B.Tech. IV Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	Machine Learning	2	1	0	3
2	Management Course- II	Human Resources & Project Management	2	0	0	2
3	Professional Elective-IV	1. Software Architecture & Design Patterns 2. Blockchain Technology 3. Internet of Things 4. Quantum Computing 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
4	Professional Elective-V	1. Soft Computing 2. Digital Image Processing 3. Natural Language Processing 4. Mobile Adhoc Networks 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective-III	1.Big Data Analytics 2. Block Chain Technologies 3.CyberSecurity 4.Devops 5. Quantum Computing	3	0	0	3
6	Open Elective-IV	1.Fundamentals of Optimization Techniques 2.Computer Forensics and Law Protection 3.Ethical Hacking 4.Augmented Reality &Virtual Reality 5.Biometrics	3	0	0	3
7	Skill Enhancement Course	Prompt Engineering/ SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	0	1	2	2
8	Audit Course	Constitution of India	2	0	0	-
9	Internship	Evaluation of Industry Internship	-	-	-	2
		Total	**18**	**2**	**02**	**21**

IV Year I Semester	Machine Learning	L	T	P	C
		2	1	0	3

The objectives of the course is to

1. Define machine learning and its different types (supervised and unsupervised) and understand their applications.
2. Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
3. Implement unsupervised learning techniques, such as K-means clustering.

Course Outcomes:

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

1. Recognize the characteristics of machine learning that make it useful to real-world problems.
2. Design decision tree to solve classification problems.
3. Design neural network to solve classification and function approximation problems.
4. Comprehend probabilistic methods for learning.
5. Build optimal classifiers using genetic algorithms.

UNIT-I: Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II: Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III: Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression. The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification, Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV: Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Back propagation for Training an MLP.

UNIT-V: Clustering : Introduction to Clustering, Partitioning of Data, Matrix Factorization, Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

i. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

i. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
ii. "Machine Learning in Action",Peter Harrington, DreamTech
iii. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

IV Year I Semester	HUMAN RESOURCES & PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:
The main objectives of the course are to

1. Provide knowledge about HR planning, recruitment, selection, and job design.
2. Develop skills in managing HR functions such as performance appraisal, compensation, and employee relations.
3. Emphasize the importance of ethical practices and HR audits in maintaining organizational health.

Course Outcomes:

1. Identify and manage the roles and responsibilities within a project team.
2. Implement strategies for team development, motivation, and performance management.
3. Develop and manage project plans, schedules, budgets, and risk assessments.
4. Apply appropriate management strategies tailored to each project type to ensure successful outcomes.
5. Evaluate the impact of organizational structure on project communication, decision-making, and resource allocation.

UNIT –I: HRM: Nature, Scope, Concept of HRM, Functions of HRM, Role of HR manager, emerging trends in HRM, E-HRM, HR audit models, ethical aspects of HRM. HR Planning, Demand and Supply forecasting of HR, Job Design, Recruitment, Sources of recruitment, Selection- Selection Procedure.

UNIT –II: HRD, HR accounting, Models, Concept of Training and Development, Methods of Training. Performance Appraisal: Importance Methods of performance appraisal, Career Development and Counseling, group interaction.

UNIT –III: Basics of Project Management, Concept, resource management, Project environment, Types of Projects, project networks-DPR, Project life cycle, Project proposals, Monitoring project progress, Project appraisal and Project selection, 80-20 rules, production technology, communication matrix

UNIT-IV: Identify various project types and their unique management challenges and apply appropriate management strategies for each. Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

UNIT-V: Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

Text Books:

i. Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human Resource Management, Cengage Learning 2016.
ii. Sharon Pande and Swapnalekha Basak, Human Resource Management, Text and Cases, Vikas

Publishing, 2e, 2016.

iii. Stewart R. Clegg, Torgeir Skyttermoen, Anne Live Vaagaasar, Project Management, Sage Publications, 1e, 2021.
iv. K. Nagarajan, Project Management, New Age International Publishers, 8e, 2017.

Reference Books :

i. Subba Rao P, "Personnel and Human Resource Management-Text and Cases", Himalaya Publications, Mumbai, 2013.
ii. K Aswathappa, "Human Resource and Personnel Management", Tata McGraw Hill, New Delhi, 2013.
iii. Prasanna Chandra, "Projects, Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill Company Pvt. Ltd., New Delhi, 1998.
iv. Vasanth Desai, "Project Management", 4th edition, Himalaya Publications, 2018.
v. Lalitha Balakrishnan, Gowri, "Project Management", Himalaya publishing house, New Delhi, 2022.

IV Year I Semester	SOFTWARE ARCHITECTURE & DESIGN PATTERNS (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Define software architecture and design patterns.
2. Understand the conceptual classes and relationships using object-oriented modeling techniques.
3. Implement patterns such as Adapter, Bridge, Composite, Decorator, Facade, Flyweight, and Proxy.

Course Outcomes:

1. Understand the basic concepts to identify state behavior of real world objects.
2. Apply Object Oriented Analysis and Design concepts to solve complex problems.
3. Construct various UML models using the appropriate notation for specific problem context.
4. Design models to Show the importance of systems analysis and design in solving complex problems using case studies.
5. Study of Pattern Oriented approach for real world problems.

UNIT - I

Introduction: What is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern, What is object oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm

UNIT – II

Analysis a System: Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading

UNIT – III

Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.

UNIT – IV

Interactive systems and the MVC architecture: Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions

UNIT – V

Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus

Text Books:

i. Object oriented analysis, design and implementation, brahma dathan, sarnathrammath , universities press,2013
ii. Design patterns, Erich Gamma, Richard helan , Ralph johman , john vlissides, PEARSON Publication,2013

Reference Books:

i. Frank Bachmann, ReginеMeunier, Hans Rohnert “Pattern Oriented Software Architecture” Volume 1, 1996.
ii. William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998

IV Year I Semester	BLOCK CHAIN TECHNOLOGY (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objective:

1. To provide conceptual understanding of the function of Block chain as a method of securing distributed ledgers.
2. To understand the structure of a Block chain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Define and explain the fundamentals of Block chain.
2. Understand decentralization and the role of Block chain in it.
3. Understand and analyze Bitcioin Crypto currency and underlying Block chain network.
4. Understand Etherium currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

i. Mastering Blockchain, Imran Bashir, Second Edition, PacktPublishing.

Reference Books:

i. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas Antonopoulos,O'Reilly.
ii. Blockchain Blueprint for a New Economy, Melanie Swan,O'Reilly.
iii. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
iv. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford UniversityPress.

IV Year I Semester	INTERNET OF THINGS (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. What IoT is and how it works today and to Understand the Architectural Overview of IoT
2. To Understand the IoT Reference Architecture and Real World Design Constraints
3. To understand the various IoT Protocols.

Course Outcomes:

The students should be able to:

1. Recognize the factors that contributed to the emergence ofIoT
2. Design and program IoT devices like Microcontrollers, sensors and actuators.
3. Use real IoT protocols for communication.
4. Define the infrastructure for supporting IoT deployment.
5. Design an IoT device to work with a Cloud Computing infrastructure and Transfer IoT data to the cloud and in between cloud providers.

UNIT-I: Introduction to IOT

Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real time Examples of IoT , Overview of IoT components and IoT Communication Technologies, Challenges in IOT**.**

UNIT - II: Arduino Simulation Environment

Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD.

Sensor & Actuators with Arduino

Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino. Interfacing of Relay Switch and Servo Motor with Arduino.

UNIT - III: Raspberry Pi Programming

Installing and **Configuring** the Raspberry Pi, Getting Started with the Raspberry Pi, Using the Pi as a Media Centre, Productivity Machine and Web Server, Remote access to the Raspberry Pi. Preparing **Raspberry Pi for IoT Projects.**

Creating the Sensor Projects, Creating the actuator Projects, Creating a IoT controller, creating a camera and working with HTTP protocol.

UNIT - IV: Basic Networking with ESP8266 WiFi module

Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server- introduction, installation, configuration, Posting sensor(s) data to web server .IoT Protocols ,M2M vs. IOT Communication Protocols.

UNIT -V:Cloud Platforms for IOT

Virtualization concepts and Cloud Architecture , Cloud computing, benefits ,Cloud services -- SaaS, PaaS, IaaS , Cloud providers & offerings ,Study of IOT Cloud platforms , Thing Speak API and MQTT , interfacing ESP8266 with Web services

Text Books:

i. Simon Monk, Programming Arduino: Getting Started with Sketches, Second Edition McGraw- Hill Education
ii. Peter Waher, Learning Internet of Things,Packt publishing.
iii. OvidiuVermesan,Peter Friess, IoT-From Research and Innovation to Market deployment, River Publishers

Reference Books:

i. 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.
ii. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
iii. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

IV Year I Semester	QUANTUM COMPUTING (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Cultivate the fundamental understanding of electromagnetism.
2. Deliver the knowledge about Fourier and nonlinear optics.
3. Develop elementary problem-solving capability of quantum optics

Course Outcomes:

By the end of this course, the student is able to

1. Analyze the behavior of basic quantum algorithms
2. Implement simple quantum algorithms and information channels in the quantum circuit model
3. Simulate a simple quantum error-correcting code
4. Prove basic facts about quantum information channels
5. Know about Quantum Computing Models

UNIT –I:

Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:

Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:

Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:

Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:

Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:

i. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia "Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/O'Reilly.
ii. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt V.K Sahni, Quantum Computing (with CD), TATA McGraw-Hill.

IV Year I Semester	SOFT COMPUTING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.
2. Introduce students to fuzzy systems, fuzzy logic and its applications.
3. Explain the students about Artificial Neural Networks and various categories of ANN.

Course Outcomes:

1. Student can be able to build intelligent systems through soft computing techniques.
2. Student should be able to understand the concept of artificial neural networks, fuzzy arithmetic, and fuzzy logic with their day-to-day applications.
3. Understand fuzzy logic and reasoning to handle and solve engineering problems.
4. Perform various operations of genetic algorithms, Rough Sets.
5. Comprehend various techniques to build model for various applications

UNIT-I:

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

UNIT-II:

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons , Back Propagation networks, Architecture of Back propagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications

UNIT-III:

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification

UNIT-IV:

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

UNIT-V:

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

GA based Back propagation Networks: GA based Weight Determination, K - factor determination in Columns.

Fuzzy Back propagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture,

Learning in Fuzzy BP, Application of Fuzzy BP Networks.

Text Books:

i. Principles of Soft Computing- S N Sivanandam, S N Deepa, Wiley India, 2007.
ii. Soft Computing and Intelligent System Design -Fakhreddine 0 Karray, Clarence D Silva, Pearson Edition, 2004.

Reference Books:

i. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
ii. Genetic Algorithms: Search and Optimization, E. Goldberg.
iii. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
iv. Build_Neural_Network_With_MS_Excel_sample by Joe choong

IV Year I Semester	DIGITAL IMAGE PROCESSING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To become familiar with digital image fundamentals
2. To get exposed to simple image enhancement techniques in Spatial and Frequency domain
3. To learn concepts of degradation function and restoration techniques

Course Outcomes:

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

1. Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and2D-transforms
2. Operate on images using the techniques of smoothing, sharpening and enhancement.
3. Use the restoration concepts and filtering techniques
4. Illustrate the basics of segmentation
5. Understand Image Compression and Recognition techniques

UNIT- I:

Digital Image Fundamentals: Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels.

UNIT -II:

Image Enhancement: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering.

UNIT –III:

Image Restoration: Image Restoration - degradation model, Properties, Noise models– Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT -IV:

Image Segmentation: Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT –V:

Image Compression and Recognition: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Text Books:

i. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Third Edition,2010.

ii. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson,2002.

Reference Books:

i. Kenneth R. Castleman, Digital Image Processing, Pearson,2006.
ii. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing, Prentice Hall Professional Technical Reference,1990.
iii. William K. Pratt, Digital Image Processing, John Wiley, New York,2002.

IV Year I Semester	NATURAL LANGUAGE PROCESSING (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP).

1. Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
2. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
3. Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:

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

1. Explain the origins and challenges of Natural Language Processing
2. Apply word-level analysis techniques in NLP using unsmoothed and smoothed N-gram models,
3. Apply grammar normal forms, feature structures, and unification techniques to resolve syntactic ambiguity.
4. Implement word sense disambiguation and word similarity methods using supervised, dictionary-based, and distributional approaches.
5. Analyze discourse structure and reference phenomena in text

UNIT I:

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II:

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III:

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT IV:

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised,

Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V:

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

ii. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin -Pearson Publication,2014.

iii. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

i. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
ii. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media,2015.
iii. Handbook of Natural Language Processing, Second, NitinIndurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
iv. Natural Language Processing and Information Retrieval, 3rd Edition, TanveerSiddiqui, U.S. Tiwary, Oxford University Press,2008.

IV Year I Semester	MOBILE ADHOC NETWORKS (Professional Elective-V)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn about the issues and challenges in the design of wireless ad hoc networks.
2. To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
3. To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.

Course Outcomes:

1. Know the basics of Ad hoc networks and Wireless Sensor Networks.
2. Identify the issues and challenges in providing QoS.
3. To know how the resources are managed in the network.
4. To get an idea about various types of mesh networks.
5. Specify and identify deficiencies in existing wireless protocols for MAC layer and Network layer, and then go onto formulate new and better protocols.

UNIT-I: Routing:

Cellular and Ad hoc wireless networks, Issues of MAC layer and Routing, Proactive, Reactive and Hybrid Routing protocols, Multicast Routing, Tree based and Mesh based protocols, Multicast with Quality of Service Provision

UNIT-II: Quality of Service:

Real-time traffic support , Issues and challenges in providing QoS , Classification of QoS Solutions ,MAC layer classifications ,QoS Aware Routing Protocols ,Ticket based and Predictive location based QoS Routing Protocols

UNIT-III:
Energy Management Ad Hoc Networks:

Need for Energy Management, Classification of Energy Management Schemes, Battery Management and Transmission Power Management Schemes, Network Layer and Data Link Layer Solutions, System power Management schemes.

UNIT-IV:
Mesh Networks:

Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic Routing, Self Configuration and Auto Configuration, Capacity Models, Fairness, Heterogeneous Mesh Networks, Vehicular Mesh Networks

UNIT -V:
Sensor Networks:

Introduction –,Sensor Network architecture , Data Dissemination ,Data Gathering ,MAC Protocols for sensor Networks, Location discovery, Quality of Sensor Networks ,Evolving Standards ,Other Issues, Recent trends in Infrastructure less Networks.

Text Books:

i. C.Siva Ram Murthy and B.S.Manoj, Ad Hoc Wireless Networks – Architectures and Protocols, Pearson Education.
ii. Holger Karl, Andreas Willing, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons,Inc.

Reference Books:

i. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, Ad Hoc Mobile Wireless Networks, Auerbach Publications.
ii. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing.
iii. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks Theory and Practice, John Wiley and Sons.

IV Year I Semester	BIG DATA ANALYTICS (OPEN ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course is to acquire knowledge on the

1. Necessity of Big data analysis and challenges in Big data analysis
2. Descriptive, Predictive, Real-time analysis of bigdata
3. Programming tools PIG & HIVE in Hadoop echo system

Course Outcomes:

The students should be able to:

1. Understand and Illustrate characteristics of big data and big data challenges in different domains including social media, transportation, finance and medicine
2. Demonstrate stream processing on real time applications
3. Do Big data processing using Map reduce on Hadoop
4. Do Big data processing using PIG scripts and HiveQLqueries
5. Understand Predictive analysis of big data.

UNIT-I: Introduction: Introduction to big data: Introduction to Big Data platform, Challenges of conventional systems, Intelligent data analysis, Nature of data, Analytic processes and tools, Analysis vs Reporting.

UNIT - II: Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications, Case Studies - Real Time Sentiment Analysis - Stock Market Predictions.

UNIT - III: Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

UNIT - IV: Frameworks and Applications: Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and ZooKeeper.

UNIT - V: Predictive Analytics and Visualizations: Predictive Analytics, Simple linear regression, Multiple linear Regressions, Interpretation of regression coefficients, Visualizations, Visual data analysis techniques, interaction techniques, Systems and application

Text Books:

i. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'reilly Media, Fourth Edition,2015.
ii. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing,2012.
iii. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CUP, 2012

References:

i. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley& sons,2012.
ii. Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, JamesGiles, David Corrigan, "Harness the Power of Big Data:The IBM Big Data Platform", Tata McGraw Hill Publications,2012.
iii. ArshdeepBahga and Vijay Madisetti, "Big Data Science & Analytics: A Hands On Approach ", VPT,2016.
iv. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)", John Wiley & Sons,2014.

E-resources:

i. https://www.edx.org/course/big-data-fundamentals
ii. https://hadoop.apache.org/
iii. https://pig.apache.org/
iv. https://hive.apache.org/

IV Year I Semester	BLOCK CHAIN TECHNOLOGIES (OPEN ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objective:

1. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
2. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Define and explain the fundamentals of Blockchain.
2. Understand decentralization and the role of Blockchain in it.
3. UnderstandandanalyzeBitcioinCryptocurrencyandunderlyingBlockchainnetwork.
4. Understand Etherium currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

i. Mastering Block chain, Imran Bashir, Second Edition, Packt Publishing.

References:

i. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas Antonopoulos,O'Reilly.
ii. Blockchain Blueprint for a New Economy, Melanie Swan,O'Reilly.
iii. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
iv. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford UniversityPress.

IV Year I Semester	CYBER SECURITY (OPEN ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objective:

1. To introduce keywords and jargons involved in securing browser
2. Understanding network basic and familiarize on security of network protocols
3. Awareness and understanding on cyber-attacks and data privacy

Course Outcomes:

By the end of this course, the student will be able to

1. Understand the basics and need for information security
2. Identify, analyze, and evaluate infrastructure and network vulnerabilities.
3. Understand and analyze different access control and authentication methods.
4. Identify and assess current and anticipated security risks and vulnerabilities with vulnerability assessment and auditing methods.
5. Learn the fundamentals of cryptography and how cryptography serves as the central language of information security.

UNIT-I:

Introduction to Security: Challenges of Securing Information, Definition of Information Security, Attackers, Attacks and Defenses.

Systems Threats and Risks: Software-Based Attacks, Hardware-Based Attacks, Attacks on Virtualized Systems, Hardening the Operating System, Preventing Attacks that Target the Web Browser, Hardening Web Servers, Protecting Systems from Communications-Based Attacks, Applying Software Security Applications.

UNIT-II:

Network Vulnerabilities and Attacks: Network Vulnerabilities, Categories of Attacks, Methods of Network Attacks.

Network Defenses: Crafting a Secure Network, Applying Network Security Devices, Host and Network Intrusion Prevention Systems (HIPS/NIPS), Protocol Analyzers, Internet Content Filters, Integrated Network Security Hardware.

UNIT-III:

Access Control: Access Control Models and Practices, Logical Access Control Methods, Physical Access Control.

Authentication: Definition of Authentication, Authentication Credentials, Extended Authentication Protocols, Remote Authentication and Security.

UNIT-IV:

Vulnerability Assessment: Risk Management, Assessment, and Mitigation, Identifying Vulnerabilities.
Security Audit: Privilege Auditing, Usage Auditing, Monitoring Methodologies and Tools.

UNIT-V:

Cryptography: Introduction to Cryptography, Cryptographic Algorithms, Using Cryptography on Files and Disks, Digital Certificates, Public Key Infrastructure, Key Management.

Text Book:

i. Security+ Guide to Network Security Fundamentals, Third Edition, Mark Ciampa, Cengage Learning.

References:

i. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord, Cengage Learning.
ii. Information Security: The Complete Reference, Rhodes-Ousley, Mark, Second Edition, McGraw-Hill.
iii. Information Security: Principles and Practices, Mark S. Merkow, Jim Breithaupt, 2nd Edition, Pearson Education.

IV Year I Semester	DEVOPS (OPEN ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the DevOps Concepts and DevOps Tools
2. DevOps improves collaboration and productivity by automating infrastructure and
3. Workflows and continuously measuring applications performance.

Course Outcomes:

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

1. Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
2. Describe DevOps & DevSecOps methodologies and their key concepts
3. Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
4. Set up complete private infrastructure using version control systems and CI/CD tools
5. Know about DevOps maturity model.

UNIT- I:

Phases of Software Development life cycle. Values and principles of agile software development.

UNIT –II:

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system.

UNIT –III:

DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.

UNIT –IV:

CI/CD: Introduction to Continuous Integration, Continuous Delivery and Deployment, Benefits of CI/CD, Metrics to track CICDpractices

UNIT -V:

Devops Maturity Model: Key factors of DevOps maturity model, stages of Devops maturity model, DevOps maturity Assessment

Text Books:

i. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations is considered the DevOps bible. It is written by Gene Kim, Jez Humble,Patrick Debois, and John Willis.
ii. Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation, is by Jez Humble and David Farley
iii. Effective DevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis &Ryn Daniels.

References/Web Links:

i. https://www.udacity.com/course/intro-to-devops--ud611 - Good online course with sample exercises.
ii. http://www.edureka.co/devops - Online Training covering high level process and tools. (Needs Registration)
iii. https://www.edx.org/course?search_query=devops – Has no. of courses from MS and Redhat.
iv. https://www.codementor.io/devops/tutorial - Basic Tutorial on DevOps.
v. https://mva.microsoft.com/training-topics/devops#!lang=1033 – Lists no. of courses related to DevOps and various tools, methods used.
vi. http://devops.com/ - A good blog, has lots of contents.
vii. https://dzone.com/devops-tutorials-tools-news - Lots of links and tutorials

IV Year I Semester	QUANTUM COMPUTING (OPEN ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the components of computing in a Quantum world
2. To gain knowledge on mathematical representation of quantum physics and operations.
3. To write computations in the real world (standard) in a Quantum computer and simulator.

Course Outcomes:
By the end of this course, the student is able to
1. Analyze the behavior of basic quantum algorithms
2. Implement simple quantum algorithms and information channels in the quantum circuit model
3. Simulate a simple quantum error-correcting code
4. Prove basic facts about quantum information channels
5. Know about Quantum Computing Models

UNIT –I:
Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:
Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:
Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:
Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:
Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:
i. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia "Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/O'Reilly.
ii. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the

world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt

IV Year I Semester	FUNDAMENTALS OF OPTIMIZATION TECHNIQUES (OPEN ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Introduction to optimization techniques using both linear and non-linear programming.
2. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization too.
3. After an adequate introduction to linear algebra and probability theory, students will learn to frame engineering minima maxima problems in the framework of optimization problems.

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

1. Comprehend the techniques and applications of engineering optimization.
2. Analyze characteristics of a general linear programming problem
3. Apply basic concepts of mathematics to formulate an optimization problem
4. Analyze various methods of solving the unconstrained minimization problem
5. Analyze and appreciate variety of performance measures for various optimization problems.

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UNIT-I

Introduction to optimization Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

UNIT-II

Linear Programming Problem Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

UNIT-III

Single Variable Optimization Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

UNIT-IV

Multivariable and Constrained Optimization Techniques Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method,

Newton‘s method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method.

UNIT-V

Intelligent Optimization Techniques Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Text books:

i. S. S. Rao, Engineering Optimisation: Theory and Practice , Wiley, 2008.
ii. K. Deb, Optimization for Engineering design algorithms and Examples , Prentice Hall, 2 nd edition 2012.

References:

i. C.J. Ray, Optimum Design of Mechanical Elements , Wiley, 2007.
ii. R. Saravanan, Manufacturing Optimization through Intelligent Techniques , Taylor & Francis Publications, 2006. 3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning , Addison-Wesley Longman Publishing, 1989.

IV Year I Semester	COMPUTER FORENSICS AND LAW PROTECTION (OPEN ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To correctly define and cite appropriate instances for the application of computer forensics Correctly collect and analyze computer forensic evidence
2. Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Computer Forensics
3. Designing procedures at a suspected crime scene which helps you to ensure that the digital evidence obtained is not corrupted.

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

1. Understand the concept of Cyber security, issues and challenges associated with it.
2. Understand the cybercrimes, their nature, legal remedies and reporting the crimes through available platforms and procedures.
3. Appreciate various privacy and security concerns on online social media and understand there porting procedure of inappropriate content, underlying legal aspects and best practices forthe use of social media platforms.
4. Understand the basic concepts related to E-Commerce and digital payments.
5. Familiar with various digital payment modes and related cyber security aspects, RBI guidelines and preventive measures against digital payment frauds.

UNIT–I

Introduction: Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems –Vendor and Computer Forensics Services.

UNIT–II

Computer forensics evidence and capture: Data Recovery – Evidence Collection and Data SeizurE-Duplication and Preservation of Digital EvidencE-Computer Image Verification and Authentication.

Current Digital Forensics Tools: Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Command-Line Forensics Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software.

UNIT–III

Computer forensic analysis: Discover of Electronic EvidencE Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military – Tactics of Terrorist and Rogues – Tactics of Private Companies.

E-mail and Social Media Investigations: Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Applying Digital Forensics Methods to Social Media Communications.

UNIT–IV

Information warfare: Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer CrimE-Identity Theft and Identity Fraud – Organized Crime &Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related CrimE-The Fourth Amendment and other Legal Issues.

UNIT–V

Computer forensic cases: Developing Forensic Capabilities –Searching and Seizing Computer Related Evidence –Processing Evidence and Report Preparation – Future Issues.

Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, ECommerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems

Text Books:

i. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18).(UNIT I – IV)
ii. Nelson, Phillips, Steuart, “Guide to Computer Forensics and Investigations, 6e”, Cengage.
iii. Marjie T Britz, “Computer Forensics and Cyber Crime: An Introduction”, Pearson Education, 2nd Edition, 2008. (CHAPTERS 3 – 13). (UNIT IV – V)\
iv. Doctrine of IT Act of India, Government of India Publication (2000)

Reference Books:

i. MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett Learning; 2nd Edition, 2014.
ii. Eamon P.Doherty, “Digital Forensics for Handheld Devices”, CRC Press.
iii. Chad Steel, “Windows Forensics”, Wiley, 1st Edition, 2006.
iv. Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover,2nd Edition, 2013.
v. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

IV Year I Semester	ETHICAL HACKING (OPEN ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objectives:

1. Learn aspects of security, importance of data gathering, foot printing and system hacking.
2. Learn tools and techniques to carry out a penetration testing.
3. Explain Intrusion Detection, Policy Creation, Social Engineering, DDoS Attacks, Buffer

Course Outcomes:

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

1. Demonstrate an understanding of the importance of security and ethical hacking
2. Explain the significance of buffer overflow vulnerabilities
3. Describe the concepts of active and passive sniffing
4. Analyze SQL injection and related web application attacks
5. Explain core web application security defense mechanisms

UNIT-I:

Introduction: Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking, Foot printing, Scanning, System Hacking, Session Hijacking.

UNIT-II:

Buffer Overflows: Significance of Buffer Overflow Vulnerability, Why Programs/Applications are vulnerable. Reasons for Buffer Overflow Attacks. Methods of ensuring that buffer overflows are trapped.

UNIT-III:

Sniffers: Active and passive sniffing. ARP poisoning and countermeasures. Man in the middle attacks, Spoofing and Sniffing attacks. Sniffing countermeasures.

UNIT-IV:

SQL Injection: Attacking SQL Servers, Sniffing, Brute Forcing and finding Application Configuration Files, Input validation attacks. Preventive Measures. Web Application Threats, Web Application Hacking, Cross Site Scripting / XSS Flaws / Countermeasures Correct Web Application Set-up.

UNIT-V:

Web Application Security: Core Defence Mechanisms. Handling User Access, Authentication, Session Management, Access Control.

Web Application Technologies: HTTP Protocol, Requests, Responses and Methods. Encoding schemes. Server side functionality technologies (Java, ASP, PHP).

Text books:

i. Patrick Engebretson, The Basics of Hacking and Penetration Testing, Elsevier, 2013.
ii. Network Security and Ethical Hacking, Rajat Khare, Luniver Press, 2006.

Reference books:

i. Network intrusion alert: an ethical hacking guide to intrusion detection, Ankit Fadia, Manu Zacharia, Thomson Course Technology PTR, 2007.
ii. Ethical Hacking, Thomas Mathew, OSB Publisher, 2003.
iii. Hacking Exposed: Network Security Secrets & Solutions, Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill, 2005.

IV Year I Semester	AUGMENTED REALITY & VIRTUAL REALITY (OPEN ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Objectives:

1. Provide a foundation to the fast growing field of AR and make the students aware of the various AR concepts.
2. To give historical and modern overviews and perspectives on virtual reality.
3. Describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

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

1. Explain the principles of AR displays, visual perception, and tracking systems
2. Apply computer vision techniques for augmented reality
3. Explain the geometric, optical, and physiological principles
4. Analyze visual perception aspects such as depth, motion, and color, and apply visual rendering techniques
5. Analyze motion dynamics in real and virtual environments

UNIT - I

Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields

Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays

Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors

UNIT - II

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking.

Interaction: Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction

Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs

UNIT - III

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception

The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations
Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT - IV
The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR
Visual Perception: Visual Perception - Perception of Depth, Perception of Motion, **Perception of Color**
Visual Rendering: Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT - V
Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection
Interaction: Motor Programs and Remapping, Locomotion, Social Interaction
Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

Text Books:

i. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India;First edition (12 October 2016),ISBN-10: 9332578494
ii. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

Reference Books:

i. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
ii. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
iii. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
iv. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN:9781491962381
v. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
vi. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005

IV Year I Semester	BIOMETRICS (OPEN ELECTIVE-IV)	L	T	P	C
		3	0	0	3

Course Objective:

1. To understand the technologies of fingerprint, iris, face and speech recognition
2. To understand the general principles of design of biometric systems and the underlying trade-offs.
3. To recognize personal privacy and security implications of biometrics based identification technology.

Course Outcomes:

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

1. Understand basic concepts of biometric technology.
2. Analyze fingerprint technology
3. Analyze face recognition systems
4. Understand voice based biometric recognition
5. Understand Multi-biometric systems

UNIT-I: INTRODUCTION TO BIOMETRICS

Introduction and background – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications.

UNIT-II: FINGERPRINT IDENTIFICATION TECHNOLOGY

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges -Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: Fingerprint Classification, Matching policies.

UNIT-III: FACE RECOGNITION

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the FaceSpare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

UNIT-IV: VOICE SCAN

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

UNIT-V: FUSION IN BIOMETRICS

Introduction to Multi biometric - Advantages of multimodal system, Information Fusion in Biometrics - Issues in Designing a Multi biometric System - Sources of Multiple Evidence -Levels of Fusion in Biometrics – Sensor level, Feature level, Rank level, Decision level fusion - Score level Fusion. Examples –gait based biometric systems.

Text Books:

i. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, ―Biometric Systems,Technology Design and Performance Evaluation‖, Springer.
ii. David D. Zhang, ―Automated Biometrics: Technologies and Systems‖, Kluwer Academic Publishers, New Delhi.
iii. Arun A. Ross , Karthik Nandakumar, A.K.Jain, ―Handbook of Multibiometrics‖, Springer, New Delhi.

References:

i. Paul Reid, ―Biometrics for Network Security‖, Pearson Education, 2004.
ii. Nalini K Ratha, Ruud Bolle, ―Automatic fingerprint Recognition System‖, Springer.
iii. L C Jain, I Hayashi, S B Lee, U Halici, ―Intelligent Biometric Techniques in Fingerprint and Face Recognition‖ CRC Press, 1999.
iv. John Chirillo, Scott Blaul, ―Implementing Biometric Security‖, John Wiley, 2003.
v. S.Y. Kung, S.H. Lin, M.W.Mak, ―Biometric Authentication: A Machine Learning Approach‖ Prentice Hall, 2005

IV Year I Semester	PROMPT ENGINEERING (SKILL ENHANCEMENT COURSE)	L	T	P	C
		0	1	2	2

Course Objectives:
The main objectives of the course are to
1. Apply iterative prompting for clarity and context.
2. Create varied prompts to steer model outputs.
3. Construct chain-of-thought and structured prompts.

Course Outcomes:
1. Understand prompt engineering as the process of crafting inputs to elicit desired outputs from large language models (LLMs).
2. Design prompts that include contextual details and explicit output formats to guide the model towards desired responses.
3. Understand the Importance of Structured Outputs and Reasoning Techniques in Real-World Applications.
4. Recognize the constraints of large language models (LLMs) regarding static knowledge and the necessity for integrating external data sources to enhance their capabilities.
5. Understand the concept of using LLMs for automated evaluation of prompts.

Unit I: Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design**,** Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation

Lab Experiments:
1. Environment & Connectivity: Install required packages (e.g., transformers, openai); securely configure the API key; run a simple "Hello, world" prompt to verify model access.
2. Baseline vs. Enhanced Prompts: Execute a naïve prompt ("Write a one-paragraph bio of Ada Lovelace.") and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.
3. Iterative Refinement on a Simple Task: Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
   a. Minimal instruction.
   b. Addition of length and style constraints
   c. Specification of key content elements (setting and theme)
   Document how each iteration changes and improves the result.
4. Diagnosing Prompt Failures & Edge Cases: Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

Unit II: Advanced Prompt Patterns & Techniques: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization

Lab Experiments:

1. Few-Shot vs. Zero-Shot Comparison: Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g., sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
2. Role-Based & Negative Prompting: Craft a role-based prompt to establish a specific persona (e.g., "You are a financial advisor…"); then create a negative prompt to suppress undesired content (e.g., "Do not mention any brand names"); evaluate how each influences the model's response.
3. Constraint Specification & Iterative Refinement: Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.

Unit III: Structured Output & Reasoning Techniques: Importance of structured outputs for real-world applications, Prompting for specific formats (lists, tables, Markdown), Generating valid JSON and YAML via explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks

Lab Experiments:

1. Structured Format Prompting: Instruct the model to output information as bullet lists and Markdown tables (e.g., "List three benefits of daily exercise in a Markdown table with columns 'Benefit' and 'Description.'"); verify the output matches the requested structure.
2. JSON/YAML Generation: Provide a brief dataset description (e.g., three books with title, author, publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
3. Chain-of-Thought & Task Decomposition: Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot CoT prompting (e.g., "Let's think step by step. Explain your reasoning before the final answer."); separately, decompose the problem into sequential sub-questions, collect partial answers, combine them, and compare accuracy against a direct-answer baseline.

Unit IV: Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval-Augmented Generation (RAG), Overview of RAG architecture (indexing vs. retrieval + generation), Getting started with LangChain for LLM applications, Basics of LangChain Expression Language (LCEL), Simplified indexing pipeline: document loading & text splitting, Fundamentals of embeddings and vector stores, Building a basic retrieval-generation pipeline with an LCEL chain

Lab Experiments:

1. Building a Simple LCEL Chain: Create a minimal LCEL script that accepts a fixed instruction (e.g., "Summarize this text: …"), passes it to an LLM, and prints the result; verify end-to-end execution.
2. Basic Data Indexing for RAG: Load a small collection of documents; split into uniform chunks (e.g., 200 tokens); generate embeddings for each chunk; store them in an in-memory vector store; inspect for consistency.
3. Constructing & Running a Basic RAG Chain: Build a pipeline that:
    a. Receives a user query
    b. Retrieves the top-k relevant chunks
    c. Constructs a combined prompt with context + query

d. Send it to the LLM
e. Returns the answer

Test with sample queries and compare factual accuracy against a prompt without retrieval.

Unit V: Agents, Multimodal AI & Ethical Evaluation: Introduction to LLM agents and their basic architecture, Overview of multimodal AI models (VLMs), Prompting for text-to-image generation and image understanding, Importance of prompt evaluation beyond subjective judgment, Manual evaluation techniques (heuristic checks for accuracy, relevance, format), Introduction to "LLM-as-Judge" for automated evaluation, Security considerations (prompt injection, sensitive-information risks), Prompt-based mitigation strategies for safety and robustness, Ethical concerns (bias, misinformation, data privacy), Brief exploration of UI frameworks (Streamlit/Gradio) for deploying prompt-driven apps, Adapting to the evolving nature of prompt engineering through continuous learning

Lab Experiments:

1. Building a Simple LLM Agent: Register a tool (e.g., a calculator function) and craft prompts that instruct the agent to invoke it when required; implement using Lang Chain or a function-calling API; test on queries requiring tool execution.
2. Multimodal Prompting Exploration: Generate images from detailed text prompts; feed one generated image into an image-understanding model or API with an appropriate prompt; compare the returned caption to the original prompt to evaluate alignment.
3. Prompt Evaluation & Ethics Workshop:
    a. Select two existing prompts and generate multiple outputs; apply manual heuristic checks for accuracy, relevance, and format compliance.
    b. Use an "LLM-as-Judge" prompt (e.g., "Rate these outputs on a scale of 1–5 for clarity and correctness.") to automate evaluation.
    c. Design a prompt- injection test (e.g., "Ignore previous instructions…"), observe the response, then refine system prompts to mitigate the vulnerability.

IV Year I Semester	Constitution of India (AUDIT COURSE)	L	T	P	C
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Course Objectives:

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

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

1. Understand historical background of the constitution making and its importance for building a democratic India.
2. Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
3. Understand the value of the fundamental rights and duties for becoming good citizen of India.
4. Analyze the decentralization of power between central, state and local self-government.
5. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
    1. Know the sources, features, and principles of Indian Constitution.
    2. Learn about Union Government, State government and its administration.
    3. Get acquainted with Local administration and Pachayati Raj.
    4. Be aware of basic concepts and developments of Human Rights.
    5. Gain knowledge on roles and functioning of Election Commission

UNIT–I: History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)
Philosophy of the Indian Constitution- Preamble, Salient, Features

UNIT–II: Contours of Constitutional Rights &Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

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

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

UNIT–V: Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

i. The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
ii. Framing of Indian Constitution, 1st Edition,Dr. S. N. Busi, Dr. B. R. Ambedkar2015

Reference Books:

i. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis,2014.