistics and Machine Learning.
3. Obtain expertise to turn actionable insights and Fast Data Applications into innovative methods to solve real-world problems.
4. To impart knowledge on Kubernetesand batch processing

UNIT –I

Introduction to Scalable Machine Learning, Some Machine Learning Background
Algorithms for Large scale Learning, Overview of Hadoop and Current Big Data Systems

UNIT II

How Programming for Data Flow Differs, Basic Spark, Working with Vectors and Matrices in Spark, Brief tour of Spark ML, beyond parallelization, Practical Big Data

UNIT III

Anatomy of Fast Data Applications, SMACK Stack – Functional Decomposition,
Message Backbone- Understanding messaging requirements, Data ingestion, Fast data& low latency, Message Delivery Semantics, Distributing Messages

UNIT IV

Compute Engines- Micro Batch Processing, One-at-a time Processing, Choice of processing engine, Storage as the Fast Data Borders, The message backbone as Transition Point

UNIT V

Sharing stateful streaming state, Data Driven Micro-services, State and Micro-services.
Deployment environments for Fast Data Applications, Application containerization, resource scheduling, Apache Mesos, Kubernetes, Cloud Deployments.

References:

1. Designing Fast Data Application Architectures by Gerard Maas, Stavros Kontopoulos, Sean Glover , Publisher: O'Reilly Media, Inc., *June 2018*
2. Spark- The definitive Guide by Bill Chambers & Matei Zaharia, O'Reilly Media, Inc., *June 2019*

CS 103

ADVANCED ALGORITHMS

Instruction : 3L hrs per week
Duration of SEE : 3 hours
CIE : 30 Marks
SEE : 70 Marks
Credits: 3

Course Objectives:

- Introduce students to the advanced methods of designing and analyzing algorithms.
- To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
- Understand different classes of problems concerning their computation difficulties.
- To introduce the students to recent developments in the area of algorithmic design.

Course Outcomes:

After Completion of the course Students will be able to:

1. Analyze the complexity/performance of different algorithms.
2. Determine the appropriate data structure for solving algorithmic problems in different domains.
3. Categorize the different problems in various classes according to their complexity.
4. Explain recent developments in the approaches to design algorithms & data structures.

UNIT-I

Sorting: Review of various sorting algorithms, topological sorting,
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT-II

Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT-III

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.
Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT- IV

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

UNIT-V

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm. Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures

References:

4. "Introduction to Algorithms" byCormen, Leiserson, Rivest, Stein, 4th edition, McGraw Hill,
5. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
6. "Algorithm Design" by Kleinberg and Tardos.

CS 343

WEB MINING

Instruction: 3L hrs per week
CIE: 30 Marks
Credits: 3

Duration of SEE: 3 hours
SEE : 70 Marks

Course Objectives:

- To learn the basic concepts of data mining and machine learning for extracting information from web.
- To learn the concepts of information retrieval, structured information extraction and integration techniques.
- To understand the concepts of web structure mining and usage mining.
- To learn the concepts of opinion mining and sentiment analysis.

Course Outcomes:

After Completion of the course Students will be able to:

- Apply association rule mining and text classification techniques for web documents.
- Use similarity metrics and clustering algorithms for web documents.
- Use link analysis for social network analysis and to rank web search results.
- Design and implement a crawler application to collect and index documents from the web.
- Use web usage mining techniques to discover web usage patterns and sentiment/ opinion finding.

UNIT-I

Introduction: The World Wide Web, History of the Web and the Internet, Web Data Mining
Association Rules and Sequential Patterns: Basic Concepts, Apriori Algorithm, Data Formats for Association Rule Mining, Mining with Multiple Minimum Supports, Mining Class Association Rules
Supervised Learning: Basic Concepts, Decision Tree Induction, Classifier Evaluation, Naïve Bayesian Classification, Naïve Bayesian Text Classification, K-Nearest Neighbor Learning, Ensemble of Classifiers

UNIT-II

Unsupervised Learning: Basic Concepts. K-means Clustering, Representation of Clusters, Hierarchical Clustering, Distance Functions, Data Standardization, Handling of Mixed Attributes, Which Clustering Algorithm to Use? Cluster Evaluation
Information Retrieval and Web Search: Basic Concepts, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression

UNIT-III

Information Retrieval and Web Search: Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming
Link Analysis: Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank, HITS, Community Discovery

UNIT-IV

Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts

Structured Data Extraction: Wrapper Generation**,** Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation, String Matching and Tree Matching, Multiple Alignment, Building DOM Trees, Extraction based on a single list page, extraction based on a single list page : Nested doda records, Extraction based on multiple pages, Some other issues.

Information Integration: Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Match, Domain and Instance-Level Matching, Combining Similarities, 1: Match, Some other issues, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface.

UNIT-V

Opinion Mining and Sentiment Analysis: Sentiment Classification, Feature-Based Opinion Mining and Summarization, Comparative Sentence and Relation Mining, Opinion Search, Opinion Spam.

Web Usage Mining: Data Collection and Pre-Processing, Data Modeling for Web Usage Mining, Discovery & analysis of web usage patterns.

References:

1. Bing Liu ,*Web Data Mining*, Springer India, 2010
2. Soumen Chakrabarti, *Mining the Web*, Morgan-Kaufmann Publishers, Elseiver, 2002
3. Manu Konchady, *Text Mining Application Programming*, Cengage Learning, 2006

CS 216

SOFT COMPUTING

Instruction : 3L hrs per week
Duration of SEE : 3 hours
CIE : 30 Marks
SEE : 70 Marks
Credits: 3

Course Objectives:

- To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
- To implement soft computing-based solutions for real-world problems.
- To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.

Course Outcomes:

After Completion of the course Students will be able to:

- Identify and describe soft computing techniques and their roles in building intelligent Machines.
- Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
- Apply genetic algorithms to combinatorial optimization problems.
- Evaluate and compare solutions by various soft computing approaches for a given problem.
- Recognize the underlying mathematics and logic behind various soft computing algorithms.

UNIT-I

Introduction to Soft Computing and Neural Networks: Evolution of Computing Soft Computing Constituents from Conventional AI to Computational Intelligence-Machine Learning Basics.

UNIT II

Genetic Algorithms: Introduction to Genetic Algorithms (GA) –Applications of GA in Machine Learning-Machine Learning Approach to Knowledge Acquisition.

UNIT III

Neural networks: Machine Learning Using Neural Network, Adaptive Networks –Feed forward Networks –Supervised Learning Neural Networks–Radial Basis Function Networks-Reinforcement Learning–Unsupervised Learning Neural Networks–Adaptive Resonance architectures – Advances in Neural networks.

UNIT IV

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT V

Neuro-Fuzzy Modelling: Adaptive Neuro, Fuzzy Inference Systems, Coactive Neuro, Fuzzy Modelling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification, Neuro-Fuzzy Control, Case studies.

References:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, *Neuro-Fuzzy and Soft Computing*, Prentice- Hall of India, 2003.
2. George J. Klir and Bo Yuan, *Fuzzy Sets and Fuzzy Logic-Theory and Applications*, Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, *Neural Networks Algorithms, Applications, and Programming Techniques*, Pearson Edn., 2003.
4. Mitchell Melanie, *An Introduction to Genetic Algorithm*, Prentice Hall, 1998.
5. David E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison Wesley, 1997.

CS 144

ARTIFICIAL NEURAL NETWORKS

Instruction : 3L hrs per week | Duration of SEE : 3 hours
CIE : 30 Marks | SEE : 70 Marks
Credits: 3

Course Objectives:

- To provide an introduction to the field of artificial neural networks and machine learning.
- To teach students how to solve practical problems via implementation of these techniques via simulation.
- To promote further independent learning on the topics of artificial neural networks and machine learning.

Course Outcomes:

After Completion of the course Students will be able to:

1. Model Neuron and Neural Network, and to analyze ANN learning, and its applications.
2. Perform Pattern Recognition, Linear classification.
3. Develop different single layer/multiple layer Perception learning algorithms
4. Design of another class of layered networks using deep learning principles.

UNIT-I

Background to ANN: Introduction to artificial neural networks (ANN), intelligence, learning and knowledge. Historical development of Artificial Intelligence (AI) leading to ANN. PDP models -- Interactive and competetion (IAC) and Constraint Satifaction (CS) models.

UNIT-II

Baiscs of ANN: Basics of ANN, terminology, models of neurons, topology, basic learning laws, activation and synaptic dynamics models

UNIT-III

Analysis of Feed
forward Neural Networks (FFNN): Overview, linear associative networks, perceptron network, multilayer perceptron, gradient descent methods, back propagation learning

UNIT-IV

Analysis of Feedback Neural Networks (FBNN): Overview, Hopfield model, capacity, energy analysis, state transition diagrams, stochastic networks, Boltzmann-Gibbs Law, simulated annealing, Boltzmann machine

UNIT-V

Applications of ANN: Travelling salesman problem, image smoothing, speech recognition and texture classification.

References:

1. B Yegnanarayana, *Artificial Neural Networks*, Prentice-Hall of India, New Delhi, 1999

2. Simon Haykin, *Neural networks and learning machines*, Pearson Education, 2011

3. Jacek M Zurada, *Introduction to artificial neural systems*, PWS publishing Company, 1992

4. David E Rumelhart, James McClelland, and the PDP research group, Eds, *Parallel and Distributed Processing: Explorations in Microstructure of Cognition, Vol 1*, Cambridge MA: MIT Press, 1986a

5. James McClelland, David E Rumelhart, and the PDP research group, Eds, *Parallel and Distributed Processing: Explorations in Microstructure of Cognition, Vol 2*, Cambridge MA: MIT Press, 1986b

6. David Rumelhart, James McClelland, and the PDP research group, Eds, *Parallel and Distributed Processing: A handbook of models*, Cambridge MA: MIT Press, 1989.

AC 035

CONSTITUTION OF INDIA

Instruction: 2 periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 0

Course Objectives:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes:

1. Students will be able to:
2. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
3. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I

• History of Making of the Indian Constitution:

History

Drafting Committee, (Composition & Working)

UNIT-II

• Philosophy of the Indian Constitution:

Preamble

Salient Features

UNIT-III

• Contours of Constitutional Rights & Duties:

• Fundamental Rights

• Right to Equality

• Right to Freedom

• Right against Exploitation

• Right to Freedom of Religion

- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT-IV

- Organs of Governance:
- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT-V

- Local Administration:
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation.
- Pachayati raj: Introduction, PRI: Zila Pachayat.
- Elected officials and their roles, CEO Zila Pachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-VI

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

Suggested Reading:

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

AC 036

PEDAGOGY STUDIES

Instruction: 2 periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 00

Course Objectives:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I

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

UNIT-II

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

UNIT-III

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

UNIT-IV

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

UNIT-V

Research gaps and future directions

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested Reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

AC 037

STRESS MANAGEMENT BY YOGA
(Audit course)

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 00

Course Objectives

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

Course Outcomes

After the completion of this course, the students shall be able to:

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

UNIT I

Introduction: Definition of **Stress** – Types of stress: Acute and chronic - Stressors – Definition of **Yoga** from various sources – Types of yoga – Karma yoga, Gnana yoga, Bhakti yoga and Raja yoga – Concept of Bhagavad Geeta - Yoga versus exercise –Basics of Physiology and Psycholoy – Brain and its parts – CNS and PNS – HPA axis – Sympethetic and Para sympethetic nervous systems – Fight and Flight mechanism - Relationship between stress and yoga.

UNIT II

Ashtanga Yoga: Do`s and Don'ts in life: (i) **Yam -** Ahinsa, satya, astheya, bramhacharya and aparigraha (ii) **Niyam**-Shaucha, santosh, tapa, swadhyay, ishwarpranidhan – (iii) **Asana** (iv) **Pranayama (**v) **Prathyahara (**vi) **Dharana** (vii) **Dhyana (**viii) **Samadhi** – Illustrations of eight steps of Ashtanga yoga.

UNIT III

Asana and Stress: Definition of Asana from Pathanjali – Origin of various names of asanas - Various yoga poses and their benefits for mind & body – Sequence of performing asanas: Standing, sitting, lying down on stomach, lying down on back and inverted postures – Activation of Annamaya kosha – Effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas.

UNIT IV

Pranayama and Stress: Definition of pranayama from Shankaracharya - Regularization of breathing techniques and its effects - Types of pranayama – Heat generating and cold generating techniques – Pranayama versus chakras and systems – Breathing techniques versus seasons - Anger and breathing rate – Activation of pranamayakosha – Pranayama as the bridge between mind and body – Stress control through pranayama.

UNIT V

Dhyana and Stress: Distinction between Dhyana and Dharana– Preparation for Dhyana through prathyahara and dharana – Activation of Vignanamayakosha – Types of mind: conscious, superconscious and subconscious – Activation of manomayakosha through Dhyana – Silencing the mind thereby controlling the stress levels

Suggested Reading:

1 '*Yogic Asanas for Group Tarining-Part-I*' : Janardan Swami Yogabhyasi Mandal, Nagpur

2 "*Rajayoga or Conquering the Internal Nature*" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

3 *"Light onYoga"* by BKS Iyengar.

4 "*The search for happiness and bliss*" by Swami Sarvapriyananda on you tube – https://youtu.be/xfywJTPkw7Y.

5 "*Mastering the mind*" by Swamini Vimalananda on you tube - https://youtu.be/EXniWH9DMF8.

AC 038

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit course)

Instruction: 3periods per week Duration of SEE: 3 hours

CIE: 30 marks SEE: 70 marks

Credits: 00

Course Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes

After the completion of this course, the students shall be able to:

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

UNIT I

- Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT II

- Approach to day-to-day work and duties.
- Shrimad Bhagwad 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.

UNIT III

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16, 17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:
- Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42,
- Chapter 4-Verses 18, 38, 39
- Chapter18 – Verses 37, 38, 63

Suggested Reading:

1 Swami SwarupanandaAdvaita Ashram "*Srimad Bhagavad Gita",* (Publication Department), Kolkata.

2 P.Gopinath, *"Bhartrihari's Three Satakam (Niti-sringar-vairagya*)", Rashtriya Sanskrit Sansthanam, New Delhi

CS070

MINI PROJECT WITH SEMINAR

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for systematic independent study of state of the art topics in broad area of his/her specialization.

Seminar topics can be choosen by the students with the advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

Literature survey

Organization of material

Preparation of Power point Presentation slides

Technical writing

Each student is required to

1. Submit one page of synopsis of the seminar talk two days before for display on notice board.
2. Give 20 minutes presentation through MS-PowerPoint Presentation Slides followed by 10 minutes discussion.
3. Submit a report on the seminar topic with a list of references and slides used within a week.

Seminars are to be scheduled from the 3rd week of the last week of the semester and any change in schedule should be discouraged.

The CIE marks will be awarded to the students by atleast 2 faculty members on the basis of oral presentation and report as well as their involvement in the discussion.

CS 156

ARTIFICIAL INTELLIGENCE LAB

Instruction**:** 3 hrs per week CIE**:** 50 marks
Credits: 1.5

Course Objectives:

- Students can impart practical knowledge on Artificial intelligence programs with Python Language and able to process NLP libraries.

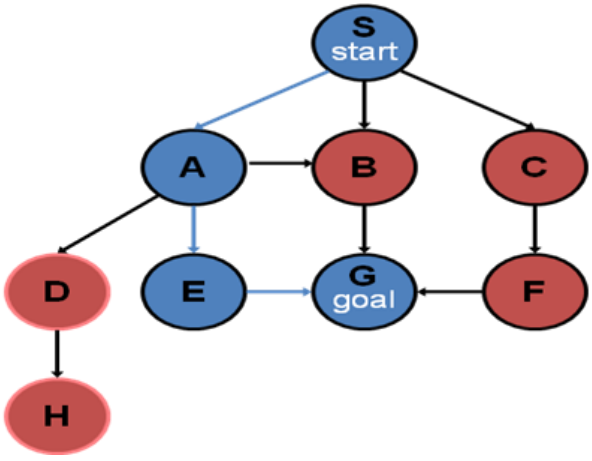
Course Outcomes:

1. Able to use various heuristic search strategies in Artificial Intelligence programs
2. Able to use probabilistic reasoning in decision problems
3. Able to use various open source ML libraries to evaluate different ML algorithms
4. Able to use open source NLP libraries for processing text processing applications

1. Implement the following graph search algorithms using Python
   a. Breadth First Search
   b. Depth First Search
   c. Depth First Iterative Deepening Search
   d. A* Search using 8 tiles game

   The input parameters will be the graph G, start state and goal state. Represent the graph using dictionary, key-value pair. Example:

```
G = {
   'S': ['A','B','C'],
   'A': ['D','E','B'],
   'B': ['G'],
   'C': ['F'],
   'D': ['H'],
   'E': ['G'],
   'F': ['G'],
   'G': [],
   'H': []
}
```



Open list should contain the states that are to be expanded and closed list should contain the states that are already expanded.

1. Implement the Minimax search algorithm in game playing using recursion in Python
2. Implement the Eight Queens problem using constraint satisfaction algorithm using Python
3. Write a program that implements Naive Bayes Machine Learning Algorithm from scratch without using the libraries in Python. Your program should read the training and test data set files that are in the ARFFformat and classify each of the instances in the test data set file. This is a binary classification problem.
4. Students are expected to learn any one of the following:
   a. Scikit-learn (https://scikit-learn.org/) an open source machine learning Python library that supports supervised and unsupervised learning. The sklearn.datasets package embeds small toy datasets. It includes utilities to load these datasets. Students are expected to study and make use of these datasets
   b. Weka (http://www.cs.waikato.ac.nz/ml/weka/) a widely used ML toolkit that supports supervised and unsupervised learning. Weka provides various data sets in ARFF format. Students are expected to study and make use of these datasets
5. Write Python program to use sklearn's DecisionTreeClassifier to build a decision tree for the sklearn's datasets or use Weka's J48 tree learner.
6. Write a Python program or use the Weka Toolkit for the K-means algorithm.
7. Design a perceptron classifier to classify handwritten numerical digits (0-9). Implement using scikit or Weka.
8. Write a Python program to segment a text into linguistically meaningful units, such as paragraphs, sentences, or words. For segmenting text into tokens (words and word-like units) use regular expressions.
9. Write a program to label words (tokens) with parts of speech such as noun, adjective, and verb using a PoS tagger

References:

1. Introduction to Python Programming. Gowrishankar S., Veena A. CRC Press, Taylor & Francis Group, 2019
2. scikit-learn user guide.https://scikit-learn.org/stable//_downloads/scikit-learn-docs.pdf
3. Ian Witten, Eibe Frank, and Mark Hall, Chris Pal. DATA MINING: Practical Machine Learning Tools and Techniques, 4th Edition. Morgan Kaufmann.
4. Jacob Perkins. Python 3 Text Processing with NLTK 3 Cookbook. Packt Publishing. 2014

CS 359

SENTIMENT ANALYSIS LAB

Instruction**:** 3 hrs per week CIE**:** 50 marks
Credits: 1.5

Course Outcomes:

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

- Take up advanced research in the field with subsequent qualitative and quantitative analysis.

Course Objectives:

1. To take a structured approach in introducing real time problems related to sentiment extraction.
2. To facilitate qualitative and quantitative analysis of sentiments.
3. To discuss the existing techniques for solving real time sentiment extraction problems.

1) Write a python program to scrap text data from the web.
   - Hint: use requests and beautiful soup libraries

2) Write a python program for following pre-processing tasks for the scraped data.

   - Remove HTML tags
   - Fix all contractions
   - Remove punctuations
   - Replace any accented characters with close approximations
   - Convert to lower case
   - Remove stopwords
   - Perform Lemmatization

3) Write a python program to create a model for the preprocessed data and extract sentiments using lexicon based approach.
   - Hint: Use opinion_lexicon in NLTK.

4) Perform Sentiment Analysis using following lexicons and compare the results.
   - Vader
   - Textblob
   - Afinn

5) Perform Sentiment Analysis using machine learning approach
   - Hint: Use scikit-learn_SVM

6) Compare text classification using machine learning and lexicon based approaches.

7) Compare Sentiment Analysis Tools.
8) Perform Sentiment Analysis using TensorFlow.
9) CASE STUDY: Write a python program to build a Deep Learning Model and classify text either as positive or negative.
10) CASE STUDY: Perform Sentiment Analysis on Codemixed Twitter Data.

SEMESTER-III									
1	Profession Elective-V	CS351	Automatic Speech Recognition	3	0	0	30	70	3
		CS352	Deep Multitasking with Meta Learning						
		CS353	Programming for Big Data Systems						
		CS218	Scripting Languages For Design Automation						
		CS151	Simulation and Modelling						
		CS354	Human Compute Interaction						
		CS153	Secure Coding Principles						
2	Open Elective	OE941	Business Analytics	3	0	0	30	70	3
		OE942	Industrial Safety						
		OE943	Operations Research						
		OE944	Cost Management of Engineering Projects						
		OE945	Composite Materials						
		OE946	Waste to Energy						
		OE947	Cyber Security						
		OE948	Internet of Things (IoT)						
3	Dissertation	CS181	Major Project Phase-I	0	0	20	100**		10
TOTAL				**6**	**0**	**20**	**160**	**140**	**16**

CS 351

AUTOMATIC SPEECH RECOGNITION

Instruction : 3L hrs per week
Duration of SEE : 3 hours
CIE : 30 Marks
SEE : 70 Marks
Credits: 3

Course Objectives

- Students will be able to know the theory and practice of automatic speech recognition (ASR),
- To familiarize students with a focus on the statistical approaches that comprise the state of the art,
- Analyze the framework for speech recognition, including speech signal analysis, acoustic modelling using hidden Markov models, language modeling and recognition search.

Course Outcomes

On completion of this course, the student will be able to:

1. Describe the statistical framework used for automatic speech recognition.
2. Understand the weakness of the simplified speech recognition systems and demonstrate knowledge of more advanced methods to overcome these problems.
3. Describe speech recognition as an optimization problem in probabilistic terms.
4. Relate individual terms in the mathematical framework for speech recognition to particular modules of the system.
5. Build a large vocabulary continuous speech recognition system, using a standard software toolkit.

UNIT I

Introduction to Statistical Speech Recognition, HMMs for Acoustic Modeling, Hiddden Markov Models and Weighted finite state transducers.

UNIT II

Weighted finite state transducers for Automatic Speech Recognition, Tied State Hidden Markov Models and Neural Networks based acoustic modeling(Hybrid/ Tandem/ Time Delay NN models)

UNIT III

Introduction to RNN based models, Language models, Acoustic feature analysis for ASR

UNIT –IV

End- to end Neural architectures for ASR, Search and Decoding multilingual and low-resource ASR.

UNIT –V

Speech Synthesis, CNN in Speech, Speaker Adaptation, Discriminative Training, Generative Adversarial Networks

References:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 3rd edition draft, 2019 [JM-2019]

2. Mark Gales and Steve Young, The application of hidden Markov models in speech recognition, Foundations and Trends in Signal Processing, 1(3):195-304, 2008.

3. Geoffrey Hinton, Li Deng, Dong Yu, George E. Dahl, Abdel-rahman Mohamed, Navdeep Jaitly, Andrew Senior, Vincent Vanhoucke, Patrick Nguyen, Tara N. Sainath, and Brian Kingsbury, Deep Neural Networks for Acoustic Modeling in Speech Recognition, IEEE Signal Processing Magazine, 29(6):82-97, 2012

CS 352

DEEP MULTI-TASKING AND META LEARNING

Instruction : 3L hrs per week
CIE : 30 Marks
Credits: 3

Duration of SEE : 3 hours
SEE : 70 Marks

Course Objectives:

- To focus on Goal-conditioned reinforcement learning techniques that leverage the structure of the provided goal space to learn many tasks significantly faster
- To use Meta-learning methods that aim to learn efficient learning algorithms that can learn new tasks quickly
- Curriculum and lifelong learning, where the problem requires learning a sequence of tasks, leveraging their shared structure to enable knowledge transfer

Course Outcomes

1. Understand and implement the state-of-the-art multi-task learning and meta-learning algorithms
2. Ready to conduct research on these topics.

UNIT I

Course introduction, problem definitions, applications.

Deep Generative Models : Deep Generative Model Overview , BoltzmannMachines , Restricted Boltzmann Machines, Deep Belief Networks (DBNs) , Deep Boltzmann Machines (DBMs) , Boltzmann Machines with Real Values.
Directed Generative Nets : Sigmoid Belief Networks , Differentiable Generator Nets.
Variational Autoencoders (VAEs) : PGM View , Neural Network View , VAE Applications.
Generative Adversarial Networks (GANs) : GAN Motivation , GAN Theory, GAN Mode Collapse, Wasserstein GAN , GAN Variants.

UNIT –II

Supervised multi-task learning, black- box meta- learning, Optimization based meta- learning, Uncertainty estimation & Bayesian Deep Learning, Applications in imitation learning, vision & language, generative models

UNIT-III

Graph convolution Networks, Few-shot learning via metric learning, Hybrid meta-learning approaches, Bayesian meta-learning, Meta-learning for active learning, weakly-supervised learning, and unsupervised learning.

UNIT- IV

Reinforcement learning primer, multi-task RL, goal-conditioned RL, Auxiliary objectives, state representation learning , Hierarchical RL, curriculum generation, Meta RL, Learning to explore, Meta-RL and emergent phenomenon.

UNIT - V

Model based RL for multi-task Learning, meta- model based RL, Lifelong learning: problem statement, forward & backward transfer, Deep imitative models for flexible inference, planning & control, Memorization, unsupervised meta learning, open problems.

References:

1. Lifelong Machine Learning: Second Edition By Zhiyuan Chen, Bing Liu

CS 353

PROGRAMMING FOR BIG DATA SYSTEMS

Instruction : 3L hrs per week
CIE : 30 Marks
Credits: 3

Duration of SEE : 3 hours
SEE : 70 Marks

Course Objectives

- Learn business case studies for big data analytics.
- Understand nosql big data management.
- Perform map-reduce analytics using Hadoop and related tools

Course Outcomes

After completion of course, students would be:

1. Describe big data and use cases from selected business domains
2. Explain NoSQL big data management
3. Install, configure, and run Hadoop and HDFS
4. Perform map-reduce analytics using Hadoop
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT 1

What is big data, why big data, convergence of key trends, unstructured data,industry examples of big data, web analytics, big data and marketing, fraud andbig data, risk and big data, credit risk management, big data and algorithmictrading, big data and healthcare, big data in medicine, advertising and big data,big data technologies, introduction to Hadoop, open source technologies, cloudand big data, mobile business intelligence, Crowd sourcing analytics, inter andtrans firewall analytics.

UNIT II

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer to peerreplication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

UNIT III

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFSconcepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

UNIT IV

Map Reduce workflows, unit tests with MRUnit, test data and local tests, anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classicMap-reduce and YARN, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats

UNIT V

Hbase, data model and implementations, Hbase clients, Hbase examples,praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients,Hadoop integration.

Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts.Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

References:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
6. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
7. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
8. Eben Hewitt, "Cassandra: The Definitive Guide",

CS 218

SCRIPTING LANGUAGES FOR DESIGN AUTOMATION

Instruction : 3L hrs per week
CIE : 30 Marks
Credits: 3

Duration of SEE : 3 hours
SEE : 70 Marks

Course Objectives:

- To introduce Decision and Repetition Structures of Scripting languages.
- To learn basics concepts and different operations on Files, strings, Dictionaries and sets.
- To introduce Object oriented features to develop real time applications.
- To understand GUI programming for design automation.

Course Outcomes:

After Completion of the course Students will be able to:

1. Use Python Programming which is a compatible scripting language to design applications.
2. Develop applications using the features of Object-oriented programming.
3. Create Graphical Interfaces for design automation.

UNIT I

Introduction to Python Programming: Program Development Cycle, Input, Processing, and Output, Variables, Performing Calculations (Operators, Type conversions, Expressions),
Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.
Repetition Structures: Introduction, while loop, for loop, Input Validation Loops, Nested Loops.

UNIT II

Functions: Introduction, Defining and Calling a Void Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions.
Lists and Tuples: Sequences, Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples.

UNIT III

File and Exceptions: Introduction to File Input and Output, Using Loops to Process Files, Processing Records, Exceptions.
Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings
Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT IV

Recursion: Introduction, Problem Solving with Recursion, Examples of Recursive Algorithms.
Object-Oriented Programming: Procedural and Object-Oriented Programming, Classes, Working with Instances, Techniques for Designing Classes, Inheritance, Polymorphism.

UNIT V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

References:

1. Tony Gaddis, Starting *out with Python*, Pearson College Division, 3rd Edition, 2014.
John V Guttag, *Introduction to Computation and Programming using Python*, MIT Press, 3rd Edition, 2016.

CS 151

SIMULATION AND MODELLING

Instruction : 3L hrs per week
CIE : 30 Marks
Credits: 3

Duration of SEE : 3 hours
SEE : 70 Marks

Course Objectives:

- Define the basics of simulation modelling and replicating the practical situations in organizations.
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer.
- Explain Verification and Validation of simulation mode.

Course Outcomes:

After Completion of the course Students will be able to:

1. Categorize the random data of a physical system into a particular type of probability distribution function.
2. Apply Chi-square test on the curve-fitting method employed on the random data of a physical system.
3. Create mathematical model to simulate for checking the correct functioning of the algorithms.
4. Evaluate on most suitable algorithm for a problem solving, after testing the different designs with modeling/simulation.

UNIT-I

Introduction to simulation: Advantages & Dis-advantages of simulation – Areas of applications, Systems and Systems Environment, Concept of a system, Discrete & Continuous system – Models, types of models, Steps in a simulation study – Examples, Discrete – Event System simulation.

UNIT-II

Overview of Statistical Models and Queuing Systems, Programming languages for Simulation: Continuous and Discrete Simulation Languages – GPSS, SIMAN, SIMSCRIPT, MATLAB and SIMULINK.

UNIT-III

Random Numbers: Generation, Properties of Random Numbers, Generation of Pseudo Random Numbers, Tests for Random Numbers.

Random Variate: Generation, Inverse Transformation Technique, Uniform Distribution, Exponential Distribution, Weibul's Distribution, Triangular Distribution, Empirical Continuous Distribution, Discrete Distributions, Direct Transformation for the Normal Distribution, Convolution Method of Erlang Distribution, Acceptance Rejection Techniques: Poisson Distribution, Gamma Distribution.

UNIT-IV

Input Data Analysis: Data Collection: Identify the Distribution, Parameter and Estimation.

Goodness of fit tests: Chi-Square Test – KS Test; Multivariate and time series input models, Verification and Validations of Simulation Models, Model Building, Verification and Validation: Verification of Simulation Models, Calibration and Validation of Models, face validity, Validation of Model Assumptions. Validation Input/output Transformations, Input/output Validation using Historical Input Data, Input/output Validation Sing Turning Test.

UNIT-V

Output Data Analysis, Stochastic, Nature of output data, Types of Simulation with respect to output Analysis, Measures of Performance and their Estimation, output Analysis for Terminating Simulations, Output Analysis for steady – State Simulations.

Comparison and Evaluation of Alternative System Designs: Comparison of several system Designs, Statistical Models for Estimating the Effect of Design Alternatives

References:

1. Jabey Banks, John S. Cansen and Barry L. Nelson, *Discrete – Event System Simulation*, Prentice Hall of India, 2001.
2. Nursing Deo, *System Simulation with Digital computer*, Prentice Hall of India, 1979.
3. Anerill M. Law and W. David Kelton, *Simulation Modelling and Analysis*, McGraw Hill. 2001.
4. Agamkumartyagi, *MATLAB and Simulink for Engineers*, Oxford Publishers, 2011

CS 354

HUMAN COMPUTER INTERACTION

Instruction : 3L hrs per week
CIE : 30 Marks
Credits: 3

Duration of SEE : 3 hours
SEE : 70 Marks

Course Objectives:

- To introduce interaction paradigms and styles.
- To introduce the concept of user-centered design.
- To introduce principles of interaction design and usability testing.
- To introduce different interface design components.

Course Outcomes:

After Completion of the course Students will be able to:

1. Describe different types of interactive environments and interaction styles.
2. Explain the steps in user interface design process and the need for user-centered design.
3. Describe techniques for developing prototypes of user interfaces and evaluation of user interfaces.
4. Illustrate how different principles of interaction design are applied in user interface design.
5. Create an appropriate usability test plan.

UNIT- I

Interaction Paradigms: Computing Environments, Analyzing Interaction Paradigms, Interaction Paradigms
Interaction Frameworks and Styles: Frameworks for Understanding Interaction, Coping with Complexity, Interaction Styles.

UNIT- II

Interaction Design Process: Iterative Design, User-Centered Design, Interaction Design Models, Overview of Interaction Design Models
Discovery: Discovery Phase Framework, Collection, Interpretation, Documentation
Design: Conceptual Design, Physical Design, Evaluation, Interface Design Standards, Designing the Facets of the Interface.

UNIT- III

Design Principles: Principles of Interaction Design, Comprehensibility, Learn ability, Effectiveness/Usefulness, Efficiency/Usability, Grouping, StimulusIntensity, Proportion, Screen Complexity, Resolution/Closure, Usability Goals
Interaction Design Models: Model Human Processor, Keyboard Level Model, GOMS, Modelling Structure, Modelling Dynamics, Physical Models
Usability Testing: Usability, Usability Test, Design the Test, Prepare for the Test, Perform the Test, Process the Data

UNIT- IV

Interface Components: The WIMP Interface, Other Components
Icons: Human Issues Concerning Icons, Using Icons in Interaction Design, Technical Issues Concerning Icons
Color: The Human Perceptual System, Using Color in Interaction Design, Color Concerns for Interaction Design, Technical Issues Concerning Color

UNIT- V

Text: Human Issues Concerning Text, Using Text in Interaction Design, Technical Issues Concerning Text
Speech and Hearing: The Human Perceptual System, Using Sound in Interaction Design, Technical Issues Concerning Sound
Touch and Movement: The Human Perceptual System, Using Haptics in Interaction Design, Technical Issues Concerning Haptics

References:

1. Steven Heim, *The Resonant Interface: HCI Foundations for Interaction Design*, Addison-Wesley, 2007
2. J. Preece, Y. Rogers, and H. Sharp, *Interaction Design: Beyond Human-Computer Interaction*, Wiley & Sons, 2nd Edition, 2007
3. Ben Shneiderman ,Catherine Plaisant,*Designing the User Interface: Strategies for Effective Human-Computer Interaction*, Addison-Wesley, 5th Edition, 2009.

CS 153

SECURE CODING PRINCIPLES

Instruction : 3L hrs per week | Duration of SEE : 3 hours
CIE : 30 Marks | SEE : 70 Marks
Credits: 3

Course Objectives:

- To understand the various security attacks
- To learn how to recognize to coding errors
- To understand techniques for developing a secure application.

Course Outcomes:

After Completion of the course Students will be able to:

1. To understand various attacks like DoS, buffer overflow, web specific, database specific, web-spoofing attacks.
2. To demonstrate skills needed to deal with common programming errors that lead to most security problems and to learn how to develop secure applications.
3. To identify the nature of the threats to software and incorporate secure coding practices throughout the planning and development of the product.

UNIT- I

Introduction: Security, CIA Triad, Viruses, Trojans, and Worms in a Nutshell, Security Concepts-exploit, threat, vulnerability, risk, attack. Malware Terminology: Rootkits, Trapdoors, Botnets, Key loggers, Honeypots. Active and Passive Security Attacks. IPSpoofing, Teardrop, DoS, DDoS, XSS, SQL injection, Man in middle Attack, Format String attack. Types of Security Vulnerabilities-buffer overflows, Invalidated input, race conditions, access-control problems, weaknesses in authentication, authorization, or cryptographic practices. Access Control Problems.

UNIT-II

Need for secure systems: Proactive Security development process, Secure Software Development Cycle(S-SDLC),Security issues while writing SRS, Design phase security, Development Phase, Test Phase, Maintenance Phase, Writing Secure Code – Best Practices SD3(Secure by design, default and deployment),Security principles and Secure Product Development Timeline.

UNIT- III

Threat modeling process and its benefits: Identifying the Threats by Using Attack Trees, Risk Mitigation Techniques and Security Best Practices. Security techniques, authentication, authorization.

Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks. Security Issues in C Language: String Handling, Avoiding Integer Overflows and Underflows and Type Conversion Issues- Memory Management Issues, Code Injection Attacks.

UNIT-IV

Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check, Time of Use and its protection mechanisms. Validating Input and Interposes Communication, Securing Signal Handlers and File Operations. XSS scripting attack and its types – Persistent and Non persistent attack XSS Countermeasures and by passing the XSS Filters.

UNIT- V

Testing Secure Applications: Security code overview, secure software installation. The Role ofthe Security Tester, Building the Security Test Plan. Testing HTTP-Based Applications, TestingFile-Based Applications

References:

1. Michael Howard and David Le Blanc," *Writing Secure Code*" ,MicrosoftPress,2nd Edition, 2004.
2. Jason Deckard, "*Buffer Overflow Attacks: Detect, Exploit, Prevent*", Syngress,1st Edition,2005.
3. Frank Swiderski and Window Snyder, "*Threat Modeling*",MicrosoftProfessional,1stEdition, 2004.

OE941

BUSINESS ANALYTICS
(Open Elective)

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives

- To understand the role of business analytics within an organization.
- To analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- To use decision-making tools/Operations research techniquesand manage business process using analytical and management tools.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand the basic concepts of business analytics.
2. Identify the application of business analytics and use tools to analyze business data.
3. Become familiar with various metrics, measures used in business analytics.
4. Illustrate various descriptive, predictive and prescriptive methods and techniques.
5. Model the business data using various business analytical methods and techniques.

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Suggested Readings:

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

Web Resources

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

OE942

INDUSTRIAL SAFETY
(Open Elective)

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives

- To understand industrial safety and remember features of factory act 1948.
- Analyze maintenance tools, corrosion preventive measures and fault causes.
- Assess the importance of periodic inspections and maintenance.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand the necessity of industrial safety and remember features of factory act 1948 for health and safety.
2. Analyze the tools used for maintenance.
3. Become thorough of the corrosion preventive measures.
4. Analyze the causes of faults and draw decision trees.
5. Understand importance of periodic maintenance and inspection procedures.

UNIT I

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

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

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, 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, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. 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: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Suggested Readings:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

3. Pump-hydraulic Compressors, Audels, Mcgraw Hill Publication.

4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OE943

OPERATIONS RESEARCH
(Open Elective)

Instruction: 3periods per week
CIE: 30 marks
Credits: 3

Duration of SEE: 3 hours
SEE: 70 marks

Course Objectives

- To understand the dynamic programming to solve problems of discrete and continuous variables
- To apply the concept of non-linear programming and carry out sensitivity analysis
- To understand deterministic and probabilistic inventory control models.

Course Outcomes

After the completion of this course, the students shall be able to:
1. apply the dynamic programming to solve problems of discrete and continuous variables
2. apply the concept of non-linear programming
3. carry out sensitivity analysis
4. understand deterministic and probabilistic inventory control models.
5.model the real-world problem and simulate it.

UNIT I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Suggested Readings:

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
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OE944

COST MANAGEMENT OF ENGINEERING PROJECTS
(Open Elective)

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives

- Introduce the concepts of cost management, inventory valuation, decision making
- Fundamentals of cost overruns, project execution and technical activities
- Introduce the concepts of Quantitative techniques for cost management, Linear Programming, PERT/CPM

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand strategic cost management process, control of cost and decision making based on the cost of the project.
2. Appreciate detailed engineering activities of the project and execution of projects
3. Prepare project report and network diagram
4. Plan Cost Behavior, Profit Planning, Enterprise Resource Planning, Total Quality Management.
5. Apply various quantitative techniques for cost management

UNIT I

Introduction: Overview of the Strategic Cost Management Process 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.

UNIT II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram.

UNIT III

Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

UNIT IV

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Suggested Readings:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

OE945

COMPOSITE MATERIALS
(Open Elective)

Instruction: 3periods per week Duration of SEE: 3 hours
CIE: 30 marks SEE: 70 marks
Credits: 3

Course Objectives

- To understand the fundamentals of composite materials and the role of matrix and reinforcement.
- To know the principles of manufacturing composite
- To understand the strength and failure criteria of lamina and laminate.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Define a composite, identify the matrix and reinforcement and highlighting the features and application of different composite materials.
2. Classify composites, illustrate the mechanical behaviour of composites and predict properties using micromechanics principles.
3. Illustrate the manufacturing of metal matrix composites and outline the properties and applications.
4. Illustrate the manufacturing of Polymer matrix composites and outline the properties and applications.
5. Apply various failure criteria to assess the strength of lamina and laminates.

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 prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Suggested Readings:

1. Material Science and Technology- Vol 13- Composites by R.W. Cahn-VCH, West Germany.
2. Materials Science and Engineering, An Introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley &Sons, NY, Indian edition, 2007.
3. Composite Materials- K. K. Chwala.
4. Composite Materials Science and Applications-Deborah D.L. Chung.
5. Composite Materials Design and Applications-Danial Gay, Suong V. Hoa and Stwphen W. Tsai.

OE946

WASTE TO ENERGY
(Open Elective)

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives

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

Course Outcomes

After the completion of this course, the students shall be able to:
1. Understand the concept of conservation of waste
2. Identify the different forms of wastage
3. Chose the best way for conservation to produce energy from waste
4. Explore the ways and means of combustion of biomass
5. Develop a healthy environment for the mankind

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

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

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V

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

Suggested Readings:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OE947

CYBER SECURITY
(Open Elective)

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives:

- Learn the various threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and IT laws and policies

Course Outcomes:

After Completion of the course Student will be able to:

1. Understand the various network threats.
2. Analyse the forensic tools for evidence collection.
3. Apply the firewalls for threat analysis.

UNIT-I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT-II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.

UNIT-III

Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, searc and seizure of computer systems, password cracking.

UNIT-IV

Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrival, Email analysis from mobile phones.

UNIT-V

Ethics, Policies and IT Act Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code , Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

Suggested Readings

1. Charles P. Fleeger, "*Security in Computing*", Prentice Hall, New Delhi, 2009.
2. BehrouzA.Forouzan, "*Cryptography & Network Security*", Tata McGraw Hill, India, New Delhi, 2009.
3. William Stallings, "*Cryptography and Network Security*", Prentice Hall, New Delhi, 2006.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "*Network Security: Private Communication in a Public Network*", Pearson Education, New Delhi, 2004.
5. Neal Krawetz, "*Introduction to Network Security*", Thomson Learning, Boston, 2007.
6. Bruce Schneier, "*Applied Cryptography*", John Wiley & Sons, New York, 2004.

OE948

INTERNET OF THINGS
(Open Elective)

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives:

- To understand the concepts of Internet of Things and able to build IoT applications
- To learn the programming and use of Arduino and Raspberry Pi boards.
- To know about data handling and analytics in SDN.

Course Outcomes:

After Completion of the course Student will be able to:

1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT – I

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT – II

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT – III

Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT - IV

Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT - V

Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

Suggested Readings:

1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. “Make sensors”: Terokarvinen, kemo, karvinen and villey valtokari, 1st edition, maker media, 2014. 3. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti
3. Vijay Madisetti, Arshdeep Bahga, “Internet of Things: A Hands-On Approach”
4. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
5. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013

CS181

MAJOR PROJECT PHASE I

Instruction	20 Periods per week
End Semester Evaluation	70 Marks
Mid Semester Evaluation	30 Marks
Credits	10

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

1. Synthesize knowledge and skills previously gained and apply them to new technical problem.
2. Select from different methodologies, methods and analyses to produce a suitable research design, and justify their design.
3. Present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.
5. Develop oral and written communication skills to present and defend their work in front of technically qualified audience

GUIDELINES:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

The student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computer Science, cyber security, parallel Algorithms and Artificial Intelligence and Machine Learning, Computing and Processing (Hardware and Software), NLP and Image Processing and Analysis and any other related domain. In case of industry sponsored projects, the relevant application notes, product catalogues should be referred and reported. The student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Evaluation for stage-I is based on mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution. Continuous assessment of Project stage – I at Mid Semester and End Semester will be monitored by the departmental committee.

A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, record of continuous progress. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

SEMESTER-IV									
1	Dissertation	CS182	Major Project Phase-II	0	0	32	0	200	16
TOTAL				**0**	**0**	**32**	**0**	**200**	**16**

CS 182

MAJOR PROJECT PHASE-II

Instruction	32 Periods per week
End Semester Evaluation	200 Marks
Credits	16

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

1. Use different experimental techniques.
2. Use different software/ computational/analytical tools.
3. Design and develop an experimental set up/ equipment/test
4. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
5. Either work in a research environment or in an industrial environment.
6. Present and convince their topic of study to the engineering community.

GUIDELINES:

Project stage – II will be extension of the work on the topic identified in Project stage – I. Student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study.

A dissertation should be presented in standard format as provided by the department. The candidate has to be in regular contact with his guide. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.