CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Kokapet (Village), Gandipet, Hyderabad, Telangana-500075. www.cbit.ac.in
ISO Certified 9001:2015

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 43 years

Scheme of Instruction and Syllabi

of
V - VI SEMESTERS

of
FOUR YEAR DEGREE COURSE

in
BE-COMPUTER SCIENCE AND ENGINEERING
(ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

(AICTE Model Curriculum with effect from AY 2022-23)

R-20 Regulation

CHAITANYABHARATHIINSTITUTEOFTECHNOLOGY
(An Autonomous Institution)
Affiliated to Osmania U niversity
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

SCHEME OF INSTRUCTIONS AND EXAMINATION

Model Curriculum(R-20)

B.E. (CSE - Artificial Intelligence and Machine Learning)

SEMESTER - V

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1.	20CSC12	Design and Analysis of Algorithms	3	-	-	3	40	60	3
2.	20CSC20	Operating Systems	3	-	-	3	40	60	3
3.	20CSC22	Software Engineering	3	-	-	3	40	60	3
4.	20CAC04	Machine Learning	3	-	-	3	40	60	3
5.		Professional Elective – I	3	-	-	3	40	60	3
6.		Open Elective-I	3	-	-	3	40	60	3
PRACTICAL									
7.	20CSC16	Design and Analysis of Algorithms Lab	-	-	2	3	50	50	1
8.	20CSC23	Operating Systems Lab	-	-	3	3	50	50	1.5
9.	20CSC25	Case Studies Lab using UML	-	-	2	3	50	50	1
10.	20CAC05	Machine Learning Lab	-	-	3	3	50	50	1.5
11.	20CAI02	Internship-II (Industrial/ Rural Internship)	3-4 weeks/ 90 hours			-	50	-	2
		TOTAL	**18**	**-**	**10**	**-**	**490**	**560**	**25**

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

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective – I	
20CSE03	System Modeling and Simulation
20CSE12	Embedded Systems
20CSE24	Blockchain Technology
20CSE26	Human Computer Interaction
20CAE01	Reinforcement Learning
20CAE02	Digital Image Processing

Open Elective-I	
20ECO10	Fundamentals of Wireless Communication
20EEO05	Waste Management
20MEO09	Organizational Behaviour
20MTO03	Quantum Computing
20BTO04	Bioinformatics

20CSC12

DESIGN AND ANALYSIS OF ALGORITHMS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basics of Data structures and algorithms.

Course Objectives: The objectives of this course are

1. To provide an introduction to formalisms to understand, analyze and denote time complexities of algorithms.
2. To introduce the different algorithmic approaches for problem solving through numerous example problems.
3. To provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

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

1. Identify and apply asymptotic notations to measure the performance of algorithms.
2. Describe the algorithmic design techniques of divide and conquer, greedy, dynamic programming, backtracking and branch and bound to solve problems.
3. Apply suitable algorithmic design techniques to solve problems to get optimal solution.
4. Analyze the performance of algorithmic design techniques.
5. Evaluate the efficiency of alternative solutions derived for a problem by applying various algorithmic design techniques.
6. Understand P, NP, NP-Hard, NP-Completeness and Reducibility.

UNIT – I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method. **Analysis of recursive algorithms through recurrence relations:** Substitution method, Recursion tree method and Masters' theorem.

UNIT – II

Greedy Algorithms: The general method, Knapsack Problem, Huffman Codes, Job scheduling with deadlines. **Dynamic Programming**: The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix chain multiplication, Longest Common subsequence, Optimal Binary search tree.

UNIT – III

Backtracking: The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound**: The general method, FIFO branch and bound, LC branch and bound, 0/1 Knapsack Problem, Travelling Salesperson problem.

UNIT – IV

Graph Algorithms: Applications of DFS: Bi-Connected components, strongly connected components, topological sorting. **Shortest Path Algorithms**: Dijkstra's, Bellman-Ford, Floyd-Warshall and Johnson's algorithms. **Minimum Spanning Tree Algorithms**: Prim's and Kruskal's.

UNIT – V

Theory of NP-Completeness: Polynomial time, Polynomial time verification, P, NP, NP-hard and NP-Complete classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, vertex-cover and Subset Sum Problem.

Text Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 3rd Edition, 2009.
2. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, 2008.

Suggested Reading:

1. Michael T Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis”, and Internet Examples, Wiley Second Edition.

Online Resources:

1. https://nptel.ac.in/courses/106101060/

20CSC20

OPERATING SYSTEMS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: Computer Architecture and Programming Fundamentals.

Course Objectives: The objectives of this course are,

1. Should be able to describe the operating system service, and the design of an operating system.
2. To understand the structure and organization of the file system, process synchronization, process scheduling, system calls and different approaches to memory management.
3. To understand about the cloud infrastructures and technologies.

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

1. Identify the basics of an operating systems and its major components.
2. Understand the concepts related to process synchronization and deadlocks.
3. Distinguish various memory management techniques.
4. Interpret various threats and defense mechanisms used to protect the system.
5. Evaluate various file allocation methods.
6. Apply security as well as recovery features in the design of algorithms.

UNIT - I

Concepts of Operating Systems: Computer System over view, concept of an operating system, Types of operating systems, general system architecture, system components, operating system services, system calls, system programs, approaches to OS design and implementation: Micro-kernel, Layered, Kernel Approach.

UNIT - II

Processes and Threads: Concept of process, process states, process state transitions, process control block, operations on processes, concurrent processes, mutual exclusion and synchronization, principles of deadlocks, integrated deadlocks strategy, scheduling levels, scheduling criteria, algorithms, Inter Process Synchronization, Inter Process Communication, Linux IPC Mechanisms, RPC, RPC exception handling, Security issues.

UNIT - III

Memory Management and Data Management: Logical and physical address space, storage allocation and management techniques, swapping concept of multi-programming, paging, segmentation, virtual storage management strategies, demand paging, page replacement algorithms, thrashing, File organization, record blocking, access methods, directory structure, protection file system structure, allocation methods, free space management, directory implementation, disk structure, disk scheduling, disk management, buffering, swap space management, RAID levels.

UNIT - IV

OS Security: Types of threats in OS, basic security mechanisms, understanding the threats, malware taxonomy, viruses, worms, rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

UNIT - V

Case studies and OS Abstractions: Linux/Unix OS design and architecture, Unix shell, Unix OS services, user perspective, representation of files in Unix, system processes and their structure, I/O system, memory management in Unix. Processes management, file management, IPC and network related system calls,

Text Books:

1. Galvin, Silberschatz, “Operating system Concepts”, 10th Edition, John Wiley & Sons, 2018.
2. Dhananjay Dhamdhare, “Operating Systems-A Concept Based Approach”, 3rd Edition, McGraw Hill Education, 2017.

Suggested Reading:

1. Ekta Walia, “Operating System Concepts”, Khanna Book Publishing, 2020.

2. William Stallings, “Operating Systems Internals and Design Principles”, Pearson Edition, 2012.
3. Charles Crowley, “Operating Systems –A Design Oriented Approach”, McGraw Hill Education, 2017.
4. Andrew S. Tanenbaum, Albert S Woodhull, “Operating systems Design and Implementation”, Pearson Edition, 2009.

20CSC22

SOFTWARE ENGINEERING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Object oriented programming, Programming for problem solving, database management systems.

Course Objectives: The objectives of this course are,

1. To understand the Software Engineering Practice and Process Models.
2. To understand Design Engineering and Project Management in Software Development.
3. To gain knowledge in software testing and overall project activities.

Course Outcomes: On Successful completion of this course, student will be able to,

1. State the software process and explain perspective process model, evolutionary process models.
2. Understand the agile Software process models and demonstrate the skills necessary to specify the requirements of software product so as to prepare SRS document.
3. Recall the modeling concepts and estimate the cost of software using empirical models
4. Enlist the design principles and construct a product using coding principles and standards.
5. Develop test cases and apply software testing methods in conventional and O-O approaches and estimates software quality of SW.

UNIT - I

Introduction to Software Engineering: The nature of Software, Software Engineering, Software Engineering Practice, The Software Process**,** Software Engineering Practice **Process Models:** A Generic Process Model, Process assessment and Improvement, Prescriptive Process Models: Waterfall Model, Incremental Process Models, RAD Model, Evolutionary Process Models - Prototyping, The Spiral Model, Concurrent Models, Specialized Process Models.

UNIT - II

An Agile Development: Agility, Agile Process, and Agile Process Models- Extreme Programming (XP), Adaptive Software Development (ASD), Scrum, Dynamic Systems Development Method (DSDM), Feature Driven Development (FDD), Agile Modeling (AM), **Requirement Engineering,** Establishing the groundwork, Eliciting Requirements, Negotiating Requirements, and Validating Requirements. **Software Requirements Analysis and Specification**: Value of a Good SRS, Problem Analysis, Requirements Specification, Components SRS, Structure of a Requirements Document

UNIT - III

Flow-Oriented Modeling, **Planning a software Project**: Effort Estimation, Project Schedule and Staffing, Quality Planning, Risk Management, **Estimation for Software Projects:** Decomposition Techniques - Software Sizing, Problem-Based Estimation, An Example of LOC-Based Estimation, An Example of FP-Based Estimation.

UNIT - IV

Design Concepts: Coupling, Cohesion, The Open-Closed Principle, Function-Oriented Design - Structure Charts, Structured Design Methodology, An Example, Software Architecture, A Brief Taxonomy of Architectural Styles, C**omponent-Level Design:** Definition, Basic Design Principles, Design Guidelines, Designing Traditional Components, Coding Principles and guidelines, Incremental Development of Code, Code Inspection – Planning, Self-Review, Group Review Meeting.

UNIT - V

Testing - Testing Concepts, Testing Process, **Testing Strategies**: A Strategic approach to software testing, strategic issues, test strategies for Conventional Software, Validation Testing, System Testing, White Box Testing, Black Box. Software Review Techniques - Informal Reviews Formal Technical Reviews, Quality Concepts - What is Quality, Software Quality.

Text Books:

1. Roger S. Pressman “Software Engineering: A practitioner's approach”, McGraw Hill, 7th Edition, 2010.
2. Pankaj Jalote “A concise Introduction to Software Engineering”, Springer, Kindle Edition, 2008.

Suggested Reading:

1. Sommerville “Software Engineering”, 10th Edition, Pearson, 2016.
2. Rajib Mal “Fundamental of Software Engineering”, 4th Edition, PHI Learning, 2014.

Online Resources:

1. https://nptel.ac.in/courses/106101061/

20CAC04

MACHINE LEARNING

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Probability theory basics, Artificial Inteligence

Course Objectives: The objectives of this course are to,

1. Understand the need for Machine Learning
2. Study various machine learning techniques and its applications
3. Design solutions for real world problems using machine learning techniques

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

1. Define the basic concepts related to Machine Learning.
2. Recognize the underlying mathematical relationships across ML algorithms and their paradigms.
3. Determine the various applications of Machine Learning.
4. Model, design and develop solutions to real world problems using Machine Learning Algorithms.
5. Evaluate and interpret the results of the various machine learning tools.

UNIT - I

Introduction to Machine Learning: Introduction, Classic and Adaptive machines, Learning Types-Supervised, Unsupervised, deep learning, bio-inspired adaptive systems, Machine Learning, and big data.

Elements of Machine Learning: Data formats, Learnability, Statistical learning concepts, Class balancing, Elements of Information theory.

UNIT - II

Feature Selection and Feature Engineering: Data sets, Creating training and test sets, managing categorical data, missing features, data scaling and normalization, whitening, Feature selection and filtering, PCA, Visualization of high-dimensional datasets.

Regression Algorithms: Linear models for regression, Regression types

UNIT - III

Classification Algorithms: KNN, Linear classification, logistic regression, grid search, classification metrics, ROC curve.

Naïve Bayes and Discriminant Analysis: Bayes theorem, Naïve Bayes classifiers, Discriminant analysis.

Decision Trees and Ensemble Learning: Binary Decision trees, Introduction, to Ensemble Learning-Random Forests, AdaBoost, Gradient Tree Boosting, Voting classifier.

UNIT – IV

Support Vector Machines: Linear SVM, Kernel based Classification.

Clustering Fundamentals: Basics, K-means, Evaluation methods, DBSCAN, Spectral Clustering, Hierarchical Clustering.

UNIT – V

Machine Learning Architectures: Data collection, Normalization and regularization, Dimensionality reduction, Data augmentation, Modeling / Grid Search / Cross-validation, Visualization, GPU support, introduction to distributed architectures, Scikit-learn tools for ML architectures, pipelines and feature Unions.

Text Books:

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

Suggested Reading:

1. Abhishek Vijavargia “Machine Learning using Python”, BPB Publications, 1st Edition, 2018
2. ReemaThareja “Python Programming”, Oxford Press, 2017
3. Yuxi Liu, “Python Machine Learning by Example”, 2nd Edition, PACT, 2017

Online Resources:

1. https://www.guru99.com/machine-learning-tutorial.htm
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20CSE03

SYSTEM MODELLING AND SIMULATION
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Objectives: The objectives of this course are to:

1. Review the cost-effectiveness and the time-effect of modeling with industry-related examples of modeling in science and engineering
2. Estimate essential inputs of the model and respective outcomes from the simulation
3. Analyze different models and simulations, describe the iterative development process of a model, and explain how models link the physical and virtual worlds.

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

1. Create a computer simulation based on the physical characteristics of the system.
2. Solve ordinary and partial differential equations with computational methods
3. Display insight into the uncertainties in a system and how they can be characterized.
4. Manipulate the data structures of numerical computing; matrices, and vectors, and visually represent data sets coming from computer simulations

UNIT – I

Introduction to Modeling; Modeling Concepts and Definitions; Introduction to MATLAB; MATLAB Scripts; MATLAB Arrays

UNIT – II

Aspects of discrete event simulation; Random number/variate generation; Linear models; Graphing data in MATLAB; MATLAB Array Math

UNIT – III

Graphing in MATLAB; Nonlinear Functions and Modeling; Curve fitting; MATLAB I/O

UNIT – IV

Stochastic models; Accuracy and precision in modeling; MATLAB conditional statements; MATLAB loops; MATLAB functions

UNIT – V

Simulation models validation methods; Read/write simulation data from/to external files

Textbooks:

1. Steven I. Gordon, Brian Guilfoos, “Introduction to Modeling and Simulation with MATLAB® and Python”, CRC Press, 2017
2. Law and Kelton, “Simulation Modeling and Analysis”, Third Edition, McGraw Hill, Boston, MA, 2000

20CSE12

EMBEDDED SYSTEMS
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer architecture and microprocessor, Digital logic design, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To be aware of general computing system, embedded system and classification of embedded system.
2. To analyze the core concepts of embedded system and its architecture.
3. To analyze the RTOS for embedded systems.
4. To learn embedded system development environment.
5. To learn to use tools in embedded software development process.

Course Outcomes: On successful of the course student will be able to,

1. Understand the basics of embedded systems.
2. Analyze the core concepts of Embedded System and Embedded System Architecture.
3. Design and develop Embedded System hardware and software using Embedded C.
4. Analyze the operating system for embedded systems.
5. Analyze the embedded system development environment and tools used in embedded software development process.

UNIT - I

Introduction to Embedded Systems: Embedded Systems, Processor embedded into a system, Embedded hardware units and devices in a system, Embedded software in a system, Examples of embedded systems, Design process in Embedded system, Formalization of system design, Design process and design examples(smart card, digital camera, mobile phone), Classification of Embedded Systems, Skills required for embedded system designer.

UNIT - II

Inter process communication and synchronization of processes, Threads and Tasks. Multiple processes in an application, Multiple threads in an application, Tasks, Task states, Task and data, Clear cut distinction between functions, ISRs and tasks and their characteristics. Concept of semaphores, Shared data, Inter process communication, Signal function, Semaphore functions, Message queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.

UNIT - III

Real time operating systems: OS services, Process management, Timer functions, Event functions, Memory management, Device , File, IO subsystems management, Interrupt routine in RTOS environment and handling of Interrupt source calls, RTOS, RTOS task scheduling models, Interrupt latency, Response of tasks as performance metrics, OS security issues.

UNIT - IV

8051 interfacing with displays (LED, 7 segment display, LCD), Switch, Relay, Buzzer, D/A and A/D converters, Stepper motor.

Networked Embedded systems, Serial communication protocols, I2C bus, CAN bus, RS232, Introduction to advanced architectures: ARM and SHARC.

UNIT - V

Embedded software Development process tools: Introduction to embedded software development process and tools, Host and Target machines, linking and locating software, Getting embedded software into target system, Issues in hardware - software design and Co-design.

Testing, simulation and debugging techniques and tools: Testing on host machine, Simulators, Laboratory tools

Text Books:

1. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education India, 2009.

Suggested Reading:

1. David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Elsevier, 2008.

20CSE24

BLOCK CHAIN TECHNOLOGY
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Structures, Cryptography and Network Security.

Course Objectives: The objectives of this course are,
1. To provide understanding and significance of Blockchain.
2. To familiarize with platforms such as Ethereum, Hyperledger Fabric involved in building Blockchain applications.
3. To impart knowledge about the applications of Blockchain in various sectors.

Course Outcomes: On successful completion of the course, students will be able to,
1. Understand the significance of Blockchain technology and its associated components.
2. Understand the need for consensus protocols in Blockchain.
3. Experience the Ethereum and Hyperledger Fabric Platforms.
4. Incorporate Blockchain in financial software Systems and supply chain environments.
5. Devise the need for Blockchain in Government sectors.
6. Understand the significance of Blockchain Security.

UNIT - I

Introduction: Overview of distributed systems; Introduction to Blockchain; Properties of Blockchain; Evolution of Blockchain, Hash Functions, Merkle Trees; Components of Blockchain Ecosystem; Types of Blockchain; Blockchain Platforms.

UNIT - II

Distributed consensus: Consensus algorithms, Consensus in a Bitcoin network, Proof of Work (PoW), Proof of Stake, Proof of Burn, Proof of Elapsed Time; Consensus models for permissioned block chain, Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, BFT over Asynchronous systems.

UNIT - III

Ethereum: Introduction to Ethereum Smart Contracts; Mining in Ethereum; Consensus mechanism in Ethereum; Technologies that support Ethereum; Ethereum Programming Languages; Hyperledger Fabric: Introduction to Hyperledger Fabric; Hyperledger Fabric architecture; Consensus in Hyperledger Fabric; Hyperledger API and Application Model; Hyperledger Composer tool.

UNIT - IV

Use Case I: Blockchain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance.

Use case II: Blockchain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting.

UNIT - V

Use Case III: Blockchain for Government: Digital identity, land records and other kinds of record keeping between government entities, Blockchain

Cryptography: Privacy and Security on Blockchain.

Text Books:

1. Imran Bashir, "Mastering Blockchain : A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more", Packt Publishing,Third Edition, 2020,
2. Mark Gates, “Blockchain: Ultimate guide to understanding blockchain, bitcoin, cryptocurrencies, smart contracts and the future of money”, Wise Fox Publishing and Mark Gates, 2017.

3. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric and Composer", 2018.
4. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", ArshdeepBahga, Vijay Madisetti publishers 2017.

Suggested Reading:

1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, Inc., 2014.
2. Melanie Swa, "Blockchain", O'Reilly Media, 2014.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs47/preview
2. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
3. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits, 2017 https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.htm
4. https://www.udemy.com/blockchain-and-bitcoin-fundamentals/

20CSE26

HUMAN COMPUTER INTERACTION
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Programming for problem solving, Internet and web technologies.

Course Objectives: The objectives of this course are,

1. To learn the foundations of Human Computer Interaction.
2. To be familiar with the design technologies for computer interaction and guidelines for web user interface.
3. To learn the ecosystem and tools of mobile HCI.

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

1. Understand the structure of models and theories of human computer interaction.
2. Understand the vision of a computer user.
3. Understand the recognition and remembrance limitations of a computer user.
4. Understand and analyze the mobile ecosystem and tools for mobile design.
5. Design an interactive mobile interfaces for mobile applications and widgets.
6. Design an interactive web interface for web applications.

UNIT - I

Foundations and Introduction: The human, the computer, The Interaction, Paradigms, Our perception is biased; our vision is optimized to see structure. Perception Biased by Experience, Perception Biased by Current Context, Perception Biased by Goals, Design implications

UNIT - II

Vision and Memory: Our Vision is Optimized to See Structure, We Seek and Use Visual Structure, Our Color Vision is Limited, Our Peripheral Vision is Poor, Reading is Unnatural, Our Attention is Limited; Our Memory is Imperfect, Limits on Attention Shape Our Thought and Action.

UNIT - III

Recognition, Recall and Decision Making: Recognition is Easy, Recall is Hard, Problem Solving and Calculation are Hard, Many Factors Affect Learning, Human Decision Making is Rarely Rational.

UNIT - IV

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Tools.

UNIT - V

Designing Web Interfaces: Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

Case Study - 1: Design a Mobile App interface or Widget interface by following designing rules

Case Study - 2: Design a Web application interface by following designing rules

Text Books:

1. Jeff Johnson "Designing with the Mind in Mind: Simple Guide to Understanding", 2nd edition, Elsevier Inc., 2014.
2. Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale, "Human Computer Interaction", 3rd edition, Pearson Education Limited, 2004.
3. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009.
4. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009.

Suggested Readings:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, "Designing the User Interface", 5th Edition, Pearson Education Limited, 2013.
2. John Haugeland, "Mind Design II", 2nd Edition, Revised and enlarged edition, The MIT Press, 1997.

20CAE01

REINFORCEMENT LEARNING
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear algebra and calculus, Machine learning.

Course Objectives: The objectives of this course are

1. To pick the best known action for any given state, which means the actions have to be ranked, and assigned values relative to one another.
2. Knowledge of basic and advanced reinforcement learning techniques.
3. Understand and work with approximate solutions (deep Q network based algorithms)
4. Understand and work with tabular methods to solve classical control problems.
5. Learn the policy gradient methods to more complex cases.

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

1. Illustrates various elements of reinforcement techniques.
2. Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
3. Analyze any given application; decide if it is formulated as reinforcement learning problem.
4. Apply Monte Carlo method and Temporal-Difference(TD) learning for prediction.
5. Apply Planning and Learning with Tabular Methods.
6. Use Value Prediction with Function Approximation concepts.

UNIT – I

The Reinforcement Learning Problem: Reinforcement Learning, Examples, Elements of Reinforcement Learning, Limitations and Scope, An Extended Example: Tic-Tac-Toe, History of Reinforcement Learning.

Multi-arm Bandits: An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search.

UNIT – II

Finite Markov Decision Processes: The Agent–Environment Interface, Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality and Approximation.

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

UNIT – III

Monte Carlo Methods: Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns.

Temporal-Difference (TD) Learning: TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-Policy TD Control, Games, Afterstates, and Other Special Cases.

UNIT – IV

Eligibility Traces: n-Step TD Prediction, The Forward View of TD(λ), The Backward View of TD(λ), Equivalences of Forward and Backward Views, Sarsa(λ), Watkins's Q(λ), Off-policy Eligibility Traces using Importance Sampling, Implementation Issues, Variable λ, Conclusions.

Planning and Learning with Tabular Methods: Models and Planning, Integrating Planning, Acting, and Learning, When the Model Is Wrong, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.

UNIT – V

On-policy Approximation of Action Values: Value Prediction with Function Approximation, Gradient-Descent Methods, Linear Methods, Control with Function Approximation.

Policy Approximation: Actor–Critic Methods, Eligibility Traces for Actor–Critic Methods, R-Learning and the Average-Reward Setting.

Text Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition.

Suggested Reading:

1. Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever,"Handbook of Reinforcement Learning and Control (Studies in Systems, Decision and Control, 325)", 1st Edition.
2. Nimish Sanghi,"Deep Reinforcement Learning with Python: With PyTorch, TensorFlow and OpenAI Gym", 1st Edition.
3. Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi, Jan Peters."Reinforcement Learning Algorithms: Analysis and Applications", 1st Edition.

Online Resources:

1. https://nptel.ac.in/courses/106106143
2. https://www.coursera.org/specializations/reinforcement-learning

20CAE02

DIGITAL IMAGE PROCESSING
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Problem Solving and linear algebra.

Course Objectives: The objectives of this course are
1. To learn the fundamentals of digital image processing.
2. To comprehend the relation between human visual system and machine perception and processing of digital images.
3. To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.

Course Outcomes: On Successful completion of the course, students will be able to
1. Explain the basic principles of image processing and its significance in real world.
2. Interpret various types of images and applies image transformations.
3. Evaluate various approaches for image segmentation and image restoration.
4. Define image processing methods and recognize morphological image processing techniques.
5. Recognize image compression and comprehend image compression techniques in both domains.
6. Apply image processing algorithms for real world problems.

UNIT – I

Digital Image Fundamentals & Image Transforms: Digital Image Fundamentals, Sampling and Quantization, Relationship between Pixels. **Image Transforms:** 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Hotelling Transform.

UNIT – II

Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial Domain, Enhancement through Point Processing, Types of Point Processing, Histogram Manipulation, Linear and Non – Linear Gray Level Transformation, Local or Neighborhood criterion, Median Filter, Spatial Domain High-Pass Filtering. **Image Enhancement (Frequency Domain):** Filtering in Frequency Domain, Low Pass (Smoothing) and High Pass (Sharpening) Filters in Frequency Domain.

UNIT – III

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration. **Image Segmentation:** Detection of Discontinuities, Edge Linking and Boundary Detection, thresholding, Region Oriented Segmentation.

UNIT – IV

Morphological Image Processing: Basics, Dilation and Erosion: Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, Hit or Miss Transformation. Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

UNIT – V

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson 4th Edition, 2018.
2. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, McGraw Hill Education, 2010.

Suggested Reading:

1. Scotte Umbaugh, "Digital Image Processing and Analysis: Human and Computer Vision Application with using CVIP Tools", CRC Press,2nd Ed, 2011.
2. Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, "Digital Image Processing using MATLAB", McGraw Hill Education, 2nd Edition, 2010.
3. Somka, Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning (Indian edition) 2008.
4. Adrian Andrew Low, "Introductory Computer Vision Imaging Techniques and Solutions", BS Pub, Second Edition, 2008.

20ECO10

FUNDAMENTALS OF WIRELESS COMMUNICATION
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: A course on basics of electronics is required.

Course Objectives: The objectives of this course are,

1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes applied in wireless communication and understand the latest Wireless technologies

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand the overview of Wireless Communication.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyse the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity technique to combat the multipath fading effects.
5. Compare the multiple access techniques and apply to wireless standards.

UNIT - I

An overview of wireless communications: Roadmap of cellular communications. First-Generation systems. Second-Generation systems. Third-Generation systems, Fourth-Generation systems and Fifth-Generation Systems.

UNIT - II

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Power Control for Reducing Interference.

UNIT - III

Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, the Three Basic Propagation Mechanisms, **Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Types of Small-Scale Fading.

UNIT - IV

Diversity Techniques: Practical Space Diversity Considerations- Selection Diversity, Feedback or Scanning, Maximal Ratio Combining Diversity Equal Gain Combining. **Orthogonal frequency division multiplexing:** Introduction, Principle of OFDM. OFDM transceivers Cyclic prefix, Spectrum of OFDM, Fading mitigation in OFDM. Intercarrier interference.

UNIT - V

Multiple access techniques: Duplexing: FDD versus TDD. FDMA. TDMA. CDMA. OFDMA. SDMA
Wireless Standards: Global System for Mobile (GSM). GSM Services and Features, GSM System Architecture, GSM Radio Subsystem. GPRS and EDGE- features.

Text Books:

1. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.
3. Ke-Lin Du, Concordia University, Montréal,M. N. S. Swamy, "Wireless Communication Systems.From RF Subsystems to 4G Enabling Technologies", April 2010.

Suggested Reading:

1. Sanjay Kumar, “Wireless Communication the Fundamental and Advanced Concepts” River Publishers, Denmark, 2015
2. Andreas F.Molisch, “Wireless Communications”, John Wiley, 2nd Edition, 2006.
3. Vijay Garg, “Wireless Communications and Networking”, Elsevier Publications, 2007.

20EEO05

WASTE MANAGEMENT
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. To imbibe the concept of effective utilization of any scrap
2. To become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Categorize the waste based on the physical and chemical properties.
2. Explain the Hazardous Waste Management and Treatment process.
3. Illustrate the Environmental Risk Assessment, methods, mitigation and control.
4. Interpret the Biological Treatment of Solid and Hazardous Waste.
5. Identify the waste disposal options, describe the design and construction, Operation, Monitoring, Closure of Landfills

UNIT - I

Introduction to waste management and Municipal Solid Waste Management: Classification of waste: Agro based, Forest residue, Industrial waste, e-Waste, Municipal Solid Waste Management: Fundamentals Sources, composition, generation rates, collection of waste, separation, transfer and transport of waste, treatment and disposal options.

UNIT - II

Hazardous Waste Management and Treatment: Hazardous Waste Identification and Classification, Hazardous Waste Management: Generation, Storage and collection, Transfer and transport, Processing, Disposal, Hazardous Waste Treatment: Physical and Chemical treatment, Thermal treatment, Biological treatment, Pollution Prevention and Waste Minimisation, Hazardous Wastes Management in India.

UNIT - III

Environmental Risk Assessment: Defining risk and environmental risk, Parameters for toxicity quantification, Types of exposure, Biomagnifications, Effects of exposure to toxic chemicals, risk analysis and risk matrix, methods of risk assessment, mitigation and control of the risk, case studies.

UNIT - IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT - V

Waste Disposal: Key Issues in Waste Disposal, Disposal Options and Selection Criteria: Disposal options, Selection criteria, Sanitary Landfill: Principle, Landfill processes, Landfill Gas Emission: Composition and properties, Hazards, Migration, Control, Leach ate Formation: Composition and properties. Leach ate migration, Control, Treatment, Environmental Effects of Landfill, Landfill Operation Issues, Design and construction, Operation, Monitoring, Closure of Landfills - Landfill Remediation, national and International Waste management programs.

Text Books:

1. John Pichtel, "Waste Management Practices", CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous, "Waste Management", McGraw Hill International Editions, New York, 1994.
3. Richard J. Watts, Hazardous, "Wastes - Sources, Pathways, Receptors", John Wiley and Sons, New York, 1997.

Suggested Reading:

1. KantiL.Shah, " Basics of Solid and Hazardous Waste Mgmt. Tech", 1999, Prentice Hall.
2. S.C.Bhatia, "Solid and Hazardous Waste Management", 2007 , Atlantic Publishers & Dist.

20MEO09

ORGANIZATIONAL BEHAVIOUR
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. Define basic organizational behavior principles and analyze how these influence behavior in the work place.
2. Analyze the influence of perceptions and personality on individual human behavior in the work place.
3. Discuss the theories of Motivation and Leadership.
4. Provide knowledge on different organizational structures; and concepts of culture, climate and organizational development and make the students familiarize with individual behavior.
5. Describe the interpersonal and their intrapersonal reactions within the context of the group and also demonstrate effective communication and decision making skills in small group settings.

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

1. Understand Organizational Behavioral principles and practices.
2. Compare various organizational designs and cultures enabling organizational development.
3. Apply motivational theories and leadership styles in resolving employee‘s problems and decision makingprocesses.
4. Understand the group dynamics, communication network, skills needed to resolve organizational conflicts.
5. Analyze the behavior, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.

UNIT – I

Introduction: Organizational behaviour, nature and levels of organizational behavior, individuals in organization, individual differences , personality and ability, the big 5 model of personality , organizationally relevant personality traits, the nature of perception , characteristics of the perceiver, target and situation, perceptual problems.

UNIT – II

Organization structure: Organizational designs and structures, traditional and contemporary organizational designs, organizational culture and ethical behavior , factors shaping organizational culture, creating an ethical culture, concepts, organizational climate, organization conflict, and organization development.

UNIT – III

Motivation and leadership: Motivation, early and contemporary theories of motivation, leadership, early and contemporary approaches to leadership.

UNIT – IV

Group dynamics: Groups and group development, turning groups into effective teams, managing change , process, types and challenges, communicating effectively in organizations, communication process, barriers to communication, overcoming barriers to communication, persuasive communication, communication in crisis situations.

UNIT – V

Power, Politics, Conflict and Negotiations: Power, politics, conflict and negotiations, sources of individual, functional and divisional power, organizational politics conflict, causes and consequences, Pondy‘s model of organizational conflict, conflict resolution strategies.

Text Books:

1. Jennifer George and Gareth Jones, “Understanding and Managing Organizational Behavior”, Pearson Education Inc., 2012.
2. Jon L Pierce and Donald G. Gardner, “Management and Organizational behavior”, Cengage Learning

India (P) Limited, 2001.
3. Richard Pettinger, "Organizational Behaviour", Routledge, 2010.

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones, "Management and Organizational Behaviour", Pearson Education Inc., 2009.
2. John Schermerhorn, Jr., James G. Hunt and Richard N. Osborn, "Organizational Behaviour", 10th edition, Wiley India Edition, 2009.

20MTO03

QUANTUM COMPUTING
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. To learn Quantum bits and compute mathematical foundation
2. To understand the evaluation of the quantum bits.
3. To learn Quantum operations by building blocks of Quantum programming
4. To know the basics of Quantum logic gates and circuits
5. To learn Quantum Algorithms by various Techniques.

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

1. Compute basic mathematical operations on Quantum bits.
2. Execute Quantum operations of Quantum computing
3. Built quantum programs
4. Develop quantum Logical gates and circuits.
5. Develop the quantum algorithm

UNIT - I

Math Foundation for Quantum Computing: Introduction of Vector Space, Subspaces, Basis and Finite Dimensions. Vectors and orthogonality, inner product and Outer product and Hilbert Spaces. Formation of Matrices by Linear Transformation. Linear Independent and dependent Vectors. Unitary operators and projectors, Eigen values and Eigen Vectors.

UNIT – II

Introduction to Quantum Computing: Quantum Mechanics (Huygens wave theory ,Photo electric effect De-Broglie hypothesis and Heisenberg's uncertainty Principle), Origin of Quantum Computing, Overview of major concepts in Quantum Commuting ,Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave

UNIT – III

Building Blocks for Quantum Program: Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product, Quantum Entanglement, Quantum Teleporation (EPR Model) and Bell State.

UNIT – IV

Quantum Logical gates and Circuits: Pauli, Hadamard, Phase shift, controlled gates, AND, OR and NAND gate, C-Not, CCNOT gate Introduction of Fourier Transform and Discrete Fourier transform.

UNIT – V

Quantum Algorithms: Z-Transform. Basic techniques exploited by quantum algorithms (Amplitude amplification, Quantum Fourier Transform, Quantum Phase estimation, Quantum walks), Major Algorithms (Shore's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm).

Text Books:

1. David McMahon, "Quantum Computing Explained", Wiley-IEEE Computer Society Pr., 2008.

Suggested Reading:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press, 2010.

20BTO04

BIOINFORMATICS
(Open Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: The school level basic knowledge in Fundamental science is required.

Course Objectives: The objectives of this course are,

1. To provide elementary knowledge in biology and bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases, Sequence analysis, data mining, sequence alignment and phylogenetics.
3. To learn methods for determining the predictinggene and protein.

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

1. Explain the basic concepts of biology and bioinformatics.
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining.
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree.
5. Describe the methods used for gene and protein structure prediction.

UNIT - I

Introduction And Basic Biology: Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Genome sequencing, Human Genome Project.

UNIT - II

Biological Databases: Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniport, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

UNIT - III

Sequence Analysis and Data Mining: Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text Mining Tools

UNIT - IV

Sequence Alignment And Phylogentics: Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

UNIT - V.

Macromolecular Structure Prediction:

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbor methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modeling, threading and fold recognition, ab initio prediction.

Text Books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rdedition, PHI Learning Private Limited, New Delhi, 2010

Suggested Reading:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009
3. JiXiong, "Essential Bioinfomatics", Cambridge University Press, 2006.

20CSC16

DESIGN AND ANALYSIS OF ALGORITHMS LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Programming and Problem Solving, Basics of Data structures and algorithms lab and Object-Oriented Programming.

Course Objectives: The objectives of this course are

1. Design and construct simple programs by using the different design strategies for solving different problems.
2. To enhance programming skills while improving their practical knowledge in implementing the algorithms.
3. To strengthen the practical ability and to apply suitable algorithmic approaches for solving real time problems.

Course Outcomes: On Successful completion of this course, student will be able to

1. Implement greedy, dynamic programming, backtracking and branch and bound techniques.
2. Demonstrate various algorithmic design techniques.
3. Analyze the performance of various algorithms.
4. Compare various design strategies.
5. Formulate solutions to solve real world problems use acquired knowledge

The following task should be carried out by the students in the laboratory for each experiment:-

1. Setup the environment for the experiment.
2. Select appropriate design technique to implement the problem.
3. Represent the solution using algorithm
4. Analyze the performance of the algorithm (Time and Space complexity)
5. Justify the performance of your solution is better than other strategies.

By performing the above task for each experiment, the following COs are achieved,

Course Outcome	-	1	2	3	4	5
Task	1	2	3	4	5	*

*As all the questions are real world applications so CO5 is achieved

List of Experiments:

1. You are given the task of choosing the optimal path to connect „N‟ devices. The devices are connected with the minimum required N-1 wires into a tree structure, and each device is connected with the other with a wire of length „L‟ ie „D1‟connected to „D2‟ with a wire of length „L1‟. This information will be available for all „N‟ devices.
   a. Determine the minimum length of the wire which consists of N-1 wires that will connect all devices.
   b. Determine the minimum length of the wire which connects Di and Dj
   c. Determine the minimum length of the wire which connects Di to all other devices.
   d. Determine the minimum length of the wire which connects Di to all other devices where $1 \leq i \leq N$.

2. An X-ray telescope (XRT) is a telescope that is designed to observe remote objects in the X-ray spectrum. In order to get above the Earth's atmosphere, which is opaque to X-rays, X-ray telescopes must be mounted on high altitude rockets, balloons or artificial satellites. Planets, stars and galaxies and the observations are to be made with telescope. Here the process of rotating equipment into position to observe the objects is called slewing. Slewing is a complicated and time consuming procedure handled by computer driven motors. The problem is to find the tour of the telescope that moves from one object to other by observing each object exactly once with a minimum total slewing time.

3. CSE department of CBIT want to generate a time table for „N‟ subjects. The following information is given- subject name, subject code and list of subjects code which clashes with this subject. The problem is to identify the list of subjects which can be scheduled on the same time line such that clashes among them do not exist.

4. A Test has „N‟ questions with a heterogeneous distribution of points. The test-taker has a choice as to which questions can be answered. Each question Qi has points Pi and time Ti to answer the question, where $1 \leq i \leq N$. The students are asked to answer the possible subsets of problems whose total point values add up to a maximum score within the time limit „T‟. Determine which subset of questions gives student the highest possible score.

5. Given N items with their corresponding weights and values, and a package of capacity C, choose either the entire item or fractional part of the item among these N unique items to fill the package such that the package has maximum value.

6. Given a bunch of projects, where every project has a deadline and associated profit if the project is finished before the deadline. It is also given that every project takes one month duration, so the minimum possible deadline for any project is 1 month. In what way the total profits can be maximized if only one project can be scheduled at a time.

7. N-Queen is the problem of placing „N‟ chess queens on an N×N chessboard. Design a solution for this problem so that no two queens attack each other. Note: A queen can attack when an opponent is on the same row, column or diagonal.

8. Bi-connected graphs are used in the design of power grid networks. Consider the nodes as cities and the edges as electrical connections between them, you would like the network to be robust and a failure at one city should not result in a loss of power in other cities.

9. Consider a source code structure where you are building several libraries DLLs (Dynamic-Link Library) and they have dependencies on each other. For example, to build DLL , you must have built DLLs B, C and D (Maybe you have a reference of B,C and D in the project that builds A).

Text Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, 3rd Edition, MIT Press/McGraw-Hill, 2009.
2. Michael T Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis, and Internet Examples”, Second Edition, Wiley, 2001.

20CSC23

OPERATING SYSTEMS LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Pre-requisites: Operating systems, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To explore Unix/Linux operating system.
2. To analyze various system calls available in Linux/Unix.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand Linux/Unix environment.
2. Identify and interpret various system programs.
3. Understand and implement shell programming.
4. Simulate memory management and file allocation techniques.
5. Analyze process and file management system calls by creating and/or modifying concurrent programs.
6. Build network-oriented applications using system calls.

List of Experiments:

1. Shell programming.
2. Implementation of memory management techniques like paging and segmentation.
3. Implementation of Linked, Indexed and Contiguous file allocation methods.
4. Demonstration of Linux/Unix file related system calls: mkdir, link, unlink, mount, unmount, users+, chown, chmod, open, close, read, write, lseek, stat, sync.
5. Demonstration of Linux/Unix process related system calls: fork, wait, exec, exit, getpid, getuid, setuid brk, nice, sleep.
6. Development of applications using Linux/Unix system calls: signal, socket, accept, snd, recv, connect.

Text Books:

1. Galvin, Silberschatz, “Operating System Concepts”, 10th Edition, John Wiley & Sons, 2018.
2. Dhananjay Dhamdhare, “Operating Systems-A Concept Based Approach”, 3rd Edition, McGraw Hill Education, 2017.

Suggested Reading:

1. Ekta Walia, “Operating System Concepts”, Khanna Book Publishing, 2020.
2. William Stallings, “Operating Systems Internals and Design Principles”, Pearson Ed., 2012.
3. Charles Crowley, “Operating Systems –A Design Oriented Approach”, McGraw Hill Education, 2017.
4. Andrew S. Tanenbaum, Albert S Woodhull, “Operating systems Design and Implementation”, Pearson Ed., 2009.

20CSC25

CASE STUDIES USING UML LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Prerequisites: Object Oriented Programming, Software Engineering.

Course Objectives: The objectives of this course are,

1. To identify Project Scope, Objectives and infrastructure.
2. To understand Software Engineering methodologies for project development
3. To gain knowledge about Computer Aided Software Engineering (CASE) tools.
4. To use effective communication and technical skills for building quality software.

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

1. Identify the problem scope and constraints in the problem.
2. Prepare software requirements specifications (SRS) for the system according to standards.
3. Apply the design notations of structured approach to develop ER and Data Flow Diagrams.
4. Apply/Use the design notations of OO approach to develop UML diagrams using rational tools.
5. Implement, analyze and prepare the documentation for the proposed system.

Select one large Information System/Approach and device the following using UML tool:

1. Structured Diagrams (Data Flow Diagrams, Entity-Relationship Diagrams etc.)
2. Preparation of Software Requirement Specification Document for a given Case Study.

UML Diagrams

1. Use Case Diagrams
2. Class Diagrams
3. Sequence Diagrams
4. Activity Diagrams
5. State Chart Diagrams
6. Component Diagrams
7. Deployment Diagrams

Text Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson: “The Unified Modeling Language User Guide”, Pearson Education, 2007.
2. Roger S. Pressman, “Software Engineering - A Practitioners Approach”, 7th Edition, Pearson Education, India, 2010.

20CAC05

MACHINE LEARNING LAB

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1.5

Course Objectives: The objectives of this course are

1. Make use of Data sets in implementing the machine learning algorithms.
2. Implement the machine learning concepts and algorithms in any suitable language of choice.
3. Make use of real world data to implement machine learning models.

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

1. Identify the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
2. Identify and utilize modern tools that are useful for data analysis
3. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
4. Implement and evaluate various Machine Learning approaches
5. Apply Keras and Tensorflow to implement ML techniques

List of Experiments:

1. Identification and Installation of python environment towards the machine learning, installing python modules/Packages Import scikitlearn, keras and tensorflows etc.
2. Build linear regression model using gradient descent, least squares, polynomial, LASSO and RIDGE approaches also compare all the algorithms and draw a table for all the metrics.
3. Demonstration of decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a newsample.
4. Demonstration of Logistic Regression for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for your dataset.
5. Demonstration of Naïve Bayesian classifier for a sample training data set stored as a .CSV file. Calculate the accuracy, precision, and recall for your dataset.
6. Build the decision tree classifier compare its performance with ensemble techniques like random forest,bagging,boosting and voting Demonstrate it with different decision trees.
7. Demonstration of SVM and use for character recognition task.
8. Implementation of Gradient Descent Algorithm using Tensorflow.
9. Case study on supervised learning algorithms.
10. Demonstration of Clustering algorithms - k-Means, Agglomerative and DBSCAN to classify for the standard datasets. Print both correct and wrong predictions using Java/Python ML library classes can be used for this problem.

Text Books:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”,2017, Packt Publishing.

20CAI02

INTERNSHIP-II
INDUSTRIAL / RURAL INTERNSHIP

Instruction	3 to 4 weeks/90 hours
Duration of End Examination	-
Semester End Examination	-
Continuous Internal Evaluation	50 Marks
Credits	2

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

SCHEME OF INSTRUCTIONS AND EXAMINATION

Model Curriculum(R-20)

B.E. (CSE - Artificial Intelligence and Machine Learning)

SEMESTER –VI

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1.	20CSC21	Data Communication and Computer Networks	3	-	-	3	40	60	3
2.	20CAC06	Deep Learning for Computer Vision	3	-	-	3	40	60	3
3.	20CIC07	Theory of Computation & Compilers	3	-	-	3	40	60	3
4.		Professional Elective – II	3	-	-	3	40	60	3
5.		Professional Elective – III	3	-	-	3	40	60	3
6.		Open Elective-II	3	-	-	3	40	60	3
7.	20EGM03	Universal Human Values-II: Understanding Harmony	3	-	-	3	40	60	3
PRACTICAL									
8.	20CAC07	Deep Learning for Computer Vision Lab	-	-	2	3	50	50	1
9.		Professional Elective – II Lab	-	-	2	3	50	50	1
10.	20EGC03	Employability Skills	-	-	2	2	50	50	1
		TOTAL	**21**	**-**	**6**	**-**	**430**	**570**	**24**

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

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective – II	
20CSC30	Cryptography and Network Security
20CSE06	Soft Computing
20CSE07	Internet of Things
20CSE11	Natural Language Processing
20CAE03	Computer Vision

Professional Elective – II Lab	
20CSC31	Cryptography and Network Security Lab
20CSE15	Soft Computing Lab
20CSE16	Internet of Things Lab
20CSE20	Natural Language Processing Lab
20CAE07	Computer Vision Lab

Professional Elective – III	
20CSE05	Optimization Techniques
20CSE25	Social Computing
20CAE04	Algorithmic Game Theory
20CAE05	Multi Agent Intelligent Systems
20CAE06	Data and Visual Analytics

Open Elective-II	
20ECO01	Remote Sensing and GIS
20MTO01	Financial Mathematics
20EEO02	Energy Management Systems
20EGO01	Technical Writing Skills
20CEO02	Disaster Risk Reduction and Management
20CHO04	Environmental and Sustainable Development

20CSC21

DATA COMMUNICATION AND COMPUTER NETWORKS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Programming for problem solving and data structures.

Course Objectives: The objectives of this course are,

1. To understand the principles of data communication and organization of computer networks,
2. To analyze various routing protocols and congestion control algorithms.
3. To study the functions of the transport layer and to understand application layer protocols.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Learn the communication protocol suites like ISO-OSI and TCP/IP.
2. Illustrate and explain Data Communications System and its components.
3. Identify and analyze various congestion control algorithms.
4. Distinguish the internet protocols like IP, ARP, ICMP, IGMP, routing protocols and DHCP.
5. Understand the transport layer protocols like TCP, UDP, RTCP.
6. Identify various application layer protocols like HTTP, WWW, DNS, Email Protocols, FTP and the underlying protocols.

UNIT - I

Introduction: Data communication, network types and models, TCP/IP and OSI Protocol Suite, transmission media (wired and wireless), switching.

UNIT - II

Data Link Layer: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, HDLC, point to point protocols, multiple access protocols.
LAN: Wired LAN, wireless LAN, connecting devices and Virtual LAN.

UNIT - III

Network Layer: Network layer design issues, routing algorithms, congestion control algorithms, Quality of service, IPV4, IPV6, network layer protocols: ARP, RARP, ICMP, IGMP and DHCP.

UNIT - IV

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission ControlProtocol (TCP), SCTP, congestion control, quality of service.

UNIT - V

Application Layer: DNS, DDNS, SMTP, POP, IMAP, SSH, SFTP,WWW, HTTP, SNMP, Firewalls.

Text Books:

1. Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw Hill, Fifth Edition, 2017.
2. S. Tanenbaum, "Computer Networks", Pearson Education, Fifth Edition, 2013.
3. William Stallings, “Data and Computer Communication”, Eighth Edition, Pearson Education, 2007.

Suggested Reading:

1. Larry L.Peterson, Peter S. Davie, “Computer Networks”, Elsevier, Fifth Edition, 2012.
2. James F. Kurose, Keith W. Ross, “Computer Networking: A Top–Down Approach Featuring the Internet”, Pearson Education, 2005.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105081/
2. https://nptel.ac.in/courses/106/106/106106091/

20CAC06

DEEP LEARNING FOR COMPUTER VISION

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Artificial intelligence, Machine Learning

Course Objectives: The objectives of this course are

1. To learn the fundamentals of deep learning and the challenging issues.
2. To acquire the knowledge in Deep learning methods, models, Optimizations, Regularizations and algorithms.
3. To understand CNN, RNN and GANs and their applications.

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

1. Understand various optimization techniques used in deep learning.
2. Analyze various Autoencoders and Regularization Techniques.
3. Design and Develop various Convolution Neural Networks architectures.
4. Design various RNNs and Encoder Decoder Models.
5. Understand the importance of GANs to develop real-time applications.
6. Evaluate the Performance of different models for deep neural network training.

UNIT - I

Introduction: Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Historical Trends in Deep Learning, Backpropagation.

Optimization: Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

UNIT - II

Autoencoders: relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, **Regularization:** Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

UNIT - III

Convolutional Neural Network: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types.

LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks

UNIT – IV

Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Encoder Decoder Models, Attention Mechanism, Attention over images

UNIT – V

Transformers: Getting Started with the model architecture of the Transformer, Fine Tuning BERT Models.

Generative Adversarial Networks (GANs): Introduction, Discriminator, Generator, Activation, Common activation functions for GANs, BCE loss, Conditional GANs, Controllable generation, real life GANs

Text Books:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Rothman, Denis, "Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", Packt Publishing Ltd, 2021.
3. Ganguly Kuntal, "Learning generative adversarial networks: next-generation deep learning simplified", Packt Publishing, 2017.

Suggested Reading:

1. Tom M. Mitchell, "Machine Learning ",MacGraw Hill, 1997.
2. LiMin Fu, “Neural Networks in Computer Intelligence”, McGraw-Hill edition, 1994.
3. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
5. Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow by Benjamin Planche, Eliot Andres, Packt Publishers, 2019
6. Tunstall, Lewis, Leandro von Werra, and Thomas Wolf, “Natural Language Processing with Transformers ”, O'Reilly Media, Inc., 2022.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85/

20CIC07

THEORY OF COMPUTATION AND COMPILERS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Discrete Mathematics, Data Structures, Algorithms.

Course Objectives: The objectives of this course are to

1. Learn the foundations of automata theory, computability theory, and complexity theory. Shows relationship between automata and formal languages.
2. Addresses the issue of which problems can be solved by computational means (decidability vs undecidability)
3. Learn the concepts related to computational complexity of problems.
4. Understand the concept of algorithm and compare the complexity of problems.

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

1. Understand formal language basics and the power of automata to recognize the languages.
2. Analyze the concept compilation Process and data structures of a compiler.
3. Attains the knowledge of context free grammars and able to implement parsers.
4. Design Syntax directed translation scheme for a given Context free grammar and generation of intermediate code.
5. Apply Optimization to intermediate code and machine code
6. Illustrate various object forms, error recovery and tools of a compiler.

UNIT-I

Formal Language and Regular Expressions: Chomsky hierarchy, Languages regular expressions, Finite Automata – DFA, NFA. Conversion of regular expression to NFA, NFA to DFA.

Overview of Compilation: phases, Lexical Analysis, Lex Specifications, Structure of a Lex Specification File, Regular Grammar and Regular Expression for Common Programming Language Features, Pass and Phases of Translation, Interpretation, Bootstrapping, Data Structures of Compiler, LEX tool.

UNIT-II

Context Free grammars and parsing: Context free grammars, derivation, parse trees, ambiguity, Types of Parsers LL(K) grammars and LL(1) parsing.

Bottom-up parsing handle pruning LR Grammar Parsing, LALR parsing, parsing ambiguous grammars, Error Recovery in Parsing YACC programming specification.

UNIT-III

Semantic Analysis: Intermediate Forms of Source Programs - Abstract Syntax Tree, Polish Notation and Three Address Codes. Attributed Grammars, Syntax Directed Translation, Language Intermediate Code Forms, Type Checker. Symbol Table: Symbol Table Format, Organization for Block Structures Languages, Hashing.

UNIT-IV

Code Optimization: Consideration for Optimization, Scope of Optimization, Local Optimization, Loop Optimization, Frequency Reduction, Folding, DAG Representation. Data Flow Analysis: Flow Graph, Data Flow Equation, Global Optimization, Redundant Sub Expression Elimination, Induction Variable Elements, Live Variable Analysis, Copy Propagation.

UNIT-V

Object Code Generation: Object code forms, machine dependent code optimization, register allocation and assignment generic code generation algorithms.

Error Recovery: various errors in phases and recovery of errors in compilation, introduction to tools of compiler.

Text Books:

1. John E. Hopcroft, Rajeev M & J D Ullman: "Introduction to Automata Theory Languages &Computation", 3rd Edition, Pearson Education, 2007.

2. Aho, Ullman, Ravisethi: "Compilers Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2009.

Suggested Reading:

1. Andrew W.Appel, "Modern Compiler Construction in C", Cambridge University Press Revised Edition, 2014..
2. Kenneth C Louden, Thomson, "Compiler Construction Principles and Practice", PWS Publishing 1st edition..
3. A. Meduna, "Elements of Compiler Design", Auerbach Publications, Taylor and Francis Group.
4. V. Raghavan, "Principles of Compiler Design", TMH.
5. K. D. Cooper, L. Torczon, "Engineering a Compiler", ELSEVIER,2014.
6. Kamala Krithivasan and Rama R, "Introduction to Formal Languages and Automata Theory and Computation", Pearson.
7. D. Grune and others, "Modern Compiler Design", Wiley-India.
8. S. F. B. Nasir, P. K. Srimani, "A Text book on Automata Theory", Cambridge Univ. Press.
9. A. Meduna, "Automata and Languages Theory & Applications", Springer.

20CSC30

CRYPTOGRAPHY AND NETWORK SECURITY
(Professional Elective-II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Communication and computer networks.

Course Objectives: The objectives of this course are,

1. To understand the importance of confidentiality, integrity, availability and authentication.
2. To understand various cryptographic algorithms.
3. To understand categories of threats to computer networks.
4. To describe public-key cryptosystem, key generation and distribution.
5. To understand implementation of Firewalls and web security.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Analyze and design classical encryption techniques and block ciphers.
2. Analyze and design hash and MAC algorithms, and digital signatures.
3. Design network application security schemes like PGP, S/MIME, IPSec, SSL, TLS, HTTPS, SSH, etc.
4. Evaluate the authentication and hash algorithms.
5. Create and configure simple firewall architectures.
6. Understand digital sign in emails and files.

UNIT - I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT - II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

UNIT - III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512).

Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

UNIT - IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH).

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT - V

E-Mail Security: Pretty Good Privacy, S/MIME.

IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations, Internet Key Exchange.

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Ransomware.

Text Books:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition

Suggested Reading:

1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

Online resources

1. https://onlinecourses.nptel.ac.in/noc21_cs16/

20CSE06

SOFT COMPUTING
(Professional Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra & Calculus, Differential Equations & Transform Theory

Course Objectives: The objectives of this course are,

1. To learn various types of soft computing techniques and their applications.
2. To acquire the knowledge of neural network architectures, learning methods and algorithms.
3. To understand Fuzzy logic, Genetic algorithms and their applications.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand various soft computing concepts and techniques.
2. Analyze and design various learning models.
3. Apply the neural network architecture for various real time applications.
4. Examine and approximate reasoning using fuzzy logic.
5. Design genetic algorithms for various applications.
6. Develop soft computing techniques to solve different applications.

UNIT - I

Soft computing vs. Hard computing, Various types of soft computing techniques.
Artificial Neural Networks: Fundamental concepts, Evolution of neural networks, Basic models of artificial neural network, important terminologies of ANNs. McCulloch-Pitts neuron, linear separability, Hebb network.

UNIT - II

Supervised Learning Neural Networks: Perceptron networks, Adaptive linear neuron (Adaline), Multiple Adaptive linear neuron (Madaline), Back propagation network.

UNIT - III

Unsupervised Learning Neural Networks: Kohonen Self Organizing networks, Adaptive resonance theory.
Associate Memory Networks: Bidirectional associative memory network, Hopfield networks.

UNIT - IV

Fuzzy Logic: Introduction to classical sets and Fuzzy sets, Fuzzy relations, Tolerance and equivalence relations, Membershipfunctions, Defuzzification.

UNIT - V

Genetic Algorithms: Introduction, Basic operators and terminology, Traditional algorithm vs. genetic algorithm, Simple genetic algorithm, General genetic algorithm, Classification of genetic algorithm, Genetic programming, Applications of genetic algorithm.

Text Books:

1. S.N. Sivanandam& S.N. Deepa, “Principles of soft computing”, Wiley publications, 2nd Edition, 2011.
2. Soft Computing – Ikvinderpal Singh, Khanna Book Publishing 2015.

Suggested Reading:

1. S. Rajasekaran& G.A. Vijayalakshmipai, “Neural Networks, Fuzzy logic & Genetic Algorithms, Synthesis & Applications”, PHI publication, 2008.
2. LiMin Fu, “Neural Networks in Computer Intelligence”, McGraw-Hill edition, 1994.
3. K.L.Du& M.N.S Swamy, “Neural Networks in a Soft Computing Framework”, Springer International edition, 2008.
4. Simon Haykins, “Neural Networks a Comprehensive Foundation”, PHI, second edition.
5. Goldberg, David E., “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, New Delhi, 2002.
6. Learning and Soft Computing by Kecman, Pearson Education, 2001

7. N.P. Padhy and S.P. Simon,"Soft Computing: With Matlab Programming", Oxford University Press, 2015.
8. Neuro fuzzy and soft computing by Jang, Pearson Education, 1996

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs13/preview.
2. https://archive.nptel.ac.in/courses/106/105/106105173/

20CSE07

INTERNET OF THINGS
(Professional Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer architecture and microprocessor, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To understand the architecture, basics and applications of IoT.
2. To impart practical knowledge on components of IoT.
3. To develop skills required for building real-time IIoT based projects.

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

1. Understand IoT, its hardware and software components.
2. Comprehend I/O interface and programming APIs.
3. Analyze the use of communication protocols in IoT.
4. Explore Solution framework for IoT applications.
5. Illustrate unstructured data storage.
6. Develop real time IoT based projects.

UNIT - I

Introduction to IoT: Architectural Overview, Design principles and requirements of IoT, IoT Applications.
Elements of IoT: Basics of networking, sensors, actuators, computing devices, software, data management and processing environment and Security issues.

UNIT - II

IoT Hardware Components: Computing (Arduino, Raspberry Pi), Communication modules, Sensors, Actuators, I/O interfaces, Programming API's.

UNIT - III

IoT Data Protocols: MQTT, CoAP, AMQP, DDS, HTTP, WebSocket
Network Protocols for IoT: 6LowPAN, RPL, IPV6, WiFi, Bluetooth, ZigBee, Z-Wave, LoRaWan, MQTT, XMPP

UNIT - IV

IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT - V

IoT Case Studies: IoT case studies based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

Text Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle,"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1st Edition, Academic Press, 2014.
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2018.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2017.

4. Cuno Pfister, "Getting Started with the Internet of Things", 0' Reilly Media, 2011.

Online Resources / Weblinks / NPTEL Courses:

1. Li Da Xu, Wu He, and Shancang Li, "Internet of Things in Industries: A Survey ", IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik , JP. Vasseur, R. Alexander, "RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks", IETF, Standards Track, Mar. 2012.
3. Z. Shelby, K. Hartke, C. Bormann, "The Constrained Application Protocol (CoAP)", Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, "What's The Difference Between IEEE 802.15.4 And ZigBee Wireless?",Electronic Design (Online), Mar. 2013.
5. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
6. F. Luo *et al*., "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.
7. https://onlinecourses.nptel.ac.in/noc19_cs31/
8. https://www.nabto.com/guide-iot-protocols-standards/

20CSE11

NATURAL LANGUAGE PROCESSING
(Professional Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Artificial Intelligence.

Course Objectives: The objectives of this course are,

1. To learn the fundamentals of natural language processing.
2. To understand the various text processing techniques in NLP.
3. To understand the role Text Classification Deep Learning for Text Classification techniques of NLP
4. To use Topic Modelling, Case Studies and apply the NLP techniques to IR applications.

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

1. Understand the basic concepts of Natural language processing pipeline and applications of NLP.
2. Illustrate various text representation techniques in NLP.
3. Analyse text classification techniques and deep learning basics to process natural language text.
4. Explore text summarization methods and example systems.
5. Demonstrate levels of NLP for several case studies.
6. Apply NLP Pipe lines to solve real world applications.

UNIT - I

NLP: A Primer, NLP in the Real World, NLP Tasks, NLP Levels, What Is Language? Building Blocks of Language, Why Is NLP Challenging? Machine Learning and Overview Approaches to NLP, Heuristics-Based, Machine Learning, Deep Learning for NLP.

NLP Pipeline: Data Acquisition, Pre-Processing Preliminaries Frequent Steps, Advanced Processing Feature Engineering Classical NLP/ML Pipeline DL Pipeline Modeling, Evaluation of Models, Post-Modeling Phases.

UNIT - II

Text Representation Vector Space Models Basic Vectorization Approaches, One-Hot Encoding Bag of Words, Bag of N-Grams, TF-IDF, Distributed Representations, Word Embedding, Going Beyond Words, Distributed Representations.

UNIT - III

Text Classification Applications One Pipeline, Many Classifiers, Using Neural Embeddings in Text Classification Deep Learning for Text Classification Interpreting Text Classification Models.

Deep Learning for Text Classification CNNs for Text Classification, LSTMs for Text Classification

UNIT - IV

Topic Modelling Text Summarization, Use Cases Setting Up a Summarizer: An Example Recommender Systems for Textual Data Machine Translation Question-Answering Systems, Social Media, E-Commerce and Retail, Healthcare, Finance and Law.

UNIT - V

Case Study on NLP Pipeline, Text Classification: Ticketing, Ecommerce, Social media, health care, Recommender systems and other applications of NLP

Text Books:

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana "Practical Natural Language Processing: A Comprehensive Guide to Building Real world NLP Systems", O'Reilly Media, Inc., 1st Edition, 2020.
2. James Allen, "Natural Language Understanding", Bejamin Cummings, 2nd edition, 1995.

Suggested Reading:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106101007/
2. http://www.cs.colorado.edu/~martin/sp2.html
3. https://web.standford.edu/~jurafsky/sp3/

20CAE03

COMPUTER VISION
(Professional Elective–II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Probability, Digital Image Processing, Deep Learning.

Course Objectives: The objectives of this course are

1. To understand the Fundamental Concepts Related to Multi-Dimensional Signal Processing.
2. To learn Feature Extraction algorithms.
3. To apply Visual Geometric Modeling and Stochastic Optimization.

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

1. Recognize the basics of computer vision and its challenging issues.
2. Develop algorithms to analyze feature detection and alignment.
3. Interpret images and videos for problems such as tracking and structure from motions.
4. Identify object, scene recognition and categorization algorithms for real time images.
5. Analyze recovery of 3D structure of ill-posed scenes.
6. Apply various techniques to build computer vision applications.

UNIT - I

Introduction to Computer Vision and Image Formation: Introduction, Geometric primitives and transformations, Photometric image formation, Digital Camera image formation. **Image Processing:** Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

UNIT – II

Feature detection and matching: Points and patches, Edges, Lines. **Segmentation**: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts. **Feature-based alignment**: 2D and 3D feature-based alignment, Pose estimation.

UNIT – III

Structure from motion: Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

UNIT – IV

Recognition: Object detection, Face recognition, Instance recognition, Category recognition, Context and scene understanding.

UNIT – V

3D Reconstruction: Shape from X, Active range finding, Surface representations, Point-based representations, volumetric representations, Model-based reconstruction, Recovering texture maps.

Text Books:

1. Richard Szeliski “Computer Vision: Algorithms and Applications”, Springer-Verlag London Limited, 2011.
2. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”; Addison Wesley, 2008.

Suggested Reading:

1. Robert J. Schallkoff, “Pattern Recognition: Statistical. Structural and Neural Approaches”, John Wiley and Sons; 1992+.
2. D. A. Forsyth and J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
3. R. Hartley and A. Zisserman, “Multiple View geometry”, Cambridge university Press, 2002.
4. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Second Edition, Cambridge University Press, March 2004.

5. K. Fukunaga; “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, Morgan Kaufmann, 1990.

Online Resources:

1. CV online: http://homepages.inf.ed.ac.uk/rbf/CVonline
2. Computer Vision Homepage:
3. http://www2.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html

20CSE05

OPTIMIZATION TECHNIQUES
(Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Mathematical Foundation for Data Science and Security.

Course Objectives: The objectives of this course are,

1. To develop optimization techniques from the verbal description of real system.
2. To learn different techniques to get optimum solution LPP.
3. To understand the Mathematical representations that are needed to solve optimization problem.
4. To analyze the results of the different real-world problems.
5. To construct network and find critical path using network scheduling technique

Course Outcomes: On Successful completion of this course, student will be able to,

1. Calculate the optimum values for given objective function by LPP.
2. Solve the solution for maximize the profit with minimum cost by Transportation problem.
3. Determine the optimum feasible solution for assignment and travelling salesman problems and computing the optimal solution for Job sequencing models.
4. Compute the optimum values for given objective function by IPP and optimal strategy for games.
5. Identify critical path using network scheduling.

UNIT - I

Introduction to Operations Research: Basics definitions, objectives, models, application and limitations. Linear Programming (LP) - Mathematical Formulation of LP problem, Graphical Method, Some Exceptional Cases, Simplex Method - Introduction, computational procedure, artificial variables technique - big-M method and 2-phase method.

UNIT - II

Introduction, Mathematical Formulation of transportation Problem, Balanced / Unbalanced, Minimization / Maximization, Determination of the initial basic feasible solution using (i) North-West Corner Rule (ii) Least cost method & (iii) Vogel's approximation method for balanced & unbalanced transportation problems. Optimality Test & obtaining of optimal solution (Considering per unit transportation cost) using MODI method and steppingstone method

UNIT - III

Introduction, Mathematical Formulation of Assignment Problem, Hungarian method for optimal solution, Solving unbalanced problem, Traveling salesman problem, Sequencing models, Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT - IV

Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's All-IPP Method, All IPP Algorithm, Branch and Bound Technique Game and strategies: Introduction, Game with maximin-minimax principle (Pure Strategies), Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

UNIT - V

Construction of Network – Rules & Precautions, C.P.M. & P.E.R.T. Networks, Obtaining of Critical Path, Time estimates for activities, Probability of completion of project, Determination of floats (total, free, independent)

Text Books:

1. Kanti Swarup, P. K. Gupta, Man Mohan, "Operations Research", Sultan Chand Publications, 2010.
2. R. Pannerselvam, "Operations Research", PHI, 2nd Edition, 2016.

Suggested Reading:

1. Deb K. "Optimization for Engineering Design Algorithms and Examples", PHI, 2000.
2. Arora J. "Introduction to Optimization Design", Elsevier Academic Press, New Delhi, 2004.
3. Saravanan R. "Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press), 2006.
4. Hardley G. "Linear Programming", Narosa Book Distributors Private Ltd., 2002.

Online Resources:

1. https://nptel.ac.in/courses/111105039
2. https://nptel.ac.in/courses/105108127

20CSE25

SOCIAL COMPUTING
(Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Data Structures, Machine Learning, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To familiarize social networks and their representation.
2. To understand the impact of social networks on society.
3. To study and analyze the social network search models.
4. To plan and execute network analytical computations.
5. To collect network data in different ways from different sources.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Identify the significance of social networks, representation, ranking techniques and challenges.
2. Understand a broad range of social networks concepts and theories.
3. Ascertain the network analysis knowledge in a diversified aspect of society.
4. Analyze social network links and web search.
5. Differentiate between centralized and decentralized search models.
6. Generate and communicate the analysis results and impact of social networks.

UNIT - I

Introduction to Social Networks: Challenges, Google page rank, searching on network, link prediction, contagious, marketing on social networks.

Graphs: Basic definitions, paths and connectivity, distance and breadth first search, network datasets.

Strong and Weak Ties: Triadic closure, strength of weak Ties, Tie strength and network structure in large-scale data, social media and passive engagement, closure, structured holes and social capital.

UNIT - II

Networks in surrounding contexts: Homophily, selection and social influence, affiliation, tracking link formation in online data, spatial model of segregation.

Positive and negative relationships: Structural balance, characterizing the structure of balanced networks, applications of structured balance.

UNIT - III

Link analysis and Web search: Searching the web, ranking, link analysis using hubs and authorities, page rank, link analysis in modern web search, applications beyond web.

Cascading behavior in networks: Diffusion in networks, modeling diffusion, cascades and clusters, thresholds and role of weak Ties, extensions of cascade model, knowledge, thresholds and collective actions.

UNIT - IV

Power Laws and Rich-get-Richer Phenomena: Popularity as a network phenomenon, power laws, rich-get-richer models, unpredictability of rich-get-richer effects, effects of search tools and recommender systems, analysis of rich-get-richer processes. Pseudo core- how to go viral on the web. Case study on rich-get-richer.

UNIT - V

Small world phenomenon: Six degrees of separation, structured and randomness, decentralized search, modeling the process of decentralization search, empirical analysis and generalized models, core-peiphery structures and difficulties in decentralized search, analysis of decentralized search. Case Study on small world phenomenon.

Text Books:

1. David Eas ley, Jon Kleinberg, “Networks, Crowds and Markets”, Cambridge Press, 2010.
2. Mathew O Jackson “Social and Economic Networks”, Princeton University, 2010.

Suggested Reading:

1. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, "Analyzing Social Networks", 2018, Second edition, SAGE Publications Ltd.
2. Krishna Raj P.M., Ankith Mohan, K.G. Srinivasa, "Practical Social Network Analysis with Python", Computer Communications and Networks, Springer; 1st Edition, 2018.

Online Resources:

1. https://nptel.ac.in/downloads/106106169/

20CAE04

ALGORITHMIC GAME THEORY
(Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Calculus, Design and analysis of algorithms.

Course Objectives: The objectives of this course are,

1. To understand how to design systems with strategic participants that has good performance guarantees.
2. To understand the study of games from the perspective of algorithms and theoretical computer science.
3. To study the complexity-theoretic hardness of computing equilibria, focusing on Nash equilibria.
4. To study the categories of topics at a basic level: combinatorial games, zero-sum games, non-zero sum games and cooperative games.
5. To obtain familiarity how to Model and analyze conflicting situations using game theory.

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

1. Acquire knowledge about the real world problems and formulate mathematical models of these problems.
2. Identifying the algorithmic Models for finding the optimal solutions for real world examples.
3. Analyze the major limitations and capabilities of game theory problems.
4. Design and analyze problems using game theory approaches.
5. Explore the real world scenarios of economic and algorithmic interactions using game theory solutions.

UNIT - I

Introduction to Stable Matchings, Men-Optimality of the Men-Proposing Gale-Shapley Algorithm, GS: Cheating, Strategies for Men, GS: Cheating Strategies for Women, Problem, Popular, Strategic Behavior in Popular Matchings, Stable Roommates: Matchings in the Non-bipartite Setting.

UNIT - II

An Introduction to Voting, The Game of Trust - Nicky Case's Interactive Essay, Arrow's Theorem, Gibbard-Satterethwaite Theorem, Domain Restrictions and Multi-winner Elections, Incentive Design in Crowd sourcing Applications, Adversarial Approaches in Deep Learning.

UNIT - III

Algorithmic for computing Market Equilibrium, Tournament fixing and superkings, Tournament Fixing Parameterized by FAS, Tournament Fixing with Bribery, An Introduction to Cake-Cutting, Envy-Freenes and Approximate EF, Sperner's Lemma and Applications, Cake Cutting with a Secret Agent, Fairness Notions for Indivisible Goods.

UNIT - IV

Combinatorial Games: Introduction and examples: N and P positions, Zermelo's Theorem, The game of Hex, Nim games, Sprague-Grundy Theorem, The Sylver Coinage Game, **Zero-Sum Games:** Introduction and examples, Saddle Point Equilibria & the Minimax Theorem, Zero, Mixed Strategies, Properties of Saddle Point Equilibria.

UNIT - V

Iterated elimination of strictly dominated strategies, Lemke-Howson Algorithm, , Evolutionary Stable Strategies, Fictitious Play, Brown-Von Neumann-Nash Dynamics, The Nash Bargaining Problem, Transferable Utility Games, The Core, Characterization of Games with non-empty Core, Shapley Value, The Nucleolus.

Text Books:

1. Noam Nisan, Tim Roughgarden, Eva Tardos, Vijay V. Vazirani (eds), “Algorithmic Game Theory”, Cambridge University, 2007.
2. Michael Maschler, Eilon Solan, and Shmuel Zamir “Game Theory”, Cambridge University Press, 2013.
3. Y. Narahari “Game Theory and Mechanism Design”, World Scientific, 2015.

4. Martin Osborne, “An Introduction to Game Theory”, Oxford University Press, 2003.
5. T. Ferguson, “Game Theory”, Web Notes.
6. Karlin and Peres, “Game Theory”, Alive, AMS.
7. DeVos and Kent, “Game Theory: A Playful Introduction”, AMS

Suggested Reading:

1. Robert Duncan Luce “Games and Decisions: Introduction and Critical Survey” (Dover Books on Mathematics), Howard Raiffa, 1989.
2. William Spaniel “Game Theory 101: The Complete Textbook”, 2011.
3. John von Neumann, Oskar Morgenstern, “Theory of Games and Economic Behavior”, Princeton Univ. Press. 2007.

Online Resources:

1. https://nptel.ac.in/courses/128106007
2. https://nptel.ac.in/courses/110101133
3. https://arxiv.org/list/cs.GT/1703
4. https://dl.acm.org/doi/book/10.1145/3241304#secAuthors

20CAE05

MULTI AGENT INTELLIGENT SYSTEMS
(Professional Elective – III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Linear Algebra and Calculus, Artificial Intelligence.

Course Objectives: The objectives of this course are,

1. To learn various types of multi agent systems and their applications.
2. To acquire the knowledge of various multi agent system architectures and their learning methods.
3. To understand multi agent decision making systems and their applications.

Course Outcomes: On Successful completion of this course, student will be able to,

1. Understand various aspects of multi agent systems and architecture of intelligent agents.
2. Understand of various types of reasoning Agents.
3. Acquire knowledge of multi agent systems communication and cooperation methods.
4. Classify various types of decision-making processes for multi agent systems.
5. Use appropriate framework for agent communication and information sharing processes.
6. Explore different kinds of Auctions for multi agent environment and applications.

UNIT - I

Introduction: The Vision Thing, Some Views of the Field, Agents as a paradigm for software engineering, Agents as a tool for understanding human societies

Intelligent Autonomous Agents: Intelligent Agents, agent and objects, agents and expert systems, agents as intentional systems, Abstract Architectures for Intelligent Agents.

UNIT - II

Deductive Reasoning agents: Agents as theorem Provers, Agent-Oriented programming.

Practical Reasoning Agents: Practical Reasoning equals Deliberation plus Means-Ends Reasoning, Means-Ends Reasoning, HOMER, The Procedural reasoning System.

Reactive and Hybrid Agents: Reactive Agents -The subsumption architecture, PENGI, Limitations of reactive agents. Hybrid agents -Touring Machines.

UNIT - III

Understanding Each Other: Ontology Fundamentals, Ontology Languages, RDF.

Communicating: Speech Acts – Austin, Searle, Speech acts as rational action, Agent Communication Languages -KQML.

Working Together: Cooperative Distributed Problem Solving, Task sharing and Result sharing-Task sharing in the Contract Net. Result Sharing, Combining Task and Result Sharing, Handling Inconsistency, coordination.

UNIT - IV

Multi agent Decision Making - Multi Agent Interactions: Utilities and Preferences, Setting the Scene, The Prisoner's Dilemma.

Making Group Decisions: Social welfare Functions and Social Choice Functions, Voting Procedures- Plurality, Sequential majority elections.

Forming Coalitions: cooperative Games

UNIT - V

Allocating Scarce Resources: Classifying Auctions, Auctions for Single items - English auctions, Dutch auctions. Combinatorial auctions - Bidding Languages. Auctions in Practice-Online auctions, Adwords auctions

Applications: Agents for Workflow and Business Process Management, Agents for Distributed Sensing, Agents for Information Retrieval and Management, Agents for Electronic Commerce, Agents for Human - Computer Interfaces, Agents for Virtual Environments, Agents for Social Simulation, Agents for X.

Text Books:

1. Michae L Wooldridg E, “An Introduction to Multi Agent Systems”, Wiley publications, 2nd Edition, 2009.

Suggested Reading:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 4th Global edition, 2021.
2. Gerhard Weiss, “Multiagent Systems”, Second Edition, 2016.

Online Resources:

1. https://www.coursera.org/lecture/model ng-simulation-natural-processes/multi-agent-systems-kAKyC

20CAE06

DATA AND VISUAL ANALYTICS
(Professional Elective–III)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Fundamentals of Data Science, Mathematical Foundation for Data Science & Security.

Course Objectives: The objectives of this course are

1. To understand techniques and algorithms for creating effective visualizations based on principles from graphic design.
2. To learn visual and computation techniques and tools, for typical data types
3. To learn how to complement each kind of methods and gain a breadth of knowledge
4. To create a compelling and interactive visualization of various real datasets and problems.

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

1. Understand the key techniques and theory used in visualization, including data models, graphical perception.
2. Analyze techniques for visual encoding and interaction.
3. Apply knowledge to a number of common data domains and corresponding analysis tasks, including multivariate data, networks, text, and cartography.
4. Describe big data and use cases from selected business domains.
5. Explain NoSQL big data management and other technologies such as Hadoop and HDFS

UNIT - I : **Introduction:** Data for Graphics, Design principles, Value for visualization, Categorical, time series, and statistical data graphics, Introduction to Visualization Tools.

UNIT - II : **Graphics Pipeline and Aesthetics and Perception :** Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space.

UNIT – III : **Visualization Design :** Visual Display of Quantitative Information, Data-Ink Maximization, Graphical Design, Exploratory Data Analysis, Heat Map.

UNIT – IV : Multidimensional Data and Interaction : Query, Analysis and Visualization of Multi-Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling.

UNIT – V : Collaboration : Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data.

Textbooks:

1. Data Visualization Handbook by J. Koponen, J. Hildén, CRC Press, 2019
2. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishing 2019.
3. The Visual Display of Quantitative Information by E. Tufte, Graphics Press, 2nd Edition, 2001

Suggested Reading:

1. The Book of Trees: Visualizing Branches of Knowledge by M. Lima, Princeton Architectural Press, 2014
2. Handbook of Graph Drawing and Visualization by R. Tamassia, CRC Press, 2013
3. Interactive Data Visualization for the Web by S. Murray O'Reilly Press, 2nd Edition, 2017

Online Resources:

1. https://nptel.ac.in/courses/110106072
2. https://nptel.ac.in/courses/108105103

20ECO01

REMOTE SENSING AND GIS
(Open Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: Basic knowledge of Geography is required

Course Objectives:

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

1. Demonstrate the understanding of basic concepts of remote sensing and interpret energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

UNIT - I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages and limitations of Remote sensing, Orbits of Remote sensing satellites, Indian remote sensing satellites.

UNIT - II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT - III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT - IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT - V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, “Remote Sensing and GIS”, 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. “Remote Sensing and Image Interpretation”, 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, “Introduction to Remote Sensing”, the Guilford Press, 2011.
2. Michael N DeMers, “Fundamentals of GIS”, 2/e, John Wiley, 2008.

20MTO01

FINANCIAL MATHEMATICS
(Open Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. To explain the terms of financial market and its derivatives including options and futures.
2. To explain the modern portfolio theory.
3. To discuss the pricing theory in discrete time.
4. To explain the stochastic calculus.
5. To discuss the pricing theory in continuous theory.

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

1. Calculate the internal rate of return, annuity and amortization.
2. Apply the portfolio theory.
3. Examine the binomial model of pricing.
4. Analyze the stochastic differential equations.
5. Solve the BSM partial differential equations.

UNIT - I

Introduction to financial markets: Introduction to financial markets, financial instruments, bonds, stocks, futures & forwards, swaps and options. Time value of money, simple and compound interest rate, net present value, annuities, Amortization, Bond yield, internal rate of return and annuities. Markowitz portfolio theory, risk and return, two and multi-asset portfolio theory, minimum variance portfolio, efficient frontier.

UNIT - II

Modern portfolio theory: Capital Asset Pricing Model and portfolio performance analysis. No arbitrage principle, pricing of forwards and futures, properties of options. Derivative pricing by replication in single and multi-period binomial model.

UNIT - III

Risk neutral pricing in discrete time: Discrete probability spaces, filtration, conditional expectation. Discrete time martingales, Markov chain, risk-neutral pricing in binomial model for European and American derivatives.

UNIT - IV

Stochastic Calculus: General probability spaces, conditional expectation, Brownian motion and its properties. Ito integral, Ito formula, Girsanov's theorem, martingale representation theorem, stochastic differential equation.

UNIT - V

Risk neutral pricing in continuous time:-Black Scholes-Merton (BSM) model, pricing of European derivatives in BSM framework. Valuation of European options in BSM model, BSM formula, BSM partial differential equation, hedging, model completeness, and fundamental theorems of asset pricing.

Text Books:

1. Ales Cerny "Mathematical Techniques in Finance: Tools for Incomplete Markets". Princeton University Press, 2009.
2. Luenberger, David G. "Investment Science", Oxford University Press. Delhi, 1998.

Suggested Reading:

1. Hull, J. C., &Basu, S. "Options, Futures and Other Derivatives" 7th Edition Pearson Education. New Delhi, 2010.
2. S. R. Pliska "Introduction to Mathematical Finance: Discrete Time Models". Blackwell Publishers Inc., 2002.
3. Ross, Sheldon M. "An elementary Introduction to Mathematical Finance" 3rd Edition, Cambridge University Press. USA, 2011.

20EEO02

ENERGY MANAGEMENT SYSTEMS
(Open Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: Students should have prior knowledge on different energy generation systems, basic idea about audit instruments.

Course Objectives: The objectives of this course are,

1. To know the concept of Energy Management.
2. To understand the formulation of efficiency for various Engineering Systems
3. To enable the students to develop managerial skills to assess feasibility of alternative approachesand drive strategies regarding Energy Management

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

1. Know the current Energy Scenario and importance of Energy Conservation.
2. Understand the concepts of Energy Management, Energy Auditing.
3. Interpret the Energy Management methodology, Energy security and Energy Strategy.
4. Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
5. Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems

UNIT - I

Various form of Energy and its features: Electricity generation methods using different energy sources such as Solar energy, wind energy, Bio-mass energy, and Chemical energy such as fuel cells. Energy Scenario in India, Impact of Energy on economy, development, and environment sectors of national and international perspective.

UNIT - II

Energy Management-I: Defining Energy Management, need for Energy Management, Energy management techniques, importance of Energy Management, managing the Energy consumption, Energy Audit and Types, Energy Audit Instruments.

UNIT - III

Energy Management-II: understanding Energy costs, bench marking, Energy performance, matching energy use to requirement, optimizing the input, fuel & Energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, Energy Security.

UNIT - IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for Engineers, Energy Efficient Technology in Mechanical engineering: Compressed Air System, Heating, ventilation and air- conditioning, Fans and blowers, Pumps and Pumping Systems,

Energy Efficient Technology in Electrical engineering: Automatic Power Factor Controllers, Energy Efficient Motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, space cooling, energy efficiency of lifts and escalator, energy saving potential of each technology.

UNIT - V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Intelligent Buildings, And Various Energy Efficiency Rating Systems for Buildings, Green Buildings Energy Efficiency: management of green buildings, importance of embodied energy in selection of sustainable materials, green building design, waste reduction/recycling, rainwater harvesting, maintenance of the green buildings, green building certification, Renewable energy applications.

Energy Efficient Technology in Chemical Engineering: Green chemistry, Low carbon cements, recycling paper.

Text Books:

1. Umesh Rathore, 'Energy Management', Kataria publications, 2nd ediiton, 2014.
2. G Hariharaiyer, “Green Building Fundamentals”, Notion press.com.
3. K V Shama, P Venkataseshaiah, "Energy management and conservation", I. K. International Publishing agency pvt. ltd., 2011.

Suggested Reading:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects.
2. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org).

20EGO01

TECHNICAL WRITING SKILLS
(Open Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: The objectives of this course are,

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

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

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

UNIT - I

Communication – Nature and process.
Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.
Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

UNIT - II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

UNIT - III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.
Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

UNIT - IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.
Technical Proposals: Definition, types, characteristics, structure and significance.

UNIT - V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.
Technical Presentations : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Text Books:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communications-Principles and Practice", Oxford University Press, Second Edition, 2012.
2. M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading:

1. Kavita Tyagi & Padma Misra, "Basic Technical Communication", PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill, 2003

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

20CEO02

DISASTER RISK REDUCTION AND MANAGEMENT
(Open Elective – II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

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

1. Identify and understand the concepts of hazards, causes and impacts of disasters.
2. Develop a critical capacity to evaluate the principles and practices of disaster risk reduction and management;
3. Develop a deep awareness of disaster resilience, risk mitigation, and recovery policies as they arise from natural hazards around the globe;
4. Apply knowledge about existing global frameworks and existing agreements and role of community in successful Disaster Risk Reduction
5. Evaluate DM study including data search, analysis and presentation as a case study.

UNIT - I

- Hazard and disaster-concepts, vulnerability and risk.
- Hazard and disaster type – Natural, Water- related, pandemic and Human induced hazards disasters.
- Causes and Impacts of disasters – Impacts on natural eco systems: physical, psychological and social impact.
- Disaster and financial resilience.
- GIS and remote sensing.
- Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance).

UNIT - II

- Disaster Management Cycle –Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness.
- Disaster risk reduction {DRR) –Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards.
- Early warning systems.

UNIT - II

- Trauma and stress management.
- First aid and emergency procedures.
- Awareness generation strategies for the community on safe practises in disaster (as per regional significance).

UNIT - II

- Components of disaster management –preparedness of rescue and relief, mitigation, rehabilitation &reconstruction.
- Institutional frame work of disaster management in India (NDMA-SDMA, NDRF, Civic volunteers, NIDM).
- Phases of disaster/risk management and post-disaster responses.
- Compensation and insurance.
- Applications of remote sensing and GIS in disaster management.

UNIT - V

- Capacity building for disaster/damage mitigation (structural and non-structural measures).
- Disaster risk reduction strategies and national disaster management guidelines.
- Disaster management Act -2005.
- Regional issues as per regional requirement/university can take minimum two topics as per high powered committee.

Text Books:

1. Singh, R. (2017), “Disaster management Guidelines for Earth quakes, Landslides, Avalanches and Tsunami”. Horizon Press publications.

2. Taimpo (2016), “Disaster management and preparedness”. CRC Press Publications
3. Nidhi, G.D. (2014), “Disaster management preparedness” .CBS Publications Pvt. Ltd.
4. Gupta, A.K.,Nair, S.S., Shiraz, A. and Dey, S. (2013), “Flood Disaster Risk Management-CBS Publications Pvt Ltd.
5. Singh, R. (2016), “Disaster management Guidelines for Natural Disasters” Oxford University Press Pvt. Ltd.

20CHO04

ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT
(Open Elective - II)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives: This course will help the students:

1. To have an increased awareness on issues in areas of sustainability.
2. To understand the role of engineering & technology within sustainable development.
3. To know the methods, tools and incentives for sustainable product service system development.
4. To establish a clear understanding of the role and impact of various aspects of engineering decisions on environmental, societal and economic problems.
5. To communicate results related to their research on sustainable engineering.

Course Outcomes: At the completion of this course students will be able:

1. To relate sustainability concepts and ethical principles towards environment.
2. To understand the different types of environmental pollution problems and their respect sustainable solutions.
3. To become aware of concepts, analytical methods/models, and resources for evaluating and comparing sustainability implications of engineering activities.
4. To critically evaluate existing and new methods.
5. To develop sustainable engineering solutions by applying methods and tools to research a specific system design.
6. To apply concepts of sustainable development to address sustainability challenges in a global context.

UNIT- I

Introduction of sustainability- Need and concept of Sustainable Engineering, Social-environmental and economic sustainability concepts, Sustainable development and challenges, Multilateral Environmental acts and protocols-Clean Development Mechanism (CDM), Environmental legislations in India- Air Act and Water Act.

UNIT- II

Economic and social factors affecting sustainability, Effects of pollution from natural sources, Solid waste-sources, impacts, 4R (Reduce, Reuse, Recycling, Recover) concept, Global environmental issues-Resource degradation, Climate change, Global warming, Ozone layer depletion, Tools used to ensure sustainability in engineering activities such as environmental management systems and environmental impact assessment studies.

UNIT- III

Global, Regional and Local environmental issues, Carbon credits and Carbon trading, Carbon foot print, Environmental management standards, ISO 14000 series, Life cycle Analysis (LCA)-scope and goal, Procedures of EIA (Environment Impact Assessment) in India-Procedures of EIA in India.

UNIT- IV

Basic concept of sustainable habitat-Sustainable cities, Sustainable transport, Sustainable sources of energy-conventional and renewable sources, Green Engineering: Green buildings, Green materials for sustainable design, Green building certification, Methods for increasing energy efficiencies of buildings.

UNIT- V

Technology and sustainable development, Sustainable urbanization, Industrialization and poverty reduction, Social and Technological change, Industrial processes-material selection, Pollution prevention, Industrial ecology, Industrial symbiosis.

Text Books:

1. Allen D. T and ShonnardD. R., Sustainability Engineering Concepts, Design and Case Studies, 1st Ed, Prentice Hall, 2011.
2. Bradley A. S, Adebayo A. O and Maria. P., Engineering Applications in Sustainable Design and Development, 1st Ed, Cengage Learning, 2016.

Suggested Reading:

1. Rag R. L., Introduction To Sustainable Engineering, 2nd Ed, PHI Learning Pvt Ltd, 2016.
2. Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams., Sustainable Engineering,1st Ed, Wiley, 2019.

20EGMO3

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY

(**B.E/B.Tech II/III Year** -Common to all Branches)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Introduction

This course discusses the role of human values in one's family, in society and in nature. In the Induction Program, students would get an initial exposure to human values through Universal Human Values–I. This exposure is to be augmented by this compulsory full semester foundation course.

Course Objectives: The objectives of this course are

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

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

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

UNIT - I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal HumanValues-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current Scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT – II

Understanding Harmony in the Human Being - Harmony in Myself

- Understanding human being as a co-existence of the sentient 'I' and the material'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.

UNIT – III

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values ofrelationship
- Understanding the meaning of Trust; Difference between intention andcompetence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other

salient values in relationship

- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co -existence as comprehensive HumanGoals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

UNIT – IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in theNature
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self-regulation innature
- Understanding Existence as Co-existence of mutually interacting units in all - pervasivespace
- Holistic perception of harmony at all levels of existence.

UNIT – V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
    a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
    b. At the level of society: as mutually enriching institutions and organizations

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor: 10 marks
Self-assessment/Assessment by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Suggested Reading:

1. A Nagaraj Jeevan Vidya: Ek Parichaya, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. Cecile Andrews, Slow is Beautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small is Beautiful"
7. J. C. Kumarappa "Economy of Permanence"
8. Pandit Sunderlal "Bharat Mein Angreji Raj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom.
12. Vivekananda - Romain Rolland (English)
13. The Story of Stuff (Book)

20CAC07

DEEP LEARNING FOR COMPUTER VISION LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Artificial Intelligence, Machine Learning.

Course Objectives: The objectives of this course are

1. Understand basic concepts of Deep learning and their applications.
2. Evaluating Deep learning methods, models and algorithms.
3. Analyzing CNN, RNN, Transformers and GAN along with their applications.

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

1. Evaluate the performance various optimization techniques used in deep learning.
2. Analyze various Autoencoders and Regularization Techniques.
3. Design and Develop various Convolution Neural Networks architectures.
4. Analyze various RNNs and Encoder Decoder Models.
5. Understand the importance of Transformers and GANs to develop real-time applications.
6. Evaluate the Performance of different models for deep neural network training.

List of Experiments:

1. Implementation of Classification with Multilayer Perceptron using Scikit-learn with MNIST Dataset.
2. Understanding of Deep learning Packages Basics: Tensorflow, Keras, Theano and PyTorch.
3. Compare the Performance of various Optimization techniques of Momentum Based GD, Stochastic GD, Adam.
4. Implementation of Denoising autoencoders.
5. Compare the Performance of the Classification model using various Regularization Techniques.
6. Train a Deep learning model to classify a given image using pre trained model of AlexNet VGGNet and compare their performance.
7. Implementation of RNN for text generation.
8. Implementation of Encoder Decoder Models
9. Understand the Finetuning of BERT Models
10. Implementation of GANs for generating synthetic datasets

Textbooks:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. .Learning Generative Adversarial Networks: Next-generation deep learning simplified by Kuntal Ganguly, Packt, 2017
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
4. Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow by Benjamin Planche, Eliot Andres, Packt Publishers, 2019
5. Huang, Shih-Chia, and Trung-Hieu Le. Principles and labs for deep learning. Academic Press, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85/

20CSC31

CRYPTOGRAPHY AND NETWORK SECURITY LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Data communication and computer networks.

Course Objectives: The objectives of this course are,

1. To provide practical understanding of cryptography and its application to network security.
2. To learn various approaches on encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
3. To familiarize with symmetric and asymmetric cryptography.
4. Able to understand the significant functionalities of secure communication.

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

1. Identify basic security attacks and services
2. Design symmetric and asymmetric key algorithms for cryptography
3. Create and use of Authentication functions
4. Identify and investigate network security threat
5. Analyze and design network security protocols

List of Experiments:

1. Write a C program that contains a string (char pointer) with a value ‘Hello world’. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value ‘Hello world’. The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms
    a. Ceaser cipher
    b. Substitution cipher
    c. Hill Cipher
    d. Play fair Cipher
4. Write a C/JAVA program to implement the DES algorithm logic.
5. Write a C/JAVA program to implement the Blowfish algorithm logic.
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java cryptography; encrypt the text “Hello world” using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement RSA algorithm.
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA.
12. Implement Simple Columner Transposition technique and Advanced Columner Transposition technique
13. Implement Euclidean Algorithm and Advanced Euclidean Algorithm
14. Familiarize the cryptographic tools (opencv)

Text Books:

1. William Stallings, “Cryptography and Network Security: Principles and Practice” Pearson Education, 6th Edition.
2. Chris Brenton, “Mastering Network Security” Bk & Cd-Rom Edition 2017.

Suggested Reading:

1. J.W. Rittiaghouse and William M.Hancok “Cyber Security Operations Handbook” Elseviers.
2. Eric Chou, “Mastering Python Networking” 3rd Edition, 2020.
3. Jean-Philippe Aumasson “Serious Cryptography: A Practical Introduction to Modern Encryption”, 2017.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_cs16/preview

20CSE15

SOFT COMPUTING LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Linear Algebra & Calculus, Differential Equations & Transform Theory.

Course Objectives: The objectives of this course are,

1. Illustrate the concepts of simple neuron.
2. Fundamentals of Neural Networks & Feed Forward Networks, Associative Memories & Artificial Neural Networks.
3. Understanding the concepts of Fuzzy Logic and Fuzzy Systems, Genetic Algorithms and its design.

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

1. Implement McCulloh-Pitts model for Boolean operations.
2. Apply perceptron learning algorithm for a given problem.
3. Design and analyze various Neural Networks Architectures.
4. Apply concepts of fuzzy sets on real-time applications.
5. Implement Genetic Algorithms with its operators.
6. Apply soft computing strategies for various real time applications

List of Experiments:

1. Implementation of Simple Neural Network (McCulloh-Pitts model) for realizing AND Operation and OR operation.
2. Implementation of Perceptron network for realizing NAND operation.
3. Implementation of ANDNOT using ADALINE network.
4. Implementation of XOR problem using MADALINE network.
5. Design and Develop the Back Propagation Algorithm.
6. Implementation of Bidirectional Associative Memory (BAM) network.
7. Implementation of Hopfield Network.
8. Implementation of Membership Functions in Fuzzy Sets.
9. Implementation of Kohonen Self-Organizing Feature Maps (KSOFM) network for Clustering.
10. Implement the Genetic Algorithm for the function $f(x) = x^2$

Textbooks:

1. S.N. Sivanandam & S.N. Deepa, “Principles of soft computing”, Wiley publications, 2nd Edition, 2011.

Suggested Reading:

1. D.K Prathikar, “Soft Computing”, Narosa Publishing House, New Delhi, 2008.
2. S.N.Sivanandam, S.N.Deepa “Principles of Soft Computing” Second Edition, Wiley Publication 2016.
3. Satish Kumar, "Neural Networks -A classroom approach"; Second Edition, TMH, 2017.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs54/preview

20CSE16

INTERNET OF THINGS LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Computer architecture and microprocessor, Programming for problem solving.

Course Objectives: The objectives of this course are,

1. To understand the basics of IoT and its components.
2. To impart practical knowledge on IoT applications.
3. To develop skills required for building real-time IoT based projects.

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

1. Use of various hardware and software IoT components.
2. Perform experiments by Interfacing I/O devices, sensors to Raspberry Pi/Arduino.
3. Understand and analyze communication protocols in IoT.
4. Monitor data and controlling of devices.
5. Develop Real time IoT based projects.

List of Experiments:

1. Introduction to IoT equipments and perform necessary software installation.
2. Write a program to interface LED/Buzzer with Arduino and to turn ON LED for 1sec after every 2 seconds.
3. Write a program to interface Digital sensor PIR with Arduino and to turn ON LED when motion detected.
4. Write a program to interface DHT22 sensor with Arduino and display temperature and humidity readings.
5. Write a program to interface motor using relay with Raspberry Pi. Turn ON motor when the temperature is high.
6. Write a program to interface LCD with Raspberry Pi and print temperature and humidity readings on it.
7. Write a program to interface flame/smoke sensor with Arduino /Raspberry Pi and give an alert message when flame/smoke is detected.
8. Implement any case study using Arduino/Raspberry Pi.

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Suggested Reading:

1. Dr. SRN Reddy, Rachit Tirnkral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs, 2018.
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2013.
3. Raj Kamal, “Internet of Things:Architecture and Design”, McGraw Hill, 2017.
4. Cuno Pfister, "Getting Started with the Internet of Things", 0 Reilly Media, 2011.
5. O. Vermesan, P. Fries**s, “**Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, Series in Communications, 2013.

Online Resources / Weblinks / NPTEL Courses:

1. Li Da Xu, Wu He, and Shancang Li, “Internet of Things in Industries: A Survey “, IEEE Transactions on Industrial Informatics, Vol. 10, No. 4, Nov. 2014.
2. T. Winter, P. Thubert, A. Brandt, J. Hui, R. Kelsey, P. Levis, K. Pister, R. Struik, JP. Vasseur, R. Alexander, “RPL: IPv6 Routing Protocol for Low-Power and Lossy Networks”, IETF, Standards Track, Mar. 2012.

3. Z. Shelby, K. Hartke, C. Bormann, “The Constrained Application Protocol (CoAP)”**,** Internet Engineering Task Force (IETF), Standards Track, 2014.
4. L.Fenzel, “What’s The Difference Between IEEE 802.15.4 And ZigBee Wireless?”,Electronic Design (Online), Mar. 2013.
5. S. N. Das and S. Misra, "Information theoretic self-management of Wireless Sensor Networks", Proceedings of NCC 2013.
6. F. Luo *et al*., "A Distributed Gateway Selection Algorithm for UAV Networks," in IEEE Transactions on Emerging Topics in Computing, vol. 3, no. 1, pp. 22-33, March 2015.

20CSE20

NATURAL LANGUAGE PROCESSING LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Artificial Intelligence, Compiler Construction

Course Objectives: The objectives of this course are
1. To learn the fundamentals of natural language processing.
2. To understand the various text processing techniques in NLP.
3. To understand the role Text Classification, Deep Learning for Text Classification techniques of NLP
4. Using Topic Modeling, Case Studies and apply the NLP techniques to IR applications.

Course Outcomes: On Successful completion of the course, students will be able to
1. Understand the basic concepts of Natural language processing pipeline
2. Implement various feature engineering and text representation techniques in NLP
3. Illustrate text classification techniques to build NLP models
4. Explore text summarization methods and example systems
5. Demonstrate levels of NLP deep learning basics to process natural language text.
6. Implement NLP Pipe lines used to solve real world applications

List of Experiments:
1. Design/construct the workflow of a general NLP project using any tool.
2. Explore NLP Libraries
3. Implement preprocessing steps: Tokenization, Stop Word Removal, Stemming and lemmatization.
4. Implement advance preprocessing steps using Spacy Library.
5. Develop an application to explore Text Representation techniques: Bag Of Words, TF-IDF, Bag Of N grams, Word Embeddings.
6. Build a text classification system with following steps:
   a. Collect or create a labeled dataset suitable for the task.
   b. Split the dataset into two (training and test) or three parts: training, validation (i.e., development), and test sets, then decide on evaluation metric(s).
   c. Transform raw text into feature vectors and Train a classifier using the feature vectors and the corresponding labels from the training set.
   d. Using the evaluation metric(s) from Step (b), benchmark the model performance on the test set.
7. Implement Deep Learning for Text Classification using RNN/CNN/LSTM.
8. Build a chatbot using NLP Techniques.

Textbooks:
1. Practical Natural Language Processing A Comprehensive Guide to Building Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana Published by O'Reilly Media, Inc., June 2020: First Edition
2. James Allen, Bejamin/ cummings, "Natural Language Understanding", 2nd edition, 1995.

Suggested Reading:
1. Real-World NLP SystemsTanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Online Resources:
1. https://nptel.ac.in/courses/106101007/
2. http://www.cs.colorado.edu/~martin/sp2.html
3. https://web.standford.edu/~jurafsky/sp3/

20CAE07

COMPUTER VISION LAB
(Professional Elective – II)

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives: The objectives of this course are

1. To learn with practical aspects of computing with images.
2. To improve quality of image by applying enhancement techniques.
3. To understand Feature Extraction algorithms.

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

1. Recognise the fundamental issues and challenges of computer vision.
2. Interpret edges using various kernels and transformations.
3. Analyse images and videos for problems such as tracking and structure from motion
4. Identify object, scene recognition and categorization algorithms for real time images
5. Evaluate computer vision system for real world problems

Description : Use any tool like OpenCV/ Scilab/ python/R Programming etc.,

List of Programs

1. Familiarization of the tool used for computer vision.
2. Implement basic image operations
    a. Loading and displaying an image.
    b. Color formats
    c. Image enhancement.
3. Demonstrate fourier Transformations.
4. Implement edge detection on images using any two edge detection masks.
5. Detection of motion from structure.
6. Implementation Dense motion estimation
7. Implement texture extraction of a given image.
8. **Case Study :**Object detection like recognizing pedestrians..
9. **Case Study :**Face recognition of an image.
10. **Case Study** : Instance recognition of an image.
11. **Case Study :**Demonstrate model based reconstruction using tensorflow.

Textbooks:

1. Gary Bradski and Adrian Kaehler, "Learning OpenCV", O'Reilly Media, Inc., 1st Edition, 2008.
2. Talita Perciano and Alejandro C Frery, "Introduction to Image Processing Using R:" Learning by Examples, Springer, 1st Edition, 2013.
3. "Computer Vision: Algorithms and Applications" by Richard Szeliski; Springer-Verlag London Limited 2011.

Suggested Reading:

1. R C Gonzalez and R E woods, "Digital Image Processing", Addison Pearson, 3rd Edition, 2013.
2. David A.Forsyth and Jean Ponce, Computer Vision-A Modern Approach, PHI, 1st Edition, 2003.

Online Resources:

1. https://atoms.scilab.org/toolboxes/IPCV/1.1
2. https://docs.opencv.org/2.4/doc/tutorials/tutorials.html.

20EGCO3

EMPLOYABILITY SKILLS

Instruction	2 Hours per week
Duration of End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives: The objectives of this course are

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

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

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to manage time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

UNIT – I : Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT – II : Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies-Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence.
Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT – III : Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management-
Corporate Culture – Grooming and etiquette-Statement of Purpose (SOP).

UNIT – IV : Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT – V : Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. Leena Sen, “Communication Skills”, Prentice-Hall of India, 2005
2. Dr. Shalini Verma, “Body Language - Your Success Mantra”, S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , “Objective English”, 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, “The ACE of Soft Skills”, New Delhi: Pearson, 2010
5. Gulati and Sarvesh, “ Corporate Soft Skills”, New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, “Presentation Skills for Students”, New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, “The Habits of Highly Effective People”, New York: Free Press, 1989