JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

R25 M.TECH CSE COURSE STRUCTURE AND SYLLABUS

Vision and Mission of the University

Vision

The University is primarily promoting quality of education in the areas of Science, Technology, Engineering and Mathematics (STEM) as four academic pillars of education, to excel in teaching, learning, research, consultancy and placements through innovative practices with global perspective.

Mission

1. Design an Industry relevant curriculum from time to time with a Global perspective
2. Promoting quality education by embracing ICT delivery mechanism with continuous pedagogy through e-learning mechanism
3. Spread across for industry collaborations with a focus to pre-training and placements for technology transfer to society
4. Establishing centers of excellence to promote research and innovations in multidisciplinary areas to bring in patent culture and consultancy practices
5. International Collaborations for student outreach
6. Facilitating international students to study in JNTUK to infuse cross culture learning practices.

Vision and Mission of the Institute

Vision and Mission of the Department

Programme Education Objectives (PEOs) of the M. Tech (CSE)

PEO 1: To build successful careers in consulting, government organizations, academic institutions, NGOs, and research & development sectors by applying advanced knowledge and technical expertise in Computer Science and Engineering.

PEO 2: To commit lifelong learning and innovation by addressing real-world research challenges and contributing to engineering education through creative and scholarly activities.

PEO 3: To make them entrepreneurs and professionals with strong interpersonal and managerial skills, capable of thriving in multidisciplinary domains and delivering socially responsible computing solutions

Mapping of Mission statements to PEOs

Programme Outcomes (POs)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

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

PO4: Explore and apply mathematical foundations, algorithms, databases, networking, and core computer science principles for modeling and designing efficient computing systems.

PO5: Demonstrate the ability to continuously upgrade skills in emerging computing technologies to achieve professional excellence and contribute effectively in academia or industry.

PO6: Apply advanced computer science tools and modern techniques to develop effective solutions for engineering and societal challenges, while adhering to ethical standards and professional responsibilities.

Note: Program may add up to three additional POs

Mapping of Programme Outcomes to PEOs

Mapping of Programme Outcomes to GAs

M. Tech Programme

CSE COURSE STRUCTURE & SYLLABUS

(Common to M. Tech Computer Science & Engineering)

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DEPARTMENT OF COMPUTER SCIENCE ENGINEERING

R25 M.TECH CSE COURSE STRUCTURE AND SYLLABUS

R25 M. Tech (CSE) Programme Structure

M. Tech(CSE) I – Semester

S.No	Course Title	L	T	P	C
1	**Program Core – 1** Data Structures and Algorithm Analysis	3	1	0	4
2	**Program Core – 2** Advanced Data warehousing and Data Mining	3	1	0	4
3	**Program Core – 3** Mathematical foundations of computer science	3	1	0	4
4	**Program Elective – I**	3	0	0	3
5	**Program Elective – II**	3	0	0	3
6	**Laboratory – 1** Data Structures and Algorithm Analysis lab	0	1	2	2
7	**Laboratory – 2** Advanced Data warehousing and Data Mining lab	0	1	2	2
8	Seminar-I	0	0	2	1
	TOTAL	**15**	**5**	**6**	**23**

List of Professional Elective Courses in I Semester (Electives – I & II)

S.No.	Course Title
1	1. Image Processing 2. Soft computing 3. Advanced Computer Networks 4. Advanced Software Engineering 5. Time Series Analysis 6. High Performance Computing 7. Agile Methodologies 8. Advanced Compiler Design 9. Any minimum12 weeks MOOCS/NPTEL courses suggested by BOS

@ Minimum 2/3 themes per elective

M. Tech (CSE) II – Semester

Sl. No.	Course Title	L	T	P	C
1	**Program Core – 4** Machine Learning	3	1	0	4
2	**Program Core – 5** Natural Language Processing	3	1	0	4
3	**Program Core – 6** Introduction to Quantum computing	3	1	0	4
4	**Program Elective – III**	3	0	0	3
5	**Program Elective - IV**	3	0	0	3
6	**Laboratory – 3** Machine Learning Lab	0	1	2	2
7	**Laboratory – 4** Natural Language Processing Lab	0	1	2	2
8	Seminar – II	0	0	2	1
	TOTAL	**15**	**5**	**6**	**23**

List of Professional Elective Courses in II Semester (Electives III & IV)

S. No.	Course Title
1	1. Feature Engineering 2. Generative AI 3. Adhoc Sensor Networks 4. Principles of Network Security 5. Block Chain Technologies 6. DevOps 7. Secure Coding 8. Design Patterns 9. Any minimum12 weeks MOOCS/NPTEL courses suggested by BOS

@ Minimum 2/3 themes per elective

M. Tech (CSE) - III Semester

S. No	Course Title	L	T	P	C
1	Research Methodology and IPR / *Swayam 12 week MOOC course – RM&IPR*	3	0	0	3
2	Summer Internship/ Industrial Training (8-10 weeks)*	-	-	-	3
3	Comprehensive Viva#	-	-	-	2
4	Dissertation Part – A$	-	-	20	10
	TOTAL	**3**	**-**	**20**	**18**

* Student attended during summer / year break and assessment will be done in 3rd Sem.
# Comprehensive viva can be conducted courses completed upto second sem.
$ Dissertation – Part A, internal assessment

M Tech. (CSE) – IV Semester

S. No.	Course Title	L	T	P	C
1	Dissertation Part – B%	-	-	32	16
	TOTAL	**-**	**-**	**32**	**16**

% External Assessment

I Semester	DATA STRUCTURES & ALGORITHMS ANALYSIS	L	T	P	C
		3	1	0	4

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Ability to write and analyze algorithms for algorithm correctness and efficiency	K2
CO2	Master a variety of advanced abstract data type (ADT) and data structures and their Implementation.	K4
CO3	Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real life	K4
CO4	Design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees	K3
CO5	Ability to compare various search trees and find solutions for IT related problems	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2	3		
CO2			3	3		
CO3			3	3		2
CO4			3	3		3
CO5			3	3	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction to Data Structures-** Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms, Stacks and Queues- Algorithm Implementation using Linked Lists.	10Hrs
UNIT – 2	**Searching-** Linear and Binary, Search Methods, Sorting- Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Trees- Binary trees, Operations- Insertion, Deletion, Properties, Representation and Traversals (DFT, BFT), Expression Trees (Infix, prefix, postfix), Graphs- Basic Concepts, Storage structures and Traversals	12Hrs
UNIT – 3	Dictionaries, ADT, The List ADT, Stack ADT, Queue ADT, Hash Table Representation, Hash Functions, Collision Resolution-Separate Chaining, Open Addressing- Linear Probing, Double Hashing	12Hrs
UNIT – 4	**Priority queues**- Definition, ADT, Realising a Priority Queue Using Heaps, Definition, Insertion, Deletion, Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations- Searching, Insertion, Deletion	12Hrs

UNIT – 5	**Search Trees**- AVL Trees, Definition, Height of AVL Tree, Operations- Insertion, Deletion and Searching. Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Data Structures: A Pseudocode Approach with C, 2 nd Edition, Richard F.Gilberg, Behrouz A. Forouzon, Cengage Learning, 2004
2. Data Structures, Algorithms and Applications in java, 2 nd Edition, Sartaj Sahni, University Press/Orient BlackSwan, 2005

Reference Books:

1. Data Structures And Algorithm Analysis, 2 nd Edition, Mark Allen Weiss, Pearson, 2002
2. Data Structures And Algorithms in C++, 3 rd Edition, Adam Drozdek, Cengage Learning, 2005
3. C and Data Structures: A Snap Shot Oriented Treatise Using Live Engineering Examples, 1 st Edition, N.B.Venkateswarulu, E.V. Prasad, S Chand & Co, 2009
4. Classic Data Structures, 2 nd Edition, Debasis Samantha, PHI Learning, 2009

I Semester	ADVANCED DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	1	0	4

Pre-requisites: Data Structures, Algorithms, Probability & Statistics, Data Base Management Systems

Course Objectives: The main objective of the course is to

- Understand Data Warehousing and OLAP
- Master Data Preprocessing and Statistical Techniques
- Apply Classification Techniques and Model Evaluation
- Perform Association and Sequential Pattern Mining
- Explore Clustering and Advanced Data Mining

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	**Describe** the architecture, modeling techniques, and implementation strategies of data warehouses and OLAP systems, including modern cloud-based approaches (K2).	K2
CO2	**Apply** statistical and visualization techniques to describe datasets and perform data preprocessing tasks such as cleaning, integration, reduction, and transformation. (K3)	K3
CO3	**Develop** and evaluate classification models using decision trees, Bayesian classifiers, and rule-based methods for solving predictive analytics problems.(K4)	K4
CO4	**Discover** meaningful associations and sequential patterns in data using algorithms like Apriori, FP-Growth, and sequential pattern mining techniques. (K3)	K3
CO5	**Implement** clustering techniques such as K-means, hierarchical clustering, and DBSCAN, and analyze advanced data mining for text, spatial, and graph data.(K4)	K4

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	2	3	
CO2			3	3	2	
CO3	2		3	3	2	
CO4	2		3	3	2	
CO5	2		3	3	3	

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Cloud Data Warehouse; Data Mining Methodologies: CRISP-DM and SEMMA, Comparison of Data Mining Methodologies. Statistical Limits on Data Mining, Introduction to Predictive Analytics, Technologies, Applications, Major issues (Text Book- 1)	10Hrs
UNIT – 2	Data Objects & Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. (Text Book- 1)	10Hrs
UNIT – 3	**Classification:** Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Rule-Based Classification, Model Evaluation and Selection. (Text Book- 2)	12Hrs
UNIT – 4	**Association Analysis:** Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm, *Sequential Patterns*: Preliminaries, Sequential Pattern Discovery (Text Book- 2)	12Hrs
UNIT – 5	**Cluster Analysis:** Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means, *Agglomerative Hierarchical Clustering*: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. *Mining rich data types*: Mining text data, Spatial-temporal data, Graph and networks. (Text Book- 2)	12Hrs
	Total	56Hrs

*Note:

Text Books:

1. Data Mining concepts and Techniques, 3rd edition, Jiawei Han, Michel Kamber, Elsevier, 2011.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar,

Pearson, 2012.

Reference Books:

3. Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher.
4. Data Mining Techniques, Arun K Pujari, 3rd edition, Universities Press,2013.

Online Resources: (NPTEL course by Prof.PabitraMitra)

1. http://onlinecourses.nptel.ac.in/noc17_mg24/preview
2. http://www.saedsayad.com/data_mining_map.htm

I Semester	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	L	T	P	C
		3	1	0	4

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	To apply the basic rules and theorems of probability theory such as Baye's Theorem, to determine probabilities that help to solve engineering problems and to determine the expectation and variance of a random variable from its distribution	K3
CO2	Able to perform and analyze of sampling, means, proportions, variances and estimates the maximum likelihood based on population parameters	K5
CO3	To learn how to formulate and test hypotheses about sample means, variances and proportions and to draw conclusions based on the results of statistical tests	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2	3		2
CO2	2		2	3		2
CO3	3	2	3	3		2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Basic Probability and Random Variables:** Random Experiments, Sample Spaces Events, the Concept of Probability the Axioms of Probability, Some Important Theorems on Probability Assignment of Probabilities, Conditional Probability Theorems on Conditional Probability, Independent Events, Bayes Theorem or Rule. Random Variables, Discrete Probability Distributions, Distribution Functions for Random Variables, Distribution Functions for Discrete Random Variables, Continuous Random Variables	10Hrs
UNIT – 2	**Sampling and Estimation Theory:** Population and Sample, Statistical Inference Sampling With and Without Replacement Random Samples, Random Numbers Population Parameters Sample Statistics Sampling Distributions, Frequency Distributions, Relative Frequency Distributions, Computation of Mean, Variance, and Moments for Grouped Data. Unbiased Estimates and Efficient Estimates Point Estimates and Interval Estimates. Reliability Confidence Interval Estimates of Population Parameters, Maximum Likelihood Estimates	10Hrs
UNIT – 3	**Tests of Hypothesis and Significance:** Statistical Decisions Statistical Hypotheses. Null Hypotheses Tests of Hypotheses and Significance Type I and Type II Errors Level of Significance Tests Involving the Normal Distribution One-Tailed and Two- Tailed Tests	12Hrs

	P Value Special Tests of Significance for Large Samples Special Tests of Significance for Small Samples Relationship between Estimation Theory and Hypothesis Testing Operating Characteristic Curves. Power of a Test Quality Control Charts Fitting Theoretical Distributions to Sample Frequency Distributions, The Chi-Square Test for Goodness of Fit Contingency Tables Yates' Correction for Continuity Coefficient of Contingency.)	
UNIT – 4	**Algebraic Structures and Number Theory**: Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism. Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic,Modular Arithmetic (Fermat's Theorem and Euler's Theorem)	12Hrs
UNIT – 5	**Graph Theory:** Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler's Formula, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Algorithms for Spanning Trees (Problems Only and Theorems without Proofs).	12Hrs
	Total	56Hrs

*Note:

Text Books:

1. Foundation Mathematics for Computer Science,1st edition, John Vince, Springer,2015
2. Probability & Statistics, 3rd Edition, Murray R. Spiegel, John J. Schiller and R. Alu Srinivasan, Schaum's Outline Series, Tata McGraw-Hill Publishers, 2018
3. Probability and Statistics with Reliability,2nd edition, K. Trivedi, Wiley, 2011
4. Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, H. Rosen, Tata McGraw Hill, 2003

Reference Books:

1. Probability and Computing: Randomized Algorithms and Probabilistic Analysis,1 st edition, M. Mitzenmacher and E. Upfal,2005
2. Applied Combinatorics,6th edition, Alan Tucker, Wiley,2012

I Semester	IMAGE PROCESSING (PROGRAM ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Describe and explain basic principles of digital image processing.	K3
CO2	Design and implement algorithms that perform basic image processing (e.g. noise removal and image enhancement).	K3
CO3	Design and implement algorithms for advanced image analysis (e.g. image compression, image segmentation).	K4
CO4	Assess the performance of image processing algorithms and systems	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		
CO2	3		3	3	2	2
CO3	3		3	3	2	3
CO4	2	2	3	2		3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Fundamental steps in Image Processing System, Components of Image Processing System, Elements of Visual Perception, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels. Image Enhancement Techniques: Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging	10Hrs
UNIT – 2	**Spatial filtering:** Smoothing, sharpening filters, Laplacian filters, Frequency domain filters, Smoothing and sharpening filters, Homomorphism is filtering. Image Restoration & Reconstruction: Model of Image Degradation/restoration process, Noise models, Spatial filtering, Inverse filtering, Minimum mean square Error filtering, constrained least square filtering,	10Hrs

	Geometric mean filter, Image reconstruction from projections. Color Fundamentals, Color Models, Color Transformations.	
UNIT – 3	**Image Compression:** Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Elements of Information Theory; Loss Less and Lossy Compression; Run length coding, Differential encoding, DCT, Vector quantization, Entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.	12Hrs
UNIT – 4	**Wavelet Based Image Compression:** Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous, Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding	12Hrs
UNIT – 5	**Image Segmentation:** Discontinuities, Edge Linking and boundary detection, Thresholding, Region Based Segmentation, Watersheds; Introduction to morphological operations; binary morphology- erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition. Digital Image Watermarking: Introduction, need of Digital Image Watermarking, applications of watermarking in copyright protection and Image quality analysis.	12Hrs
	Total	56Hrs

*Note:

Text Books:

1. Digital Image Processing. 2nd ed. Gonzalez, R.C. and Woods, R.E. India: Person Education,2009

Reference Books:

1. Digital Image Processing. John Wiley, Pratt, W. K, Fourth Edition-2001
2. Digital Image Processing, Jayaraman, S., Veerakumar, T. and Esakkiranjan, S.,Tata McGraw-Hill,Edition-3,2009

I Semester	SOFT COMPUTING (Program Elective-I)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the concepts in Soft Computing such as Artificial Neural Networks, Fuzzy logic-based systems, genetic algorithm-based systems and their hybrids.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Learn soft computing techniques and their applications.	K2
CO2	Analyze various neural network architectures.	K3
CO3	Define the fuzzy systems	K2
CO4	Understand the genetic algorithm concepts and their applications.	K2
CO5	Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution	K4

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3	2	
CO2	2		3	3		
CO3	1		2	2		
CO4	2		3	3	2	
CO5	3	2	3	3	3	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	Introduction to Soft Computing, Artificial neural networks, biological neurons, Basic models of artificial neural networks, Connections, Learning, Activation Functions, McCulloch and Pitts Neuron, Hebb network.	10Hrs

UNIT – 2	Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm	10Hrs
UNIT – 3	Fuzzy logic, fuzzy sets, properties, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations, Fuzzy membership functions, fuzzification, Methods of membership, value assignments, intuition, inference, rank ordering, Lambda –Cuts for fuzzy sets , Defuzzification methods	12Hrs
UNIT – 4	Truth values and Tables in Fuzzy Logic, Fuzzy propositions, Formation of fuzzy rules, Decomposition of rules, Aggregation of rules, Fuzzy Inference Systems, Mamdani and Sugeno types, Neuro-fuzzy hybrid systems, characteristics, classification	12Hrs
UNIT – 5	Introduction to genetic algorithm, operators in genetic algorithm, coding, selection, crossover, mutation, stopping condition for genetic algorithm flow, Genetic-neuro hybrid systems, Genetic Fuzzy rule based system	12Hrs
	Total	56Hrs

*Note:

Text Books:

1. S. N. Sivanandam and S. N. Deepa, Principles of soft computing–John Wiley & Sons,2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications, John Wiley & Sons, 2016.

Reference Books:

1. N.K. Sinhaand M.M. Gupta,Soft Computing & Intelligent Systems:Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network-A Comprehensive Foundation-Prentice Hall International, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
3. Driankov D., Hellendoorn H.and Reinfrank M.,An Introduction to Fuzzy Control Narosa Pub., 2001.
4. BartKosko, Neural Network and Fuzzy Systems-Prentice Hall,Inc.,Englewood Cliffs, 1992
5. Goldberg D.E, Genetic Algorithms in Search , Optimization , and Machine Learning Addison Wesley, 1989

I Semester	ADVANCED COMPUTER NETWORKS (Program Elective-I)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

1. The course is aimed at providing basic understanding of Computer networks starting with OSI Reference Model, Protocols at different layers with special emphasis on IP, TCP & UDP and Routing algorithms.
2. Some of the major topics which are included in this course are CSMA/CD, TCP/IP implementation, LANs/WANs, internetworking technologies, Routing and Addressing.
3. Provide the mathematical background of routing protocols.
4. Aim of this course is to develop some familiarity with current research problems and research methods in advance computer networks

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Illustrate reference models with layers, protocols, and interfaces.	K4
CO2	Describe routing algorithms, subnetting, and addressing in IPv4 and IPv6.	K3
CO3	Analyze basic network protocols and their use in network design and implementation.	K3
CO4	Describe concepts related to wireless networks such as WLANs, WiMAX, IEEE 802.11, cellular and satellite systems.	K4
CO5	Describe emerging network trends such as MANETs and Wireless Sensor Networks (WSNs).	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3	2		3	3		2
CO4			2	2		
CO5			2	2	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Network layer:** Network Layer design issues: store-and forward packet switching, services provided transport layers, implementation connection less services, implementation connection oriented services, comparison of virtual – circuit and datagram subnets, Routing Algorithms-shortest	12Hrs

	path routing, flooding, distance vector routing, link state routing, Hierarchical routing, congestion control algorithms : Approaches to congestion control, Traffic aware routing, Admission control, Traffic throttling, choke Packets, Load shedding, Random early detection, Quality of Service, Application requirements, Traffic shaping, Leaky and Token buckets.	
UNIT – 2	**Internetworking and IP protocols:** How networks differ, How networks can be connected, internetworking, tunneling, The network layer in the internet, IPV4 Protocol, IP addresses, Subnets, CIDR, classful and Special addressing, network address translation (NAT),IPV6 Address structure address space, IPV6 Advantages, packet format, extension Headers, Transition from IPV4 to IPV6 , Internet Control Protocols-IMCP, ARP, DHCP.	12Hrs
UNIT – 3	**Transport Layer Protocols**: Introduction, Services, Port numbers, User Datagram Protocol: User datagram, UDP services, UDP Applications, Transmission control Protocol: TCP services, TCP features, Segment, A TCP connection, State transition diagram, Windows in TCP, Flow control and error control, TCP Congestion control, TCP Timers, SCTP: SCTP services SCTP features, packet format, An SCTP association, flow control, error control	12Hrs
UNIT – 4	**Wireless LANS:** Introduction, Architectural comparison, Access control, The IEEE 802.11 Project: Architecture, MAC sub layer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Bluetooth Layers Other Wireless Networks: WIMAX: Services, IEEE project 802.16, Layers in project 802.16, Cellular Telephony: Operations, First Generation (1G), Second Generation (2G), Third Generation (3G), Fourth Generation (4G), Satellite Networks: Operation, GEO Satellites, MEO satellites, LEO satellites	12Hrs
UNIT – 5	**Emerging trends in Computer networks: Mobile computing:** Motivation for mobile computing, Protocol stack issues in mobile computing environment, mobility issues in mobile computing, security issues in mobile networks, MOBILE Ad Hoc Networks: Applications of Ad Hoc Networks, Challenges and Issues in MANETS, MAC Layer Issues Routing Protocols in MANET, Transport Layer Issues, Ad hoc Network Security **Wireless Sensor Networks:** WSN functioning, Operating system support in sensor devices, WSN characteristics, sensor network operation, Sensor Architecture: Cluster management, Wireless Mesh Networks: WMN design, Issues in WMNs, Computational Grids, Grid Features, Issues in Grid construction design, Grid design features,P2P Networks:	12Hrs

	Characteristics of P2P Networks, Classification of P2P systems, Gnutella, BitTorrent, Session Initiation Protocol(SIP) , Characteristics and addressing, Components of SIP, SIP establishment, SIP security.	
	Total	60Hrs

*Note:

Text Books:

1. Data communications and networking 4th edition Behrouz A Fourzan,TMH- 2007
2. Computer networks 4th edition Andrew S Tanenbaum, Pearson,2012
3. Computer networks, Mayank Dave,CENGAGE, First edition.2012

Reference Books:

1. Computer networks, A system Approach, 5thed, Larry L Peterson and Bruce S Davie, Elsevier-2012.

I Semester	ADVANCED SOFTWARE ENGINEERING (PROGRAM ELECTIVE-I)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

1. This course is designed to provide an in depth understanding of phases of Software Development, common process models including Waterfall, the Unified Process, hands-on experience with elements of the agile process, a variety of Software Engineering practices such as requirements analysis and specification, code analysis, code debugging, testing, and Software Design techniques.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Demonstrate software process, various models and Agile methodologies	K4
CO2	Analyze and Specify software requirements through a SRS documents	K5
CO3	Design and Plan software solutions to problems	K3
CO4	Analyze the importance of Quality assurance and design, implement, and execute test cases at the Unit level.	K5
CO5	Design, implement, and execute test cases at Integration level and analyze the role of various metrics	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		2
CO2	2		3	3		2
CO3	3	2	3	3		3
CO4	2		3	3		3
CO5	2		3	3		3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Software and Software Engineering:** Nature of software, Software Process, Software Engineering Practice. Process Models: Generic process model, defining a framework activity, identifying task set, process assessment and improvement, perspective process models Aglity	10Hrs

	and process: Agility, Agile process, Scrum, other Agile frameworks, recommended process model	
UNIT – 2	**Human aspects of Software Engineering:** characteristics and psychology of Software Engineer, software team, team structure. **Principles that guide practice:** core principles, principles that guide each framework activity. **Understanding Requirements:** Requirements engineering, establishing groundwork, requirements gathering, developing use cases, building analysis model, negotiating requirements, requirements monitoring, validating Requirements **Requirements modeling:** requirements analysis, class-based modeling, functional modeling, behavioral modeling.	12Hrs
UNIT – 3	**Design: Design process, design concepts, design model Architectural design:** software architecture, architectural styles, architectural design, assessing alternative architectural designs. **User experience design:** elements, golden rules, User interface analysis and design, user experience analysis, user interface design, design evaluation, usability and accessibility **Design for mobility:** mobile development life cycle, mobile architecture, web design pyramid, , mobility and design quality, best practices.	12Hrs
UNIT – 4	**Quality: software quality, quality dilemma, achieving software quality Reviews:** review metrics, Informal reviews, Formal technical reviews. **Software Quality Assurance:** elements, SQA process, Product characteristics, SQA tasks, goals and metrics, statistical software quality assurance, software reliability, ISO 9000 quality standards, SQA plan. **Software testing:** strategic approach to software testing, planning and recordkeeping, test case design, white box testing, black box testing, object oriented testing.	12Hrs
UNIT – 5	**Software testing- integration level:** Software testing fundamentals, integration testing, regression testing, integration testing in OO context, validation testing. **Software testing- testing for mobility:** mobile testing guidelines, testing strategies, User experience testing issues, web application testing, Web testing strategies, security testing, performance testing. **Software metrics and analytics:** software measurement, software analytics, product metrics, metrics for testing, metrics for maintenance, process and project metrics, software measurement, metrics for software quality	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. "Software Engineering, A practitioner's Approach", Roger S. Pressman, Bruce R. Maxim, 9th Edition, Tata McGraw-Hill.
2. "Software Engineering", Ian Sommerville, 9th edition, Pearson education

Reference Books:

1. Software Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

I Semester	TIME SERIES ANALYSIS (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

1. The main objective of the course is to introduce a variety of statistical models for time series and cover the main methods for analyzing these models

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	formulate real life problems using time series models	K1
CO2	Describe the statistical software to estimate the models from real data, and draw conclusions and develop solutions from the estimated models.	K3
CO3	Explain the visual and numerical diagnostics to assess the soundness of their models	K2
CO4	Develop to communicate the statistical analyses of substantial data sets through explanatory text, tables and graphs	K5
CO5	combine and adapt different statistical models to analyse larger and more complex data	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		3
CO2	2		3	3	2	3
CO3	3	2	3	3		2
CO4	2		2	2		2
CO5	2		3	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION OF TIMESERIES ANALYSIS:** Introduction to Time Series and Forecasting, Different types of data, Internal structures of time series. Models for time series analysis, Autocorrelation and Partial autocorrelation. Examples of Time series Nature and uses of forecasting, Forecasting Process, Data for forecasting, Resources for forecasting	10Hrs

UNIT – 2	**STATISTICS BACKGROUND FOR FORECASTING:** Graphical Displays, Time Series Plots, Plotting Smoothed Data, Numerical Description of Time Series Data, Use of Data Transformations and Adjustments, General Approach to Time Series Modeling and Forecasting, Evaluating and Monitoring Forecasting Model Performance	12Hrs
UNIT – 3	**TIME SERIES REGRESSION MODEL:** Introduction Least Squares Estimation in Linear Regression Models, Statistical Inference in Linear Regression, Prediction of New Observations, Model Adequacy Checking, Variable Selection Methods in Regression, Generalized and Weighted Least Squares, Regression Models for General Time Series Data, Exponential Smoothing, First order and Second order	12Hrs
UNIT – 4	**AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA)MODELS:** Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Detecting Nonstationarity, Autoregressive Integrated Moving Average (ARIMA) Models, Forecasting using ARIMA, Seasonal Data, Seasonal ARIMA Models Forecasting using Seasonal ARIMA Models Introduction, Finding the "BEST" Model. **Example:** Internet Users Data Model Selection Criteria, Impulse Response Function to Study the Differences in Models Comparing Impulse Response Functions for Competing Models.	12Hrs
UNIT – 5	**MULTIVARIATE TIME SERIES MODELS AND FORECASTING:** Multivariate Time Series Models and Forecasting, Multivariate Stationary Process, Vector ARIMA Models, Vector AR (VAR) Models, Neural Networks and Forecasting Spectral Analysis, Bayesian Methods in Forecasting.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Introduction To Time Series Analysis And Forecasting, 2nd Edition, Wiley Series In Probability And Statistics, By Douglas C. Montgomery, Cheryl L. Jen(2015)
2. Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek PalDr. PksPrakash (2017)

I Semester	HIGH PERFORMANCE COMPUTING (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

1. The main objective of the course is to introduce a variety of statistical models for time series and cover the main methods for analyzing these models

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Describe different parallel architectures, inter-connect networks, programming models	K3
CO2	Develop an efficient parallel algorithm to solve given problem	K4
CO3	Analyze and measure performance of modern parallel computing systems	K5
CO4	Build the logic to parallelize the programming task	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		
CO2	3		3	3	2	3
CO3	3		3	3	2	3
CO4	3		3	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi- core architecture.	10Hrs
UNIT – 2	**Parallel Programming:** Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for	12Hrs

	Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.	
UNIT – 3	**Basic Communication:** Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads- basics, synchronization, OpenMP programming	12Hrs
UNIT – 4	**Analytical Models:** Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. **Dense Matrix Algorithms:** Matrix Vector Multiplication, Matrix-Matrix Multiplication.	12Hrs
UNIT – 5	**Parallel Algorithms- Sorting and Graph :** Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best First Search. **CUDA Architecture:** CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

Reference Books

1. Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 780124159884
3. David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A Hardware/ Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, “Essential Algorithms”, Wiley, ISBN: ISBN: 978-1-118-61210-1

I Semester	AGILE METHODOLOGIES (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Objectives: This course is aimed at enabling the students to

1. The main objectives of this course are to introduce the important concepts of Agile software development Process, emphasize the role of stand-up meetings in software collaboration, impart the knowledge on values and principles in understanding agility

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Understand the core values and mindset of Agile Methodology for effective project development	K1
CO2	Explain Agile Principles and apply them in Agile Project management practices	K3
CO3	Describe Key concepts of XP, Simplicity, and Incremental Design	K2
CO4	Apply Lean Principles to identify and Eliminating Waste in software processes	K4

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3	2	2
CO2	2	2	3	3	2	3
CO3	2		3	3		2
CO4	3		3	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Learning Agile**: Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue, adding Agile makes a difference. A fractured perspective, How a fractured perspective causes project problems. The Agile Manifesto, Purpose behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software over Comprehensive Documentation, Customer Collaboration over Contract Negotiation, Responding to Change over Following a Plan, Principles over Practices. Understanding the Elephant,	10Hrs

	Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology	
UNIT – 2	**The Agile Principles:** The 12 Principles of Agile Software, The Customer Is Always Right, "Do As I Say, Not As I Said". Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together	12Hrs
UNIT – 3	**SCRUM and Self-Organizing Teams:** The Rules of Scrum, Act I: I Can Haz Scrum?, Everyone on a Scrum Team owns the Project, The Scrum Master Guides the Team's Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values ,Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental?, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint **Scrum Planning And Collective Commitment:** Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call It Scrum), Is Your Company's Culture Compatible with Scrum Values.	12Hrs
UNIT – 4	**XP And Embracing Change:** Going into Overtime, The Primary Practices of XP, Programming Practices, Integration Practices, Planning Practices, Team Practices, Why Teams Resist Changes, and How the Practices Help. The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, XP Helps Developers Learn to Work with Users, Practices Only "Stick" When the Team Truly Believes in Them, An Effective Mindset Starts with the XP Values, The XP Values, Paved with Good Intentions. The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change, The Principles of XP, XP Principles Help You Understand Planning, XP Principles Help You Understand Practices—and Vice Versa, Feedback Loops. **XP, Simplicity, and Incremental Design:** Code and Design, Code Smells and Antipatterns (or, How to Tell If You're Being Too Clever), XP Teams Look for Code Smells and Fix Them, Hooks, Edge Cases, and Code That Does Too Much. Make Code and Design Decisions at the Last Responsible Moment, Fix Technical Debt by Refactoring Mercilessly, Use Continuous Integration to Find Design Problems, Avoid Monolithic Design, Incremental Design and the Holistic XP Practices. Teams Work Best When They Feel Like They Have Time to Think, Team Members Trust Each Other and Make Decisions Together. The XP Design,	12Hrs

	Planning, Team, and Holistic Practices Form an Ecosystem Incremental Design Versus Designing for Reuse, When Units Interact in a Simple Way, the System Can Grow Incrementally, Great Design Emerges from Simple Interactions, Final Score.	
UNIT – 5	**Lean, Eliminating Waste, and Seeing the whole:** Lean Thinking, Commitment, Options Thinking, and Set-Based Development, Creating Heroes and Magical Thinking. Eliminate Waste, Use a Value Stream Map to Help See Waste Clearly, Gain a Deeper Understanding of the Product, See the Whole, Find the Root Cause of Problems That You Discover. Deliver As Fast As Possible, Use an Area Chart to Visualize Work in Progress, Control Bottlenecks by Limiting Work in Progress. **Kanban, Flow, and Constantly Improving:** The Principles of Kanban, Find a Starting Point and Evolve Experimentally from There. Stories Go into the System; Code Comes Out, Improving Your Process with Kanban, Visualize the Workflow, Limit Work in Progress. Measure and Manage Flow, Managing Flow with WIP Limits Naturally Creates Slack. Make Process Policies Explicit So Everyone Is on the Same Page. Emergent Behavior with Kanban. **The Agile Coach:** Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

Reference Books:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013

I Semester	ADVANCED COMPILER DESIGN (PROGRAM ELECTIVE-II)	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Demonstrate various phases involved in the design of compiler	K4
CO2	Organize and apply Syntax Analysis Techniques such as Top Down Parsing and LL(1) grammars	K3
CO3	Design Bottom Up Parsing and Construct LR parsers	K4
CO4	Analyse synthesized, inherited attributes and syntax directed translation schemes	K5
CO5	Determine appropriate algorithms for a target code generation	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		2
CO2			3	3		
CO3	2		3	3		2
CO4	3		3	3		2
CO5	3		3	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Lexical Analysis:** Language Processors, Structure of a Compiler, Lexical Analysis, The Role of the Lexical Analyzer, Bootstrapping, Input Buffering, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator-LEX, Finite Automata, Regular Expressions and Finite Automata, Design of a Lexical Analyzer Generator.	10Hrs
UNIT – 2	**Syntax Analysis:** The Role of the Parser, Context-Free Grammars, Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring, Top Down Parsing: Pre Processing Steps of Top Down Parsing, Backtracking, Recursive Descent Parsing, LL (1) Grammars, Non-recursive Predictive Parsing, Error Recovery in Predictive Parsing	12Hrs
UNIT – 3	**Bottom Up Parsing:** Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers,	12Hrs

	Construction of SLR Parsing Tables, More Powerful LR Parses, Construction of CLR (1) and LALR Parsing Tables, Dangling Else Ambiguity, Error Recovery in LR Parsing, Handling Ambiguity Grammar with LR Parsers	
UNIT – 4	**Syntax Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's. Intermediate Code Generation: Variants of Syntax Trees, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Backpatching, Intermediate Code for Procedures.	12Hrs
UNIT – 5	**Run Time Environments:** Storage Organization, Run Time Storage Allocation, Activation Records, Procedure Calls, Displays, Code Optimization: The Principle Sources of Optimization, Basic Blocks, Optimization of Basic Blocks, Structure Preserving Transformations, Flow Graphs, Loop Optimization, Data-Flow Analysis, Peephole Optimization, Code Generation: Issues in the Design of a Code Generator, Object Code Forms, Code Generation Algorithm, Register Allocation and Assignment.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson Publishers,2007

Reference Books:

1. Compiler Construction, Principles and Practice, Kenneth C Louden,Cengage Learning, 2006
2. Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
3. Optimizing Compilers for Modern Architectures, Randy Allen, Ken Kennedy, Morgan Kauffmann, 2001.
4. Levine, J.R., T. Mason and D. Brown, Lex and Yacc, edition, O'Reilly & Associates, 1990

I Semester	DATA STRUCTURES ALGORITHM & ANALYSIS LAB	L	T	P	C
		0	1	2	2

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Ability to write and analyze algorithms for algorithm correctness and efficiency	K2
CO2	Master a variety of advanced abstract data type (ADT) and data structures and their Implementation.	K4
CO3	Demonstrate various searching, sorting and hash techniques and be able to apply and solve problems of real life	K4
CO4	Design and implement variety of data structures including linked lists, binary trees, heaps, graphs and search trees	K3
CO5	Ability to compare various search trees and find solutions for IT related problems	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2	3		
CO2			3	3		
CO3			3	3		2
CO4			3	3		3
CO5			3	3	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
Experiment– 1	Write a java program to perform various operations on single linked list	10Hrs
Experiment– 2	Write a java program for the following a) Reverse a linked list b) Sort the data in a linked list c) Remove duplicates d) Merge two linked lists	12Hrs
Experiment– 3	Write a java program to perform various operations on doubly linked list	12Hrs
Experiment– 4	Write a java program to perform various operations on circular linked list	

Experiment– 5	Write a java program for performing various operations on stack using linked list	12Hrs
Experiment– 6	Write a java program for performing various operations on queue using linked list	12Hrs
Experiment– 7	Write a java program for the following using stack a) Infix to postfix conversion. b) Expression evaluation. c) Obtain the binary number for a given decimal number.	
Experiment– 8	Write a java program to implement various operations on Binary Search Tree Using Recursive and Non-Recursive methods.	
Experiment– 9	Write a java program to implement the following for a graph. a) BFS b) DFS	
Experiment– 10	Write a java program to implement Merge & Heap Sort of given elements	
Experiment– 11	Write a java program to implement Quick Sort of given elements	
Experiment– 12	Write a java program to implement various operations on AVL trees	
Experiment– 13	Write a java program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree	
Experiment– 14	Write a java program to implementation of recursive and non-recursive functions to Binary tree Traversals	
Experiment– 15	Write a java program to implement all the functions of Dictionary (ADT) using Hashing	
	Total	58Hrs

*Note:

I Semester	ADVANCED DATA WAREHOUSING AND DATA MINING LAB	L	T	P	C
		0	1	2	2

Pre-requisites: Data Base Management Systems, Python Programming

COURSE OBJECTIVES: The main objective of the course is to

- Inculcate Conceptual, Logical, and Physical design of Data Warehouses OLAP applications and OLAP deployment
- Design a data warehouse or data mart to present information needed by management in a form that is usable
- Emphasize hands-on experience working with all real data sets.
- Test real data sets using popular data mining tools such as WEKA, Python Libraries
- Develop ability to design various algorithms based on data mining tools.

Software Requirements: WEKA Tool/Python/R-Tool/Rapid Tool/Oracle Data mining

UNIT	CONTENTS	Contact Hours
Experiment– 1	Creation of a Data Warehouse. ➢ Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects,etc.,) ➢ Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc). ➢ Write ETL scripts and implement using data warehouse tools. ➢ Perform Various OLAP operations such slice, dice, roll up, drill up and pivot	10Hrs
Experiment– 2	Explore machine learning tool “WEKA” ➢ Explore WEKA Data Mining/Machine Learning Toolkit. ➢ Downloading and/or installation of WEKA data mining toolkit. ➢ Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface. ➢ Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel) ➢ Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.) ➢ Load each dataset and observe the following:	12Hrs

	1. List the attribute names and they types 2. Number of records in each dataset 3. Identify the class attribute (if any) 4. Plot Histogram 5. Determine the number of records for each class. 6. Visualize the data in various dimensions	
Experiment– 3	Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets ➢ Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset ➢ Load weather. nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values. ➢ Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated. ➢ Derive interesting insights and observe the effect of discretization in the rule generation process.	12Hrs
Experiment– 4	Demonstrate performing classification on data sets Weka/R ➢ Load each dataset and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic. ➢ Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix. ➢ Load each dataset into Weka/R and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained. ➢ Plot RoC Curves ➢ Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.	
Experiment– 5	Demonstrate performing clustering of data sets ➢ Load each dataset into Weka/R and run simple k-means clustering algorithm with different values of k (number of desired clusters). ➢ Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights. ➢ Explore other clustering techniques available in Weka/R. Explore visualization features of Weka/R to visualize the clusters. Derive interesting insights and explain	12Hrs

Experiment– 6	Demonstrate knowledge flow application on data sets into Weka/R ➢ Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms ➢ Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree	12Hrs
Experiment– 7	Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations	
Experiment– 8	Write a java program to prepare a simulated data set with unique instances	
Experiment– 9	Write a Python program to generate frequent item sets / association rules using Apriori algorithm	
Experiment– 10	Write a program to calculate chi-square value using Python/R. Report your observation.	
Experiment– 11	Implement a Java/R program to perform Apriori algorithm	
Experiment– 12	Write a R program to cluster your choice of data using simple k-means algorithm using JDK	
Experiment– 13	Write a program of cluster analysis using simple k-means algorithm Python/R programming language	
Experiment– 14	Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python	
Experiment– 15	Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)	
	Total	58Hrs

II Semester	MACHINE LEARNING	L	T	P	C
		3	1	0	4

Course Objectives:

The objectives of the course are to

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

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Enumerate the Fundamentals of Machine Learning	K2
CO2	Build Nearest Neighbour based models	K2
CO3	Apply Models based on decision trees and Bayes rule	K4
CO4	Choose appropriate clustering technique	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3		
CO2	2		3	3	2	2
CO3	2		3	3	2	2
CO4	3		3	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**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	10Hrs

UNIT – 2	**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	12Hrs
UNIT – 3	**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)	12Hrs
UNIT – 4	**: 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 Perceptron's (MLPs), Backpropagation for Training an MLP	12Hrs
UNIT – 5	**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	12Hrs
	Total	58Hrs

*Note:

Text Books:

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

Reference Books:

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

II Semester	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	1	0	4

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

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- 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, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Demonstrate a given text with basic Language features	K5
CO2	Design an innovative application using NLP components	K3
CO3	Explain a rule based system to tackle morphology/syntax of a language	K3
CO4	Design a tag set to be used for statistical processing for real-time applications	K3
C05	compare and contrast the use of different statistical approaches for different types of NLP applications	K5

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3		
CO2	3	2	3	3	3	3
CO3	2		3	3		
CO4	2		3	3	2	
CO5	2	2	3	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION:** Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and	10Hrs

	rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance	
UNIT – 2	**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	12Hrs
UNIT – 3	**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	12Hrs
UNIT – 4	**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.	12Hrs
UNIT – 5	**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	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin - Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

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

II Semester	INTRODUCTION TO QUANTUM COMPUTING	L	T	P	C
		3	1	0	4

Course Objectives: The main objectives of the course are to

- Introduce fundamental concepts of quantum mechanics and its mathematical formalism.
- Explore quantum computing and communication principles and technologies.
- Understand the physical implementation and limitations of quantum systems.
- Enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
- Familiarize students with the emerging trends in quantum technologies

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Describe the Historical development of quantum theory and its relevance to modern computing	K2
CO2	Define Qubits and Compare the Classical vs. quantum information	K4
CO3	Explain the Classical computing review and limitations	K3
CO4	Demonstrate the principles and techniques of Quantum error correction	K4
C05	Discuss the working, applications and potential of Quantum sensors in real-world scenarios	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2			
CO2	2		3	3		
CO3	2		3	2		
CO4	3		3	3	2	1
CO5	2		2	2	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**History of Quantum Computing:** Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations	10Hrs

UNIT – 2	**Background Mathematics**: Basics of Linear Algebra, Hilbert space, Probabilities and measurements. **Background Physics:** Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Background Biology: Basic concepts of Genomics and Proteomics (Central Dogma)	12Hrs
UNIT – 3	**Qubit:** Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.	12Hrs
UNIT – 4	**Quantum Algorithms:** Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm	12Hrs
UNIT – 5	**Noise and error correction:** Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

II Semester	FEATURE ENGINEERING (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Describe the Basic concepts of Data, Tasks, Models, Features and Model building	K2
CO2	Explain the concept of coverting Text into Flat Vectors using Bag- of-Words, and Bag-of-n-Grams	K3
CO3	Demonstrate techniques for Dimensionality Reduction	K4
CO4	Discuss non linear Featurization	K4
C05	Explain the concept of Item-Based Collaborative Filtering	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	2		
CO2	2		3	3		
CO3	3		3	3	2	
CO4	3		3	3	2	1
CO5	2		2	3	3	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**The Machine Learning Pipeline:** Data, Tasks, Models, Features, Model Evaluation Fancy Tricks with Simple Numbers: Scalars, Vectors, and Spaces, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Log Transform in Action, Power Transforms: Generalization of the Log Transform, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling), ℓ2 Normalization, Interaction Features, Feature Selection	10Hrs
UNIT – 2	**Text Data: Flattening, Filtering, and Chunking: Bag-of-X:** Turning Natural Text into Flat Vectors, Bag- of-Words, Bag-of-n-Grams, Filtering for Cleaner Features: Stopwords, Frequency-Based Filtering, Stemming; Atoms of Meaning: From Words to n-Grams to Phrases: Parsing and Tokenization, Collocation Extraction for Phrase Detection The Effects of Feature Scaling: From Bag-of-Words to Tf-Idf :Tf-Idf : A Simple Twist on Bag-of- Words, Putting It to the Test : Creating a Classification Dataset,	12Hrs

	Scaling Bag-of-Words with Tf-Idf Transformation, Classification with Logistic Regression, Tuning Logistic Regression with Regularization	
UNIT – 3	**Categorical Variables:** Counting Eggs in the Age of Robotic Chickens: Encoding Categorical Variables: One-Hot Encoding, Dummy Coding, Effect Coding, Pros and Cons of Categorical Variable Encodings; Dealing with Large Categorical Variables: Feature Hashing, Bin Counting. **Dimensionality Reduction:** Squashing the Data Pancake with PCA: Intuition, Derivation: Linear Projection, Variance and Empirical Variance, Principal Components: First Formulation, Principal Components: Matrix-Vector Formulation, General Solution of the Principal Components; Transforming Features, Implementing PCA: PCA in Action, Whitening and ZCA, Considerations and Limitations of PCA	12Hrs
UNIT – 4	**Nonlinear Featurization via K-Means Model Stacking:** k-Means Clustering, Clustering as Surface Tiling, k-Means Featurization for Classification: Alternative Dense Featurization, Pros, Cons, and Gotchas	12Hrs
UNIT – 5	**Item-Based Collaborative Filtering, First Pass:** Data Import, Cleaning, and Feature Parsing, Academic Paper Recommender: Naive Approach, Second Pass: More Engineering and a Smarter Model, Academic Paper Recommender: Take 2, Third Pass: More Features is More Information, Academic Paper Recommender: Take 3	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. "Feature Engineering for Machine Learning Principles and Techniques for Data Scientists", Alice Zheng& Amanda Casari, O'REILLY, 2018
2. "Feature Engineering and Selection: A Practical Approach for Predictive Models", Max Kuhn, Kjell Johnson, CRC Press, 2019

II Semester	GENERATIVE AI (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn Python and TensorFlow skills for Generative AI.
2. To study techniques for cleaning and preparing data for Generative AI tasks.
3. To implement generative AI models
4. To develop innovative applications using generative AI tools and techniques.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Implement Python and TensorFlow basics, including data handling and preprocessing techniques	K5
CO2	Implement Generative AI models such as GANs, VAEs, LSTM networks, and Transformer models for image text, and music generation tasks	K4
CO3	Evaluate model performance and experiment with hyper parameters and optimization techniques to enhance Generative AI outcomes.	K6
CO4	Develop innovative applications in image, text, and music generation, showcasing practical skills	K5

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3	2	
CO2	3		3	3	3	1
CO3	3		3	3	3	2
CO4	3	2	3	3	3	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction To Gen Ai:** Historical Overview of Generative modelling, Difference between Gen AI and Discriminative Modeling, Importance of generative models in AI and Machine Learning, Types of Generative models, GANs, VAEs, autoregressive models and Vector quantized Diffusion models, Understanding if probabilistic modeling and generative process, Challenges of Generative Modeling, Future of Gen AI, Ethical Aspects of AI, Responsible AI, Use Cases	10Hrs
UNIT – 2	**Generative Models For Text:** Language Models Basics, Building blocks of Language models, Transformer Architecture, Encoder and Decoder, Attention mechanisms, Generation of Text, Models like BERT	12Hrs

	and GPT models, Generation of Text, Autoencoding, Regression Models, Exploring ChatGPT, Prompt Engineering: Designing Prompts, Revising Prompts using Reinforcement Learning from Human Feedback (RLHF), Retrieval Augmented Generation, Multimodal LLM, Issues of LLM like hallucination	
UNIT – 3	**Generation of Images:** Introduction to Generative Adversarial Networks, Adversarial Training Process, Nash Equilibrium, Variational Autoencoders, Encoder-Decoder Architectures, Stable Diffusion Models, Introduction to Transformer-based Image Generation, CLIP, Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V, Issues of Image Generation models like Mode Collapse and Stability.	12Hrs
UNIT – 4	**Generation of Painting, Music, and Play:** Variants of GAN, Types of GAN, Cyclic GAN, Using Cyclic GAN to Generate Paintings, Neural Style Transfer, Style Transfer, Music Generating RNN, MuseGAN, Autonomous agents, Deep Q Algorithm, Actor-critic Network.	12Hrs
UNIT – 5	**Open Source Models And Programming Frameworks**: Training and Fine tuning of Generative models, GPT 4 All, Transfer learning and Pretrained models, Training vision models, Google Copilot, Programming LLM, LangChain, Open Source Models, Llama, Programming for TimeSformer, Deployment, Hugging Face.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Denis Rothman, “Transformers for Natural Language Processing and Computer Vision”, Third Edition , Packt Books, 2024

Reference Books:

1. David Foster, ”Generative Deep Learning”, O’Reily Books, 2024.
2. Altaf Rehmani, “Generative AI for Everyone”, BlueRose One, 2024.

II Semester	ADHOC SENSOR NETWORKS (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understandings of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Describe fundamentals of wireless communication, wireless propagation, and challenges in adhoc and sensor networks	K2
CO2	Analyze MAC layer issues and protocols in adhoc networks including IEEE 802.11	K4
CO3	Evaluate routing and transport layer protocols in adhoc wireless networks and explain their security considerations	K5
CO4	Explain WSN architecture ,sensor node components and MAC protocols including IEEE 802.15.4	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3		1
CO2	2		2	3	2	
CO3	3	2	3	3	2	2
CO4	2		3	3	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction:** Fundamentals of Wireless Communication Technology, The Electromagnetic Spectrum, Radio propagation Mechanisms, Characteristics of the Wireless channel mobile ad hoc networks (MANETs), Wireless Sensor Networks (WSNs): concepts and architectures, Applications of Ad Hoc and Sensor Networks, Design Challenges in Ad hoc and Sensor Networks	10Hrs

UNIT – 2	**MAC Protocols for Ad Hoc Wireless Networks:** Issues in designing a MAC Protocol, Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, Classification of MAC Protocols, Contention based protocols, Contention based protocols with Reservation Mechanisms, Contention based protocols with Scheduling Mechanisms, Multi-channel MAC – IEEE 802.11.	12Hrs
UNIT – 3	**Routing Protocols and Transport Layer In Ad Hoc Wireless Networks:** Routing Protocol: Issues in designing a routing protocol for Ad hoc networks, Classification, proactive routing, reactive routing (on-demand), hybrid routing, Transport Layer protocol for Ad hoc networks, Design Goals of a Transport Layer Protocol for AdHoc Wireless Networks, Classification of Transport Layer solutions-TCP over Ad hoc wireless, Network Security, Security in Ad Hoc Wireless Networks, Network Security Requirements.	12Hrs
UNIT – 4	**Wireless Sensor Networks (WSNS) And Mac Protocols:** Single node architecture - hardware and software components of a sensor node, WSN Network architecture: typical network architectures, data relaying and aggregation strategies, MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4.	12Hrs
UNIT – 5	**: WSN Routing, Localization & Qos:** Issues in WSN routing, OLSR, Localization, Indoor and Sensor Network Localization, absolute and relative localization, triangulation, QOS in WSN, Energy Efficient Design, Synchronization.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Ad Hoc Wireless Networks: Architectures and Protocols ", C. Siva Ram Murthy, and B. S. Manoj, Pearson Education, 2008
2. "Wireless Adhoc and Sensor Networks", Labiod. H, Wiley, 1 st edition-2008
3. "Wireless ad -hoc and sensor Networks: theory and applications", Li, X, Cambridge University Press, fifth edition-2008.

Reference Books:

1. "Ad Hoc & Sensor Networks: Theory and Applications", 2nd edition, Carlos De MoraisCordeiro, Dharma Prakash Agrawal ,World Scientific Publishing Company, 2011
2. Wireless Sensor Networks Feng Zhao and LeonidesGuibas,Elsevier Publication 2nd edition-2004
3. "Protocols and Architectures for Wireless Sensor Networks", Holger Karl and Andreas Willig,Wiley, 2005 (soft copy available)
4. "Wireless Sensor Networks Technology, Protocols, and Applications", KazemSohraby, Daniel Minoli, &TaiebZnati, John Wiley, 2007. (soft copy available)

II Semester	CRYPTOGRAPHY & NETWORK SECURITY (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand the basic categories of threats to computers and networks
- Discusses the Mathematics of Cryptography
- Discuss the fundamental ideas of Symmetric and Asymmetric Cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application Layer Protocols Enhanced security mechanisms

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

CO	Course Outcomes	Knowledge Level (K)#
CO1	Understand security issues related to computer networks and learn different symmetric key techniques	K2
CO2	Apply mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	K3
CO3	Understand and Compare different types of symmetric and Asymmetric algorithms	K2
CO4	Explain Hash functions, message authentication and digital signature and their importance to the security	K2
CO5	Analyze enhanced security protocols at various network layer,	K4

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3		2
CO2	2		3	3	2	1
CO3	1		2	3		2
CO4	2	2	3	3		3
CO5	3	2	3	3	2	3

(Please fill the above with Levels of Correlation, viz., L-1, M-2, H-3)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**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.Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stegnography.	10Hrs
UNIT – 2	**Introduction to Symmetric Cryptography: Algebraic Structures**-Groups, Rings, Fields, GF(2^n) fields, Polynomials.**Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm.	12Hrs
UNIT – 3	**Symmetric key Ciphers:** Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5 **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	12Hrs
UNIT – 4	**Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA) **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S,MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.	12Hrs
UNIT – 5	**Network and Internet Security: Transport-Level Security:** Web Security Considerations, Transport Level Security, HTTPS, SSH. **IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication Header Protocol. **Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.	12Hrs
	Total	58Hrs

*Note:

TEXT BOOKS:

1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

REFERENCE BOOKS:

1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice By Wenbo Mao. Pearson

II Semester	BLOCK CHAIN TECHNOLOGIES (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

- Architect sensor networks for various application setups.
- Devise appropriate data dissemination protocols and model links cost.
- Understandings of the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols at various layers.
- Evaluate the performance of sensor networks and identify bottlenecks

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Discuss the Cryptographic primitives used in Blockchain (K2)	K2
CO2	Discuss about various technologies borrowed in blockchain (K2)	K2
CO3	Illustrate various models for blockchain (K2)	K2
CO4	Discuss about Ethereum (K2)	K2
CO5	Discuss about Hyperledger Fabric (K2)	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		2	3	2	2
CO2	1		2	2	3	2
CO3			2	2	2	
CO4			2	2	3	2
CO5			2	2	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**INTRODUCTION TO BLOCKCHAIN:** Introduction, history of Bitcoin and origins of Blockchain, Fundamentals of Blockchain and key components **(Chapter 1-book1),** Permission and Permission-less platforms**(Chapter 1-book2),** Introduction to Cryptography, SHA256 and ECDSA, Hashing and Encryption, Symmetric/ Asymmetric keys, Private and Public Keys(**Chapter 3-book2**).	10Hrs

UNIT – 2	**TECHNOLOGIES BORROWED IN BLOCKCHAIN:** Technologies Borrowed in Blockchain –hash pointers- - Digital cash etc.- Bitcoin blockchain - Wallet – Blocks Merkley Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending - Mathematical analysis of properties of Bitcoin - Bitcoin- the challenges and solutions. (**Chapter 3-book2)**.	12Hrs
UNIT – 3	**CONSENSUS MECHANISMS : Consensus Algorithms:** Proof of Work (PoW) as random oracle -Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains -Hybrid models (PoW + PoS), Byzantine Models of fault tolerance. ((**Chapter 1-book2)**)	12Hrs
UNIT – 4	**ETHEREUM:** Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum -Solidity - Smart Contracts **(Chapter 5-book1),** - The Turing Completeness of Smart Contract Languages and verification challenges- Using smart contracts to enforce legal contracts- Comparing Bitcoin scripting vs. Ethereum Smart Contracts-Some attacks on smart contracts **(Chapter 6 and Chapter 7-book2)**	12Hrs
UNIT – 5	**HYPERLEDGER FABRIC:** Hyperledger fabric- the plug and play platform and mechanisms in permissioned blockchain - Beyond Cryptocurrency – applications of blockchain in cyber security- integrity of information- E-Governance and other contract enforcement mechanisms - Limitations of blockchain as a technology and myths vs reality of blockchain technology **(Chapter 16-book1), (Chapter 9 - book2)**	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Blockchain Technology Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, University Press, 2020.
2. Mastering Blockchain - Distributed ledger technology, decentralization, and smart contracts explained, Imran Bashir,2nd ed. Edition,2018, pakct publication

Reference Books:

1. .Shukla, M.Dhawan, S.Sharma,S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications" ,Oxford University Press 2019 .
2. Cryptography and network security principles and practice, William Stallings, Pearson, 8th edition,

WEB REFERENCES:

1. https://drive.google.com/file/d/1PtYaDmWYaqPVGjKDnMYGWO5eoI5wMPtJ/view
2. https://archive.nptel.ac.in/courses/106/104/106104220/
3. https://www.tutorialspoint.com/blockchain/index.htm

II Semester	DEVOPS (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives: The main objectives of this course are to:

1. Describe the agile relationship between development and IT operations.
2. Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
3. Implement automated system update and DevOps lifecycle.

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Explain DevOps Life cycle process	K2
CO2	Demonstrate the concept of Code coverage	K3
CO3	Explain Jenkins , jenkins workflow, jenkins master slave architecture, Jenkins Pipelines	K2
CO4	Discuss the concept of Dockers Command and running containers	K2

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		2	2	3	
CO2			2	3	3	
CO3			2	3	3	
CO4			2	2	3	

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction to DevOps:** Introduction to SDLC, Agile Model. Introduction to DevOps. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples	10Hrs

UNIT – 2	**Source Code Management (GIT)**: The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. UNIT TESTING-CODECOVERAGE: Junit ,nUnit & Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.	12Hrs
UNIT – 3	**Build Automation - Continuous Integration (CI):** Build Automation, What isCI Why Cl is Required, CI tools, Introduction to Jenkins (With Architecture), jenkins workflow, jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects& Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.	12Hrs
UNIT – 4	**Continuous Delivery:** Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, Docker File, running containers, working with containers and publish to Docker Hub. Testing Tools: Introduction to Selenium and its features, Java Script testing	12Hrs
UNIT – 5	**Configuration Management - ANSIBLE**: Introduction to Ansible, Ansible tasks Roles, Jinja2 templating, Vaults, Deployments using Ansible. CONTAINERIZATION USING UBERNETES(OPENSHIFT): Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC& Config Maps, Deploying Apps on Open shift Container Pods. Introduction to Puppet master and Chef	12Hrs
	Total	58Hrs

*Note:

List of Experiments:

1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with the source code written in exercise 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.

8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application developed in exercise 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in Java Script and perform testing using Selenium.
12. Develop test cases for the above containerized application sing selenium.

Text Books

1. Joyner, Joseph., DevOps for Beginners: DevOps Software Development Method Guide for Software Developers and It Professionals, 1st Edition Mihails Konoplows, 2015.
2. Alisson Machado de Menezes., Hands-on DevOps with Linux,1st Edition, BPB Publications, India, 2021.

Reference Books

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3. Verona ,Joakim Practical DevOps,1stEdition,Packt Publishing,2016.
4. Joakim Verona. Practical Devops, Second Edition.In gram short title; 2nd edition (2018). ISBN10: 1788392574
5. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's View point. Wiley publications. ISBN:9788126579952

Web Resources:

4. https://archive.nptel.ac.in/courses/106/104/106104220/
5. https://www.tutorialspoint.com/blockchain/index.htm

II Semester	SECURE CODING (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives:

- Understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities.
- Knowledge of outline of the techniques for developing a secure application.
- Recognize opportunities to apply secure coding principles

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Demonstrate the development of process of software leads to secure coding practices	K3
CO2	Apply Secure programs and various risk in the software's	K3
CO3	Classify various errors that lead to vulnerabilities	K4
CO4	Design Real time software and vulnerabilities	K6

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3	2	2
CO2	2		3	3	3	3
CO3			2	3	2	3
CO4	3	2	3	3	3	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	**Introduction-** Need for secure systems, Proactive security development process, Security principles to live by and threat modelling.	10Hrs
UNIT – 2	**Secure Coding in C-** Character strings- String manipulation errors, String Vulnerabilities and exploits Mitigation strategies for strings, Pointers, Mitigation strategies in pointer based vulnerabilities Buffer Overflow based vulnerabilities	12Hrs
UNIT – 3	**Secure Coding in C++ and Java-** Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double –free vulnerabilities, Integer security, Mitigation strategies	12Hrs

UNIT – 4	**Database and Web Specific Input Issues**- Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS related attacks and remedies	12Hrs
UNIT – 5	**Software Security Engineering-** Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software security practices and knowledge for architecture and design	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Writing Secure Code, 2 nd Edition, Michael Howard, David LeBlanc, Microsoft Press, 2003

Reference Books:

2. Secure Coding in C and C++, Robert C. Seacord, 2 nd edition, Pearson Education, 2013
3. Software Security Engineering: A guide for Project Managers, 1 st ed, Julia H. Allen, Sean J.Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, Addison-Wesley Professional,2008

II Semester	DESIGN PATTERNS (PROGRAM ELECTIVE-III)	L	T	P	C
		3	0	0	3

Course Objectives

1. Demonstration of patterns related to object oriented design.
2. 2 Describe the design patterns that are common in software applications.
3. 3 Analyze a software development problem and express it.
4. 4 Design a module structure to solve a problem, and evaluate alternatives.
5. 5 Implement a module so that it executes efficiently and correctly

Course Outcomes: At the end of the course, student will be able to (Four to Six)

		Knowledge Level (K)#
CO1	Construct a design consisting of a collection of modules	K6
CO2	Exploit well-known design patterns (such as Iterator, Observer, Factory and Visitor). Analyze	K4
CO3	Distinguish between different categories of design patterns. Analyze	K4
CO4	Ability to understand and apply common design patterns to incremental/iterative development.	K3
CO5	identify appropriate patterns for design of given problem	K3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	3	2	
CO2	2		3	3	2	
CO3			3	3		
CO4			2	3	2	
CO5			3	3	2	

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	What is a Design Pattern, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalogue of Design Patterns, Organizing The Cato log, How Design Patterns solve Design Problems, How to Select a Design pattern, How to Use a Design Pattern.	10Hrs

UNIT – 2	**A Case Study**: Designing a Document Editor, Design Problems , Document Structure, Formatting , Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary, Creational Patterns, Abstract Factory, Builder , Factory Method, Prototype, Singleton, Discussion of Creational Patterns.	12Hrs
UNIT – 3	Structural Pattern Part-I, Adapter, Bridge, Composite. Structural Pattern Part-II, Decorator, Facade, Flyweight, Proxy.	12Hrs
UNIT – 4	Behavioral Patterns Part: I, Chain of Responsibility, Command, Interpreter, Iterator. Behavioral Patterns Part: II, Mediator, Memento, Observer, Discussion of Behavioral Patterns.	12Hrs
UNIT – 5	**Behavioral Patterns Part:** III, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern Community, An Invitation, A Parting Thought.	12Hrs
	Total	58Hrs

*Note:

Text Books:

1. Design Patterns By Erich Gamma, Pearson Education

Reference Books:

1. Patterns in JAVA Vol-I (or) Vol-II By Mark Grand, Wiley Dream Tech.
2. Java Enterprise Design Patterns Vol-III By Mark Grand Wiley Dream Tech

II Semester	MACHINE LEARNING LAB	L	T	P	C
		0	1	2	2

Pre-requisites: Data Base Management Systems, Python Programming

COURSE OBJECTIVES: The main objective of the course is to

- To learn about computing central tendency measures and Data pre-processing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

Software's Required: Python/R/Weka

UNIT	CONTENTS	Contact Hours
Experiment– 1	Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.	10Hrs
Experiment– 2	Apply the following Pre-processing techniques for a given dataset. a. Attribute selection b. Handling Missing Values c. Discretization d. Elimination of Outliers	12Hrs
Experiment– 3	Apply KNN algorithm for classification and regression	12Hrs
Experiment– 4	Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results	
Experiment– 5	Demonstrate decision tree algorithm for a regression problem	12Hrs
Experiment– 6	Apply Random Forest algorithm for classification and regression	12Hrs
Experiment– 7	Demonstrate Naïve Bayes Classification algorithm	
Experiment– 8	Apply Support Vector algorithm for classification	
Experiment– 9	Demonstrate simple linear regression algorithm for a regression problem	
Experiment– 10	Apply Logistic regression algorithm for a classification problem	
Experiment– 11	Demonstrate Multi-layer Perceptron algorithm for a classification problem	
Experiment– 12	Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the	

	Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.	
Experiment–13	Demonstrate the use of Fuzzy C-Means Clustering	
Experiment–14	Demonstrate the use of Expectation Maximization based clustering algorithm	
	Total	58Hrs

II Semester	NATURAL LANGUAGE PROCESSING LAB	L	T	P	C
		0	1	2	2

Pre-requisites: Data Base Management Systems, Python Programming

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

- Design Neural networks to solve real world problems
- Build RNN, CNN models for classification
- Choose appropriate pre-trained model to solve real time problem
- Apply different NLP techniques using NLTK package.
- Design solutions to real-world problems using NLP

Software Packages Required:

- Keras
- Tensorflow
- PyTorch
- NLTK

UNIT	CONTENTS	Contact Hours
Experiment– 1	Implement Multilayer Perceptron algorithm for MNIST Handwritten Digit Classification.	10Hrs
Experiment– 2	Design Neural Network for following problems i). Movie reviews classification (Binary Classification) using IMDB dataset. ii). News Wires classification (Multiclass Classification) using Reuters dataset.	12Hrs
Experiment– 3	Implement a Recurrent Neural Network(RNN) and LSTM for IMDB movie review classification problem	12Hrs
Experiment– 4	Build a Convolution Neural Network for simple image (dogs and Cats) Classification	
Experiment– 5	Use a Pre-trained Convolution Neural Network LeNet, AlexNet for image classification	12Hrs
Experiment– 6	Implement One Hot Encoding and Word Embeddings on any real world dataset	12Hrs
Experiment– 7	Create Sample list at least 10 words POS tagging and find the POS for any given word	
Experiment– 8	Write a Python program to	

	i). Perform Morphological Analysis using NLTK library ii)Generate n-grams using NLTK N-Grams library iii). Implement N-Grams Smoothing	
Experiment– 9	Write a program to implement Named Entity Recognition(NER)for any corpus	
Experiment–10	Using NLTK package to convert audio file to text and text file to audio files	
Experiment–11	Write a program to perform Auto-Correction of spellings for any text	
Experiment–12	Implement twitter sentiment analysis using NLP.	
	Total	58Hrs