SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade.

Recognised as Scientific and Industrial Research Organisation

SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R25	**I - M. Tech (CST) I - Semester**

COMPUTER SCIENCE & TECHNOLOGY

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	CIE	SEE	Total Marks
D2515901	Advanced Algorithms Analysis	PC	3	1	0	4	40	60	100
D2515902	Advanced Data warehousing and Data Mining	PC	3	1	0	4	40	60	100
D2515903	Artificial Intelligence	PC	3	1	0	4	40	60	100
#PE-III	Program Elective – I	PE	3	0	0	3	40	60	100
#PE-IV	Program Elective – II	PE	3	0	0	3	40	60	100
D2515904	Advanced Algorithms Analysis lab	PC	0	1	2	2	40	60	100
D2515905	2 Advanced Data Mining lab	PC	0	1	2	2	40	60	100
D2515906	Seminar-I	PR	0	0	2	1	100	--	100
		TOTAL	**15**	**5**	**6**	**23**	**380**	**420**	**800**

List of Courses for Program Elective – I in M. Tech (CST) I - Semester		
PE#1	**Course Code**	**Course Name**
	D25159A0	Image Processing
	D25159A1	Soft computing
	D25159A2	Advanced Computer Networks
	D25159A3	Advanced Software Engineering
List of Courses for Program Elective – II in M. Tech (CST) I - Semester		
PE#2	**Course Code**	**Course Name**
	D25159B0	Time Series Analysis
	D25159B1	High Performance Computing
	D25159B2	Agile Methodologies
	D25159B3	Advanced Compiler Design
	D25159B4	Any minimum12 weeks MOOCS/NPTEL courses suggested by BOS

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2515901	PC	3	1	--	4	40	60	3 Hrs.

ADVANCED ALGORITHMS ANALYSIS

Computer Science & Technology

Course Objectives: The main objective of the course is to

1.	Analyze the time complexity & performance of different algorithms.
2.	Categorize the different problems in various classes
3.	Discuss Dynamic Programming

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

S.No	Course Outcome	Knowledge Level
1.	Analyze the complexity/performance of different algorithms.	**K4**
2.	Apply matroid theory, greedy methods, maximum matching algorithms, augmenting paths, and Edmond's Blossom algorithm to solve graph optimization problems.	**K3**
3.	Categorize the different problems in various classes according to their complexity	**K4**
4.	Apply dynamic programming, modulo arithmetic, and Fourier-based algorithms in solving computational problems.	**K3**
5.	Analyze linear programming methodsand modern data-structure based techniques to solve computational problems.	**K4**

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SYLLABUS

UNIT-I (10Hrs)	Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.
UNIT-II (12Hrs)	Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.
UNIT-III (12Hrs)	Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUPdecomposition.
UNIT-IV (12 Hrs)	Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo

	Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. SchonhageStrassen Integer Multiplication algorithm
UNIT-V (12 Hrs)	Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NPcompleteness. Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Textbooks:	
1.	Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms".
Reference Books:	
1.	Aho, Hopcroft, Ullman "The Design and Analysis of Computer Algorithms"
2.	Kleinberg and Tardos."Algorithm Design".
e-Resources	
1.	https://www.coursera.org/learn/advanced-algorithms-and-complexity
2.	https://www.geeksforgeeks.org/dsa/analysis-of-algorithms/

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2515902	PC	3	1	--	4	40	60	3 Hrs.

ADVANCED DATA WAREHOUSING AND DATA MINING

Computer Science & Technology

Course Objectives: The main objective of the course is to

1.	Understand Data Warehousing and OLAP
2.	Master Data Pre-processing and Statistical Techniques
3.	Apply Classification Techniques and Model Evaluation
4.	Perform Association and Sequential Pattern Mining
5.	Explore Clustering and Advanced Data Mining

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

S.No	Course Outcome	Knowledge Level
1.	Describe the architecture, modeling techniques, and implementation strategies of data warehouses and OLAP systems, including modern cloud based approaches	**K2**
2.	Apply statistical and visualization techniques to describe datasets and perform data preprocessing tasks such as cleaning, integration, reduction, and transformation.	**K3**
3.	Develop and evaluate classification models using decision trees, Bayesian classifiers, and rule-based methods for solving predictive analytics problems.	**K4**
4.	Discover meaningful associations and sequential patterns in data using algorithms like Apriori, FP-Growth, and sequential pattern mining techniques.	**K3**
5.	Implement clustering techniques such as K-means, hierarchical clustering, and DBSCAN, and analyze advanced data mining for text, spatial, and graph data	**K4**

SYLLABUS

UNIT-I (10Hrs)	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 and Patten Mining, Technologies, Applications, Major issues, Data Objects & Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.
UNIT-II (10Hrs)	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.
UNIT-III (12 Hrs)	Classification: 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.
UNIT-IV (12 Hrs)	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
UNIT-V (12 Hrs)	Cluster Analysis: Clustering techniques, Different Types of Clusters; Kmeans: The Basic K-means Algorithm, K-means Additional Issues, Bisecting 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.

Textbooks:	
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:	
1.	Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher.
2.	Data Mining Techniques, Arun K Pujari, 3rd edition, Universities Press,2013
e-Resources (NPTEL course by Prof.PabitraMitra)	
1.	http://onlinecourses.nptel.ac.in/noc17_mg24/preview
2.	http://www.saedsayad.com/data_mining_map.htm

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2515903	PC	3	1	--	4	40	60	3 Hrs.

ARTIFICIAL INTELLIGENCE

Computer Science & Technology

Course Objectives: The main objective of the course is to

1.	Demonstrate building blocks of AI
2.	Analyze and formalize the A I problems
3.	Solving the problems with certain as well as uncertain information

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

S.No	Course Outcome	Knowledge Level
1.	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents	K3
2.	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them	K3
3.	Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.	K3
4.	Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.	K2
5.	Solve problems with uncertain information using Bayesian approaches	K2

SYLLABUS

UNIT-I (10Hrs)	Introduction to artificial intelligence: Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-tie game playing, development of AI languages, current trends in AI, Problem solving: state space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques, iterative-deepening A*, constraint satisfaction.
UNIT-II (10Hrs)	Problem reduction and game playing: Introduction, problem reduction, game playing, alpha-beta pruning, two-player perfect information games, Logic concepts: Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic tableau system in proportional logic, resolution refutation in proportional logic, predicate logic.
UNIT-III (12Hrs)	Knowledge representation: Introduction, approaches to knowledge representation, knowledge representation using semantic network, extended semantic networks for KR, knowledge representation using frames, advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure, cyc theory, case grammars, semantic web.

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UNIT-IV (12Hrs)	Uncertainty measure: probability theory: Introduction, probability theory, Bayesian belief networks (exact and approximate inference) certainty factor theory, dempster-shafer theory, non-monotonic reasoning, TMS.
UNIT-V (12Hrs)	Expert systems:- Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.
Textbooks:	
1.	Artificial intelligence, A modern Approach, 2nded, Stuart Russel, Peter Norvig, Prentice Hall
2.	Artificial Intelligence, Saroj Kaushik, 1st Edition, CENGAGE Learning, 2011.
1.	Artificial intelligence, structures and Strategies for Complex problem solving, 5th Edition, George F Lugar, PEA
2	Introduction to Artificial Intelligence, Ertel, Wolf Gang, Springer, 2017
3	Artificial Intelligence, A new Synthesis, 1st Edition, Nils J Nilsson, Elsevier,1998
4	Artificial Intelligence- 3rd Edition, Rich, Kevin Knight, Shiv Shankar B Nair, TMH
5	Introduction To Artificial Intelligence And Expert Systems, 1st Edition,Patterson, Pearson India, 2015
e-Resources	
1.	https://www.geeksforgeeks.org/artificial-intelligence/artificial-intelligence/
2.	https://en.wikipedia.org/wiki/Artificial_Intelligence:_A_Modern_Approach

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159A0	PE	3	--	--	3	40	60	3 Hrs.

IMAGE PROCESSING

Computer Science & Technology

Course Objectives:

1.	Describe and explain basic principles of digital image processing.
2.	Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement).
3.	Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation).
4.	Assess the performance of image processing algorithms and systems.

Course Outcomes:

S. No.	Course Outcome	Knowledge Level
1.	Describe and explain basic principles of digital image processing.	K3
2.	Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement).	K3
3.	Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation).	K4
4.	Assess the performance of image processing algorithms and systems	K4
5.	Describe Feature extraction and Classification	K3

SYLLABUS

UNIT-I (10 Hrs)	**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
UNIT-II (10 Hrs)	**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, Geometric mean filter, Image reconstruction from projections. Color Fundamentals, Color Models, Color Transformations.
UNIT-III (12 Hrs)	**Image Compression:** Redundancies Coding, Interpixel, Psycho visual, Fidelity, Source and Channel Encoding, Elements of Information Theory, Lossless and Lossy Compression, Run length coding, Differential encoding, DCT, Vector quantization, Entropy coding, LZW coding; Image Compression Standards-JPEG, JPEG 2000, MPEG; Video compression.

UNIT-IV (12 Hrs)	**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.
UNIT-V (12 Hrs)	**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.
Textbooks:	
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

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159A1	PE	3	--	--	3	40	60	3 Hrs.

SOFT COMPUTING

Computer Science & Technology

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.
2	Discuss about fuzzy systems
3	Analyze genetic algorithms

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Learn soft computing techniques and their applications.	K2
2.	Analyze various neural network architectures.	K4
3.	Define the fuzzy systems	K2
4.	Understand the genetic algorithm concepts and their applications.	K2
5.	Identify and select a suitable Soft Computing technology to solve the problem; construct a solution and implement a Soft Computing solution	K4

SYLLABUS

UNIT-I (10Hrs)	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.
UNIT-II (10Hrs)	Perceptron networks, Learning rule, Training and testing algorithm, Adaptive Linear Neuron, Back propagation Network, Architecture, Training algorithm.
UNIT-III (12Hrs)	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
UNIT-IV (12Hrs)	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.
UNIT-V (12Hrs)	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

Textbooks:

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.
4.	Driankov D., Hellendoorn H.and Reinfrank M.,An Introduction to Fuzzy Control Narosa Pub., 2001.
5.	BartKosko, Neural Network and Fuzzy Systems-Prentice Hall,Inc.,Englewood Cliffs, 1992
6.	Goldberg D.E, Genetic Algorithms in Search , Optimization , and Machine Learning Addison Wesley, 1989
e-Resources	
1.	https://nptel.ac.in/courses/106105173
2.	https://en.wikipedia.org/wiki/Soft_computing

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159A2	PE	3	--	--	3	40	60	3 Hrs.

ADVANCED COMPUTER NETWORKS

Computer Science & Technology

Course Objectives:

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.	Sum 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 algorithms.
4.	Aim of this course is to develop some familiarity with cuurent research problems and research methods in advanced computer networks.

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Explain the design issues, routing algorithms, congestion control techniques, and quality of service mechanisms used in the network layer.	K2
2.	Apply IPv4 and IPv6 addressing schemes, subnetting, and internetworking techniques to design and configure efficient network communication systems.	K3
3.	Demonstrate the use of UDP, TCP, and SCTP protocols to establish reliable and efficient end-to-end communication.	K3
4.	Describe the architecture, operations, and protocols of IEEE 802.11, Bluetooth, WiMAX, cellular, and satellite networks for effective wireless communication design.	K2
5.	Describe emerging trends in networks-MANETS and WSN.	K2

SYLLABUS

UNIT-I (12Hrs)	**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 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-II (12Hrs)	**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.
UNIT-III (12Hrs)	**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.
UNIT-IV (12Hrs)	**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.
UNIT-V (12Hrs)	**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: Characteristics of P2P Networks, Classification of P2P systems, Gnutella, BitTorrent, Session Initiation Protocol(SIP) , Characteristics and addressing, Components of SIP, SIP establishment, SIP security.

Textbooks:	
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.
2.	Mobile and Wireless Networks, 1st ed, Khaldoun Al Agha, Guy Pujolle, and Thierry Znati, Wiley, 2016.
3.	Wireless Communications & Networks, 2nd ed, William Stallings, Pearson Education, 2005.
4.	Wireless Sensor Networks: Technology, Protocols, and Applications, 1st ed, Kazem Sohraby, Daniel Minoli, Taieb Znati, Wiley, 2007.
5.	Ad Hoc Wireless Networks: Architectures and Protocols, 1st ed, C. Siva Ram Murthy & B. S. Manoj, Pearson Education, 2004.
e-Resources	

1.	https://nptel.ac.in/courses/106105183
2.	https://www.netacad.com/courses/packet-tracer

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159A3	PE	3	--	--	3	40	60	3 Hrs.

ADVANCED SOFTWARE ENGINEERING

Computer Science & Technology

Course Objectives:

1.	Equip students with knowledge of software development life cycles, process models (both traditional and agile), and best engineering practices for building quality software.
2.	Enable students to gather and model requirements, design software architectures and user interfaces (including for mobile), ensure quality, and apply effective testing strategies.
3.	To enable students to apply software metrics, analytics, and knowledge of human and team dynamics for the effective management, evaluation, and continuous improvement of software products and processes.

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Explain appropriate software processes, various process models, and Agile methodologies used in software development	**K2**
2.	Analyze and specify software requirements by developing a structured Software Requirements Specification (SRS) document	**K4**
3.	Determine and plan effective software solutions to address defined problems	**K3**
4.	Analyze quality assurance principles and design, implement, and execute unit-level test cases	**K4**
5.	Model, implement, and execute integration-level test cases and evaluate software quality using various metrics.	**K3**

SYLLABUS

UNIT-I (10Hrs)	**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 Agility and process: Agility, Agile process, Scrum, other Agile frameworks, recommended process model
UNIT-II (12Hrs)	**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.
UNIT-III	**Design:** Design process, design concepts, design model Architectural design: software

(12Hrs)	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.
UNIT-IV (12Hrs)	**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.
UNIT-V (12Hrs)	**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
Textbooks:	
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.

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159B0	PE	3	--	--	3	40	60	3 Hrs.

TIME SERIES ANALYSIS

Computer Science & Technology

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, students will be able to

S. No.	Course Outcome	Knowledge Level
1.	Formulate real-life problems using time series models	K1
2.	Use statistical software to estimate the models from real data, and draw conclusions and develop solutions from the estimated models.	K3
3.	Use visual and numerical diagnostics to assess the soundness of their models	K2
4.	communicate the statistical analyses of substantial data sets through explanatory text, tables, and graphs	K4
5.	Combine and adapt different statistical models to analyse larger and more complex data	K3

SYLLABUS

UNIT-I (10Hrs)	**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.
UNIT-II (12Hrs)	**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
UNIT-III (12Hrs)	**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.
UNIT-IV (12Hrs)	**AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA)MODELS:** Autoregressive Moving Average (ARMA) Models, Stationarity and Invertibility of ARMA Models, Checking for Stationarity using Variogram, Detecting Nonstationary, 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.
UNIT-V (12Hrs)	**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.
Textbooks:	
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)
e-resources	
	https://www.intel.com/content/www/us/en/developer/topic-technology/artificial-intelligence/training/course-time-series-analysis.html
	https://www.linkedin.com/learning/python-for-time-series-forecasting

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159B1	PE	3	--	--	3	40	60	3 Hrs.

HIGH PERFORMANCE COMPUTING

Computer Science & Technology

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

S.No	Course Outcome	Knowledge Level
1.	Describe different parallel architectures, inter-connect networks, programming models	K3
2.	Develop an efficient parallel algorithm to solve given problem	K4
3.	Analyze and measure performance of modern parallel computing systems	K5
4.	Build the logic to parallelize the programming task	K2
5.	Demonstrate the architecture of CUDA and applications of CUDA	K2

SYLLABUS

UNIT-I (10Hrs)	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
UNIT-II (12 Hrs)	Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.
UNIT-III (12 Hrs)	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
UNIT-IV (12 Hrs)	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.

UNIT-V (12 Hrs)	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
Textbooks:	
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, ISBN13: 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: 9780124159884
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
e-Resources	
1.	https://www.geeksforgeeks.org/computer-organization-architecture/high-performance-computing/

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159B2	PE	3	--	--	3	40	60	3 Hrs.

AGILE METHODOLOGIES

Computer Science & Technology

Course Objectives:

1.	Develop an in-depth understanding of Agile philosophy, principles, and values for delivering high-quality software solutions
2.	Apply different Agile frameworks (Scrum, XP, Lean, Kanban) to real-world projects for improved adaptability, productivity, and customer satisfaction.

Course Outcomes:

S. No.	Course Outcome	Knowledge Level
1.	Explain Agile values and principles and how they influence team collaboration and adaptability	K2
2.	Describe the 12 Agile principles and their role in guiding project delivery.	K2
3.	Apply Scrum roles, events, and artifacts to manage an iterative development cycle.	K3
4.	Illustrate XP practices and their importance in improving software quality and team responsiveness.	K2
5.	Apply Lean and Kanban principles to identify waste and improve software development workflows.	K3

SYLLABUS

UNIT-I (10Hrs)	**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, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology
UNIT-II (12Hrs)	**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
UNIT-III	**SCRUM and Self-Organizing Teams:** The Rules of Scrum, Act I: I Can Haz Scrum?,

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(12Hrs)	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.
UNIT-IV (12Hrs)	**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, 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-V (12Hrs)	**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.
Textbooks:	
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
e-Resources	
1.	https://www.agilealliance.org
2.	https://www.scrum.org
3.	https://www.scrumtrainingseries.com
4.	https://www.agilemanifesto.org
5.	https://www.scrumguides.org
6.	https://www.theserverside.com/video/Scrum-methodology-explained

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25159B3	PE	3	--	--	3	40	60	3 Hrs.

ADVANCED COMPILER DESIGN

Computer Science & Technology

Course Objectives:

1.	To study the various phases in the design of a compiler
2.	To understand the design of top-down, bottom-up parsers and syntax directed translation schemes
3.	To learn to develop algorithms to generate code for a target machine

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

S.No	Course Outcome	Knowledge Level
1.	Demonstrate phases in the design of compiler	**K3**
2.	Organize Syntax Analysis, Top Down and LL(1) grammars	**K3**
3.	Design Bottom Up Parsing and Construction of LR parsers	**K3**
4.	Analyse synthesized, inherited attributes and syntax directed translation chemes	**K4**
5.	Determine algorithms to generate code for a target machine	**K4**

SYLLABUS

UNIT-I (10Hrs)	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.
UNIT-II (12 Hrs)	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
UNIT-III (12 Hrs)	Bottom Up Parsing: Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers, 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-IV (12 Hrs)	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, Back patching, Intermediate Code for Procedures.

UNIT-V (12 Hrs)	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.
Textbooks:	
1.	Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson Publishers,2007
2.	Compiler Construction, Principles and Practice, Kenneth C Louden,Cengage Learning, 2006
Reference Books:	
1.	Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge, University Press.
2.	Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge, University Press.
3.	Levine, J.R., T. Mason and D. Brown, Lex and Yacc, edition, O'Reilly & Associates, 1990
e-Resources	
1.	https://www.geeksforgeeks.org/compiler-design/introduction-of-compiler-design/
2.	https://www.tutorialspoint.com/compiler_design/index.htm

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2515904	PC	--	1	2	2	40	60	3 Hrs

ADVANCED ALGORITHMS ANALYSIS LAB

Computer Science & Technology

Course Objectives: Students are expected to

1	Analyze the time complexity & performance of different algorithms.
2	Categorize the different problems in various classes
3	Discuss Dynamic Programming

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

S.No	Outcome	Knowledge Level
1	Implement and analyse divide and conquer algorithms	K4
2	Implement and analyse Greedy algorithms	K4
3	Implement and analyse Graph algorithms	K4

SYLLABUS

1	Implement assignment problem using Brute Force method
2	Perform multiplication of long integers using divide and conquer method.
3	Implement a solution for the knapsack problem using the Greedy method
4	Implement Gaussian elimination method.
5	Implement LU decomposition
6	Implement Warshall algorithm
7	Implement the Rabin Karp algorithm.
8	Implement the KMP algorithm.
9	Implement Harspool algorithm
10	Implement max-flow problem.

Reference Books:

1.	Design and Analysis of Algorithms, P. H. Dave and H.B.Dave, Pearson education.
2.	Data Structures and algorithms in Java, 2nd Edition, R.Lafore, Pearson Education

e-Resources

1.	https://visualgo.net/en

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2515905	PC	--	1	2	2	40	60	3 Hrs

ADVANCED DATA MINING LAB

Computer Science & Technology

Course Objectives: Students are expected to

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

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

S.No	Outcome	Knowledge Level
1	**Use** the Weka tool to design a robust Data Mart to facilitate efficient data analysis and decision-making.	K3
2	**Apply** appropriate data preprocessing techniques using the WEKA tool to prepare real-world datasets for mining tasks	K3
3	**Analyze** data mining algorithms like classification, prediction, clustering and association rule mining to solve real-world problems using Weka and Python	K4
4	**Use** data visualization tools to interpret and communicate data mining results effectively.	K3

SYLLABUS

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

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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: List the attribute names and they types Number of records in each dataset Identify the class attribute (if any) Plot Histogram Determine the number of records for each class. Visualize the data in various dimensions
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.
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
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.

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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
7	Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations
8	Write a java program to prepare a simulated data set with unique instances
9	Write a Python program to generate frequent item sets / association rules using Apriori algorithm
10	Write a program to calculate chi-square value using Python/R. Report your observation.
11	Implement a Java/R program to perform Apriori algorithm
12	Write a R program to cluster your choice of data using simple k-means algorithm using JDK
13	Write a program of cluster analysis using simple k-means algorithm Python/R programming language
14	Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python
15	Visualize the datasets using matplotlib in python.(Histogram, Box plot, Bar chart, Pie chart etc.,)
Reference Books:	
1	Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal. 5th edition,2023) Morgan Kaufmann Publishers.
2	Machine Learning for Data Streams: with Practical Examples in MOA by Albert Bifet, Ricard Gavaldà, Geoffrey Holmes, Bernhard Pfahringer,2018, The MIT Press.

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2515906	PR	--	--	2	1	100	--	3 Hrs.

SEMINAR -I

Computer Science & Technology

A student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful

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Regulation: R25	**I - M.Tech. (CST) II - Semester**

COMPUTER SCIENCE & TECHNOLOGY

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2525901	Machine Learning	PC	3	1	0	4	40	60	100
D2525902	Generative AI	PC	3	1	0	4	40	60	100
D2525903	Quantum Science and Technology	PC	3	1	0	4	40	60	100
#PE-III	Program Elective – III	PE	3	0	0	3	40	60	100
#PE-IV	Program Elective – IV	PE	3	0	0	3	40	60	100
D2525904	Machine Learning Lab	PC	0	1	2	2	40	60	100
D2525905	Generative AI Lab	PC	0	1	2	2	40	60	100
D2525906	Seminar – II	PR	0	0	2	1	100	--	100
	TOTAL		**15**	**5**	**6**	**23**	**380**	**420**	**800**

List of Courses for Program Elective – III in M. Tech (CST) II - Semester		
PE#3	**Course Code**	**Course Name**
	D25259A0	Feature Engineering
	D25259A1	Natural Language Processing
	D25259A2	Adhoc Sensor Networks
	D25259A3	Cryptography & Network Security
List of Courses for Program Elective – IV in M. Tech (CST) II - Semester		
PE#4	**Course Code**	**Course Name**
	D25259B0	Block Chain Technologies
	D25259B1	DevOps
	D25259B2	Secure Coding
	D25259B3	Design Patterns.
	D25259B4	Any minimum12 weeks MOOCS/NPTEL courses suggested by BOS

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2525901	PC	3	1	--	4	40	60	3 Hrs.

MACHINE LEARNING

Computer Science & Technology

Course Objectives:

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

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

S.No	Outcome	Knowledge Level
1.	Enumerate the Fundamentals of Machine Learning	K2
2.	Build Nearest neighbour based models	K2
3.	Apply Models based on decision trees and Bayes rule	K4
4.	Choose appropriate clustering technique	K2
5.	Determine algorithms to generate code for a target machine	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Machine Learning:** Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets
UNIT- II (12Hrs)	**Nearest Neighbor-Based Models:** Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms
UNIT- III (12Hrs)	**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 Naïve Bayes Classifier (NBC)
UNIT- IV (12Hrs)	**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.
UNIT-V (12Hrs)	**Clustering :** Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering
Text Books:	
1.	"Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024
2.	Applied Machine Learning, M. Gopal, McGraw Hill Education
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

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2525902	PC	3	1	--	4	40	60	3 Hrs.

GENERATIVE AI

Computer Science & Technology

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 for real world applications.
4.	To develop innovative applications using generative AI tools and techniques.

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

S.No	Course Outcome	Knowledge Level
1.	Illustrate Generative AI models such as GANs, VAEs, autoregressive.	K2
2.	Explain the transformer architecture and the functioning of large language models like BERT and GPT and prompt engineering strategies.	K2
3.	Apply GAN models for generation of images.	K3
4.	Apply Variants of GAN algorithms for Generation of Painting, Music, and Play	K3
5.	Demonstrate Open Source Models and Programming Frameworks to fine-tune Generative and pretrained models.	K2

SYLLABUS

UNIT-I (10Hrs)	**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
UNIT-II (12Hrs)	**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 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-III (12Hrs)	**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

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	Generation, CLIP, Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V, Issues of Image Generation models like Mode Collapse and Stability.
UNIT-IV (12Hrs)	**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.
UNIT-V (12Hrs)	**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 Transformer, Deployment, Hugging Face.

Textbooks:	
1.	Denis Rothman, "Transformers for Natural Language Processing and Computer Vision", Third Edition , Packt Books, 2024.
2.	Chakraborty, Tanmoy. "Introduction to Large Language Models: Generative AI for Text." (2025).
Reference Books:	
1.	David Foster, Generative Deep Learning: Teaching Machines to Paint, Write, Compose, Play, 2nd Edition, Oreilly
2.	Altaf Rehmani, "Generative AI for Everyone", BlueRose One, 2024.
e-Resources	
1.	Generative AI with LLMs - DeepLearning.AI

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2525903	PC	3	1	--	4	40	60	3 Hrs.

QUANTUM SCIENCE & TECHNOLOGY

Computer Science & Technology

Course Objectives:

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

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Explain the fundamental principles of quantum mechanics and their relevance to quantum computing	**K2**
2.	Apply quantum information concepts such as qubits, entanglement, and quantum gates using circuit models	**K2**
3.	Analyze quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's algorithm for computational problems	**K3**
4.	Illustrate quantum error correction techniques and experiment with QFT and quantum programming platforms like Qiskit, Cirq	**K2**
5	Evaluate quantum hardware platforms, applications in technology, and assess current initiatives and ethical considerations	**K3**

SYLLABUS

UNIT-I (10Hrs)	Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian;
UNIT-II (12 Hrs)	Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli- X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation;
UNIT-III (12 Hrs)	Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance);

UNIT-IV (12 Hrs)	Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, and Shor's 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview).
UNIT-V (12 Hrs)	Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, DWave, IonQ, India's NQM; Ethical concerns and future prospects

Textbooks:	
1.	"Quantum Computation and Quantum Information", Michael A. Nielsen, Isaac L. Chuang
2.	"Quantum Mechanics: Concepts and Applications", Nouredine Zettili
Reference Books:	
1.	"Quantum Mechanics: Concepts and Applications", Nouredine Zettili
e-Resources	
1.	https://scienceexchange.caltech.edu/topics/quantum-science-explained

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259A0	PE	3	--	--	3	40	60	3 Hrs.

FEATURE ENGINEERING

Computer Science & Technology

Course Objectives:

1.	**Explain** the role of features in the machine-learning pipeline and basic mathematical foundations for feature transforms.
2.	**Apply** numerical, categorical and text feature extraction and transformation techniques to real datasets.
3.	**Implement** dimensionality reduction, clustering-based featurization, and encoding techniques to improve model performance.
4.	**Use** feature-selection methods and automated feature-engineering tools to build compact, high-quality feature sets.
5.	**Design and evaluate** end-to-end feature pipelines that are robust to leakage, scaling issues and production deployment.

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Describe the basic concepts of data, types of tasks, models, and feature representations	**K2**
2.	Explain text representation techniques such as Bag-of-Words and Bag-ofn-Gram	**K2**
3.	Demonstrate the application of dimensionality reduction techniques	**K3**
4.	Discuss non-linear feature transformation techniques and their role in improving model performance	**K2**
5	Explain and apply item-based collaborative filtering techniques for recommendation systems	**K3**

SYLLABUS

UNIT-I (10Hrs)	**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
UNIT-II (12 Hrs)	**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, Scaling Bag-of-Words with Tf-Idf Transformation, Classification with Logistic Regression, Tuning Logistic Regression with Regularization
UNIT-III (12 Hrs)	**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: MatrixVector Formulation, General Solution of the Principal Components; Transforming Features, Implementing PCA: PCA in Action, Whitening and ZCA, Considerations and Limitations of PCA
UNIT-IV (12 Hrs)	**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
UNIT-V (12 Hrs)	**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

Textbooks:	
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
3.	Feature Engineering Bookcamp — *Sinan Ozdemir*, Manning (2022). (Project-based, practical case studies across domains).
Reference Books:	
1.	"Python Feature Engineering Cookbook", Soledad Galli, Packt Publishing, 3rd Edition, 2024.
2.	Practical Feature Engineering", Alice Zheng, O'Reilly Online Release, 2020.
3.	"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Aurélien Géron, 3rd Edition, O'Reilly, 2022.
e-Resources	
1.	Kaggle Micro-Course: Feature Engineering – https://www.kaggle.com/learn/feature-engineering
2.	Feature Engineering for Machine Learning – Companion GitHub Repository (Alice Zheng & Amanda Casari) – https://github.com/alicezheng/feature-engineering-book
3.	Analytics Vidhya Blog: Feature Engineering Tutorials – https://www.analyticsvidhya.com/blog/tag/feature-engineering/

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259A1	PE	3	--	--	3	40	60	3 Hrs.

NATURAL LANGUAGE PROCESSING

Computer Science & Technology

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Demonstrate a given text with basic Language features	K2
2.	Design an innovative application using NLP components	K4
3.	Explain a rule-based system to tackle morphology/syntax of a language	K1
4.	Design a tag set to be used for statistical processing for real-time applications	K4
5.	Compare and contrast the use of different statistical approaches for different types of NLP applications	K4

SYLLABUS

UNIT-I (10Hrs)	**INTRODUCTION:** Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance
UNIT-II (12Hrs)	**WORD LEVEL ANALYSIS**: Unsmoothed N-grams, Evaluating Ngrams, Smoothing, Interpolation and Backoff – Word Classes, Partof- Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models
UNIT-III (12Hrs)	**SYNTACTIC ANALYSIS**: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures
UNIT-IV	**SEMANTICS AND PRAGMATICS:** Requirements for representation, First-Order

(12Hrs)	Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.
UNIT-V (12Hrs)	**DISCOURSE ANALYSIS AND LEXICAL RESOURCES:** Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)
Text Books:	
1.	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2ndEdition, 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, 1stEdition, Breck Baldwin, Atlantic Publisher, 2015.
2.	Natural Language Processing with Java, 2ndEdition, 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
4.	Natural Language Processing and Information Retrieval, 3rdEdition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press, 2008.
e-Resources	
1.	nptel.ac.in/courses

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259A2	PE	3	--	--	3	40	60	3 Hrs.

ADHOC SENSOR NETWORKS

Computer Science & Technology

Course Objectives:

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

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Explain the fundamentals of wireless communication, characteristics of wireless channels, and design challenges in MANETs and WSNs	K2
2.	Analyze and categorize MAC protocols used in Ad Hoc networks based on contention, reservation, and scheduling mechanisms	K4
3.	Classify routing and transport layer protocols in Ad Hoc networks and evaluate security requirements	K4
4.	Describe node architecture, network architecture, and MAC protocols in Wireless Sensor Networks	K2
5.	Apply concepts of routing, localization, synchronization, and QoS in Wireless Sensor Networks	K3

SYLLABUS

UNIT-I (10Hrs)	**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.
UNIT-II (12Hrs)	**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.
UNIT-III (12Hrs)	**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 (ondemand), 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.
UNIT-IV (12Hrs)	**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.
UNIT-V (12Hrs)	**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.
Textbooks:	
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 DeMorais Cordeiro, Dharma Prakash Agrawal ,World Scientific Publishing Company, 2011
2.	Wireless Sensor Networks Feng Zhao and Leonides Guibas,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)
e-Resources	
1.	nptel.ac.in/courses/106105160/
2.	https://www.tutorialspoint.com/mobile_computing/mobile_computing_quick_guide.h

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259A3	PE	3	--	--	3	40	60	3 Hrs.

CRYPTOGRAPHY & NETWORK SECURITY

Computer Science & Technology

Course Objectives:

1.	Explain the objectives of information security
2.	Explain the importance and application of each of confidentiality, integrity, authentication and availability
3.	Understand the basic categories of threats to computers and networks
4.	Discusses the Mathematics of Cryptography
5.	Discuss the fundamental ideas of Symmetric and Asymmetric cryptographic Algorithms
6.	Discusses the Network layer, Transport Layer and Application layer Protocols Enhanced security mechanisms

Course Outcomes

S.No	Outcome	Knowledge Level
1.	Student will be able to understand security issues related to computer networks and learn different symmetric key techniques	K2
2.	Students will be able learn mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	K3
3.	Students will be able learn different types of symmetric and Asymmetric algorithms.	K3
4.	Students will be able learn different algorithms of Hash functions, message authentication and digital signature and their importance to the security.	K3
5.	Students will be able learn different Enhanced security protocols of Application Layer, Transport Layer and Network layer	K3

SYLLABUS

UNIT-I (10Hrs)	**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.
UNIT-II (12Hrs)	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.

UNIT-III (12Hrs)	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**.**
UNIT-IV (12Hrs)	**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.
UNIT-V (12Hrs)	**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.

Text Books:	
1.	Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2.	Cryptography and Network Security: Behrouz A. ForouzanDebdeep, Mc Graw Hill, 3rd Edition, 2015
Reference Books:	
1.	Cryptography and Network Security: AtulKahate, Mc Graw Hill, 3rd Edition
2.	Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3.	Modern Cryptography: Theory and Practice ByWenbo Mao. Pearson
e-Resources	
1	https://www.geeksforgeeks.org/computer-networks/cryptography-and-network-security-principles/

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259B0	PE	3	--	--	3	40	60	3 Hrs.

BLOCK CHAIN TECHNOLOGIES

Computer Science & Technology

Course Objectives:

1.	Architect sensor networks for various sensor networks.
2.	Device appropriate data dissemination protocols and model links cost.
2.	To Understand blockchain fundamentals, history, and cryptographic foundations.
3.	To illustrate blockchain technologies, consensus mechanisms, and applications.
4.	To Apply blockchain concepts to design and evaluate real-world solutions.

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

S.No	Course Outcome	Knowledge Level
1.	Discuss the Cryptographic primitives used in Blockchain.	K2
2.	Discuss about various technologies borrowed in blockchain.	K2
3.	Illustrate various Consensus Algorithms for blockchain.	K2
4.	Demonstrate about Ethereum mechanisms.	K2
5.	Discuss about application and limitations of blockchain for Hyperledger Fabric	K2

SYLLABUS

UNIT-I (10Hrs)	**INTRODUCTION TO BLOCKCHAIN:** Introduction, history of Bitcoin and origins of Blockchain, Fundamentals of Blockchain and key component, Permission and Permission-less platforms, Introduction to Cryptography, SHA256 and ECDSA, Hashing and Encryption, Symmetric/ Asymmetric keys, Private and Public Keys.
UNIT-II (12Hrs)	**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.
UNIT-III (12Hrs)	**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.
UNIT-IV (12Hrs)	**ETHEREUM:** Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum - Solidity - Smart Contracts (Chapter 5-book1), - The Turing Completeness of Smart Contract Languages and verification challengesUsing smart contracts to enforce legal contracts- Comparing Bitcoin scripting vs. Ethereum Smart Contracts-Some attacks on smart contracts

UNIT-V (12Hrs)	**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
Textbooks:	
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, 8 th edition
e-Resources	
1.	https://archive.nptel.ac.in/courses/106/104/106104220/
2.	https://www.tutorialspoint.com/blockchain/index.htm

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259B1	PE	3	--	--	3	40	60	3 Hrs.

DevOps

Computer Science & Technology

Course Objectives:

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:

S. No.	Course Outcome	Knowledge Level
1.	Describe the DevOps lifecycle, features, tools, and the role of Agile and SDLC in DevOps practices	K2
2.	Demonstrate the use of Git for source code management and analyze code quality using SonarQube	K3
3.	Apply jenkins for continuous integration and manage build automation and pipelines	K3
4.	Demonstrate Continuous Delivery using Docker and test automation tools like Selenium and JavaScript testing	K3
5.	Use Ansible and Kubernetes (OpenShift) for configuration management and deployment	K3

SYLLABUS

UNIT-I (10Hrs)	**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
UNIT-II (12Hrs)	**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.
UNIT-III (12Hrs)	**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.
UNIT-IV (12Hrs)	**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
UNIT-V (12Hrs)	**Configuration Management - ANSIBLE:** Introduction to Ansible, Ansible tasks Roles, Jinja2 templating, Vaults, Deployments using Ansible. CONTAINERIZATION USING KUBERNETES(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

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.

Textbooks:

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.

5.	Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's View point. Wiley publications. ISBN:9788126579952
e-Resources	
1.	https://archive.nptel.ac.in/courses/106/104/106104220/
2.	https://www.tutorialspoint.com/blockchain/index.htm

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259B2	PE	3	--	--	3	40	60	3 Hrs.

SECURE CODING

Computer Science & Technology

Course Objectives:

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

Course Outcomes By the end of this course student will be able to

S.No	Outcome	Knowledge Level
1.	Outline the secure systems and various security attacks	K2
2.	Demonstrate the development of process of software leads to secure Coding practices	K2
3.	Apply Secure programs and various risk in the software's	K3
4.	Classify various errors that lead to vulnerabilities	K3
5.	Design Real time software and vulnerabilities	K4

SYLLABUS

UNIT-I (10 Hrs)	**Introduction-**Need for secure systems, Proactive security development process, Security principles to live by and threat modelling.
UNIT-II (12 Hrs)	**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
UNIT-III (12 Hrs)	**Secure Coding in C++ and Java-** Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double –free vulnerabilities, Integer security, Mitigation strategies
UNIT-IV (12 Hrs)	**Database and Web Specific Input Issues-** Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS related attacks and remedies
UNIT-V (12 Hrs)	**Software Security Engineering-** Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software security practices and knowledge for architecture and design

Text Books:

1	Writing Secure Code, 2nd Edition, Michael Howard, David LeBlanc, Microsoft Press, 2003
Reference Books:	
1.	Secure Coding in C and C++, Robert C. Sea cord, 2nd edition, Pearson Education, 2013
2.	Software Security Engineering: A guide for Project Managers, 1st ed, Julia H. Allen, Sean J.Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, Addison-Wesley Professional,2008
e-Resources	
1	https://www.geeksforgeeks.org/blogs/secure-coding-what-is-it-all-about/

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D25259B3	PE	3	--	--	3	40	60	3 Hrs.

DESIGN PATTERNS

Computer Science & Technology

Course Objectives:

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

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Construct a design consisting of a collection of modules	K5
2.	Exploit well-known design patterns (such as Iterator, Observer, Factory and Visitor). Analyze	K4
3.	Distinguish between different categories of design patterns. Analyze	K5
4.	Ability to understand and apply common design patterns to incremental/iterative development. Understand	K3
5.	Identify appropriate patterns for design of given problem	K4

SYLLABUS

UNIT-I (10Hrs)	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.
UNIT-II (12Hrs)	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.
UNIT-III (12Hrs)	Structural Pattern Part-I, Adapter, Bridge, Composite. Structural Pattern Part-II, Decorator, Facade, Flyweight, Proxy.
UNIT-IV (12Hrs)	Behavioral Patterns Part: I, Chain of Responsibility, CommandInterpreter, Iterator. Behavioral Patterns Part: II, Mediator, Memento, Observer, Discussion of Behavioral Patterns.
UNIT-V	Behavioral Patterns Part: III, State, Strategy, Template Method, Visitor, Discussion of

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(12Hrs)	Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern Community, An Invitation, A Parting Thought.
Textbooks:	
1.	Design Patterns By Erich Gamma, Pearson Education
2.	Marc Farley Osborne, "Building Storage Networks'', Tata McGraw-Hill, 2001.
3.	Robert Spalding and Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, 2003.
4.	Meeta Gupta, "Storage Area Network Fundamentals", Pearson Education Ltd., 2002.
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
3.	GeraldJ Kowalski and Mark TMaybury," Information Storage Retrieval Systems theory &Implementation", BS Publications, 2000.
4.	The jendra BS, "Disaster Recovery& Business continuity", Shroff Publishers& Distributors, 2006.
e-Resources	
1.	https://www.geeksforgeeks.org/system-design/software-design-patterns/

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2525904	PC	--	1	2	2	40	60	3 Hrs.

MACHINE LEARNING LAB

Computer Science & Technology

Course Objectives:

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

Course Outcomes

S.No	Outcome	Knowledge Level
1	Apply statistical measures and preprocessing techniques such as central tendency, dispersion, attribute selection, handling missing values, discretization, and outlier elimination to prepare datasets for analysis.	**K4**
2	Implement and evaluate supervised learning algorithms including KNN, Decision Trees, Random Forest, Naïve Bayes, Support Vector Machines, Logistic Regression, and Multi-layer Perceptron for classification and regression tasks.	**K5**
3	Apply and assess unsupervised learning algorithms such as K-Means, Fuzzy C-Means, and Expectation Maximization for clustering, and analyze their performance based on parameter tuning and distance measures.	**K4**
4	Demonstrate the ability to select and tune models by optimizing algorithm parameters, comparing performance metrics, and applying suitable models to solve real-world machine learning problems.	**K4**

LIST OF EXPERIMENTS

1.	Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.
2.	Apply the following Pre-processing techniques for a given dataset. a. Attribute selection b. Handling Missing Values c. Discretization d. Elimination of Outliers
3.	Apply KNN algorithm for classification and regression
4.	Demonstrate decision tree algorithm for a classification problem and Perform parameter tuning for better results
5.	Demonstrate decision tree algorithm for a regression problem
6.	Apply Random Forest algorithm for classification and regression
7.	Demonstrate Naïve Bayes Classification algorithm
8.	Apply Support Vector algorithm for classification
9.	Demonstrate simple linear regression algorithm for a regression problem
10.	Apply Logistic regression algorithm for a classification problem
11.	Demonstrate Multi-layer Perceptron algorithm for a classification problem

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.
13.	Demonstrate the use of Fuzzy C-Means Clustering
14.	Demonstrate the use of Expectation Maximization based clustering algorithm
Reference Books:	
1.	Han, J., Kamber, M., & Pei, J. Data Mining: Concepts and Techniques (3rd Edition) Morgan Kaufmann, 2011.
2.	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R (2nd Edition) Springer, 2021.
3.	Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd Edition) O'Reilly Media, 2022.
4.	Mehmed Kantardzic Data Mining: Concepts, Models, Methods, and Algorithms (3rd Edition) Wiley-IEEE Press, 2020.

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Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2525905	PC	--	1	2	2	40	60	3 Hrs.

GENERATIVE AI LAB

Computer Science & Technology

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

S.No	Outcome	Knowledge Level
1	To learn Python and TensorFlow skills for Generative AI	**K4**
2	To study techniques for cleaning and preparing data for Generative AI tasks., image and video generation using trained Generative AI models	**K5**
3	Implement a Long Short-Term Memory (LSTM) network using TensorFlow 2	**K4**
4	To develop innovative applications using generative AI tools and techniques and Generate Novel Music Compositions	**K4**

LIST OF EXPERIMENTS

1.	Write Python scripts to implement basic operations and TensorFlow 2 tensors
2.	Implement a Generative Adversarial Network (GAN) architecture using TensorFlow 2. Train the GAN model on a dataset such as MNIST or CIFAR-10 for image generation tasks.
3.	Train a GAN model on a custom dataset for image generation. Experiment with hyper parameters, loss functions, and optimization techniques to optimize GAN training
4.	Explore advanced techniques such as Wasserstein GANs, Progressive GANs, or StyleGANs for image generation. Implement and compare these techniques for generating high-quality images
5.	Develop applications for image and video generation using trained Generative AI models. Use the models to generate art, create deep fakes, or synthesize video content
6.	Text Generation: Implement a Long Short-Term Memory (LSTM) network using TensorFlow 2 for text generation tasks. Train the LSTM model on a dataset of text sequences and generate new text samples
7.	Text generation: Implement a Transformer-based language model (e.g., GPT) using TensorFlow 2 for text generation. Fine-tune the model on a text corpus and generate coherent and contextually relevant text
8.	Text generation: Develop applications for text generation tasks such as story generation, dialogue generation, or code generation using trained Generative AI models
9.	Music Generation: Pre-process music data and represent it in a suitable format for music generation tasks. Explore MIDI or audio representations for training Generative AI models
10.	Generate Novel Music Compositions: Transformer-based Music Generation: Implement a Transformer-based architecture (e.g., Music BERT, Music GPT) using Tensor Flow 2 for music Generation. Fine-tune the model on a music dataset and generatenovel music

	compositions
Reference Books:	
1.	Responsible AI: Implementing Ethical and Unbiased Algorithms, by Shashin Mishra and Sray Agarwal
2.	Generative AI in Practice: 100+ Amazing Ways Generative Artificial Intelligence is Changing business and Society, Bernard Marr
3.	“Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models”, Joseph Babcock and Raghav Bali
4.	"Generative Adversarial Networks: An Overview" by Vinod Nair and Geoffrey E. Hinton.
5	"Hands-On Generative Adversarial Networks with PyTorch 1.x" by Stefano Bosisio and Vijaya bhaskar J.

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2525906	**PR**	**--**	**--**	**2**	**1**	**100**	**--**	**3 Hrs.**
SEMINAR -II								
Computer Science & Technology								
A student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful								

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Regulation: R25	**II - M.Tech. (CST) III - Semester**

COMPUTER SCIENCE & TECHNOLOGY

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2535901	Research Methodology and IPR / Swayam 12 week MOOC course – RM&IPR	PC	3	0	0	3	40	60	100
D2535902	Summer Internship/ Industrial Training (8-10 weeks)*	PR	--	--	--	3	100	--	100
D2535903	Comprehensive Viva#	PR	--	--	--	2	100	--	100
D2535904	Dissertation Part – A$	PR	--	--	20	10	100	--	100
		TOTAL	**3**	**--**	**20**	**18**	**340**	**60**	**400**

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

Course Code	Category	L	T	P	C	CIE	SEE	Exam
D2535901	PC	3	--	--	3	40	60	3 Hrs.

RESEARCH METHODOLOGY AND IPR

Computer Science & Technology

Course Objectives:

1.	To bring awareness on Research Methodology and research ethics.
2.	Familiarize the concepts of IPR.

Course Outcomes:

S.No	Course Outcome	Knowledge Level
1.	Identify the research problem through effective literature review and data analysis	**K3**
2.	Develop a technical paper with essential sections	**K3**
3.	Choose the patents, trade, and copyrights for protecting intellectual creations	**K3**
4.	Identify patents rights and transfer of technology	**K3**
5.	Identify appropriate IPR mechanism for protecting various types of intellectual creations.	**K3**

SYLLABUS

UNIT-I (10Hrs)	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
UNIT-II (12Hrs)	Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
UNIT-III (12Hrs)	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
UNIT-IV (12Hrs)	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
UNIT-V (12Hrs)	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1.	Stuart Melville and Wayne Goddard, ―Research methodology: an introduction for science & engineering students'
2.	Wayne Goddard and Stuart Melville, ―Research Methodology: An Introduction
3.	Ranjit Kumar, 2nd Edition, ―Research Methodology: A Step by Step Guide for beginners
Reference Books:	
1.	Halbert, ―Resisting Intellectual Property‖, Taylor & Francis Ltd, 2007.
2.	Mayall, ―Industrial Design‖, McGraw Hill, 1992.
3.	Niebel, ―Product Design‖, McGraw Hill, 1974.
4.	Asimov, ―Introduction to Design‖, Prentice Hall, 1962
5.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, ― Intellectual Property in New Technological Age, 2016.
6.	T. Ramappa, ―Intellectual Property Rights Under WTO‖, S. Chand, 2008

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2535902	PR	--	--	--	3	100	--	3 Hrs.

SUMMER INTERNSHIP

Computer Science & Technology

Students shall undergo mandatory summer internship / industrial training for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of a Professor of the department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2535903	PR	--	--	--	2	100	--	3 Hrs.

COMPREHENSIVE VIVA

Computer Science & Technology

The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. The duration of the viva will be around 30 min. The examination committee will be constituted by the HoD and consist of Professor of the department and two faculty. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2535904	PR	--	--	20	10	100	--	3 Hrs.

DISSERTATION PART – A

Computer Science & Technology

The Student has to register for Dissertation-I / Industrial project in III semester. Student has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

Continuous assessment of Dissertation-I during the III-Semester will be monitored by the PRC.

Dissertation-Part A will be only internal evaluation by PRC for 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

The candidate shall submit a status report to the PRC in two stages, each accompanied by an oral presentation, with a minimum interval of three months between the two

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Regulation: R25	**II - M.Tech. (CST) IV - Semester**

COMPUTER SCIENCE & TECHNOLOGY

COURSE STRUCTURE
(With effect from 2025-26 admitted Batch onwards)

Course Code	Course Name	Category	L	T	P	Cr	C.I.E.	S.E.E.	Total Marks
D2545901	Dissertation Part – B%	PR	--	--	32	16	--	100	100
		TOTAL	**--**	**--**	**32**	**16**	**--**	**100**	**100**

% External Assessment

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Course Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
D2545901	PR	--	--	32	16	--	100	3 Hrs.

DISSERTATION PART B

Computer Science & Technology

The student has to continue his/her work from Dissertation Part-A to complete Dissertation Part-B in IV semester.

Continuous assessment of Dissertation Part-B during IV-Semester will be monitored by the PRC.

Dissertation Part-B is evaluated for 100 external marks based on Review and Viva Voce.

Review and Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work for 100 marks.

If the report of the Viva-Voce is unsatisfactory (ie, < 50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the College.

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