You Choose, We Do It
St. JOSEPH'S COLLEGE OF ENGINEERING
(An Autonomous Institution)
St. JOSEPH'S GROUP OF INSTITUTIONS
OMR, CHENNAI - 119

M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATION – 2025

CHOICE BASED CREDIT SYSTEM

I - IV SEMESTERS CURRICULA AND SYLLABI

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

Profession: Graduates excel in computer technology in order to pursue higher education and research, or have a successful career in industries or as entrepreneurs.

Technophile: Graduates will have the ability and attitude to adapt emerging technological changes in the field of Computer Science and Engineering.

Team Player: Possess an ability to collaborate as a team member and team leader to affect technical solutions for computing systems, providing improved function and outcomes.

PROGRAM OUTCOMES POs:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‗s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs):

Efficacy: Ability to apply mathematical methodologies and foundational concepts of Computer Science and Engineering to solve computational tasks, model the real world problem using appropriate data structure and algorithm with suitable programming languages.

Potentiality to design: Analyze, design and evaluate a computer based system by applying software engineering principles and practices for developing quality software for scientific and business applications.

Technical expertise: Adapt to modern engineering technologies and thereby build robust, reliable, maintainable, scalable, innovative and efficient computing systems by considering social, environmental, economic, and security constraints

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA25151	Advanced Mathematics for computing	FC	60	3	1	0	4
2	CP25101	Advanced Data Structures and Algorithms	PCC	60	3	1	0	4
3	CP25102	Advanced Database Technologies	PCC	45	3	0	0	3
4	CP25103	Networking Principles and Protocols	PCC	45	3	0	0	3
5	CP25104	Machine Learning	PCC	45	3	0	0	3
6	RM25101	Research Methodology and IPR	RMC	45	3	0	0	3
PRACTICAL								
7	CP25105	Machine Learning Laboratory	PCC	60	0	0	4	2
Total					**18**	**2**	**4**	**22**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CP25201	Advanced Operating Systems	PCC	45	3	0	0	3
2	CP25202	Big Data Mining and Analytics	PCC	45	3	0	0	3
3	CP25203	Soft Computing	PCC	60	3	1	0	4
4	CP25204	Cloud Computing Technologies	PCC	45	3	0	0	3
5		Professional Elective - I	PEC	45	3	0	0	3
6		Professional Elective - II	PEC	45	3	0	0	3
PRACTICAL								
7	CP25205	Big Data Mining Laboratory	PCC	60	0	0	4	2
Total					**18**	**1**	**4**	**21**
8		Audit Course (Optional)	AC		2	0	0	0

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CP25301	Cyber Security Strategies	PCC	45	3	0	0	3
2		Professional Elective - III	PEC	45	3	0	0	3
3		Professional Elective - IV	PEC	45	3	0	0	3
PRACTICAL								
4	CP25302	Project Work - Phase I	EEC	180	0	0	12	6
Total					**9**	**0**	**12**	**15**
5		Value Added Course	EEC	Two Weeks				1
6		Internship	EEC	Two Weeks				1

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1	CP25401	Project Work - Phase II	EEC	360	0	0	24	12
Total					**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	MA25151	Advanced Mathematics for computing	60	3	1	0	4

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP25101	Advanced Data Structures and Algorithms	60	3	1	0	4
2	CP25102	Advanced Database Technologies	45	3	0	0	3
3	CP25103	Networking Principles and Protocols	45	3	0	0	3
4	CP25104	Machine Learning	45	3	0	0	3
5	CP25105	Machine Learning Laboratory	60	0	0	4	2
6	CP25201	Advanced Operating Systems	45	3	0	0	3
7	CP25202	Big Data Mining and Analytics	45	3	0	0	3
8	CP25203	Soft Computing	60	3	1	0	4
9	CP25204	Cloud Computing Technologies	45	3	0	0	3
10	CP25205	Big Data Mining Laboratory	60	0	0	4	2
11	CP25301	Cyber Security Strategies	45	3	0	0	3

RESEARCH METHODOLOGY COURSE (RMC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	RM25101	Research Methodology and IPR	45	3	0	0	3

PROFESSIONAL ELECTIVE COURSES (PEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP25001	Design and Analysis of Parallel Algorithms	45	3	0	0	3
2	CP25002	Open Source Programming	45	3	0	0	3
3	CP25003	Compiler Optimization Techniques	45	3	0	0	3
4	CP25004	Computer Graphics and Image Processing	45	3	0	0	3
5	CP25005	Internet of Things	45	3	0	0	3
6	CP25006	Human Computer Interaction	45	3	0	0	3
7	CP25007	Imaging and Multimedia Systems	45	3	0	0	3
8	CP25008	Agent Based Intelligent Systems	45	3	0	0	3
9	CP25009	Deep Learning	45	3	0	0	3
10	CP25010	Software Quality Assurance	45	3	0	0	3
11	CP25011	Block chain Technologies	45	3	0	0	3
12	CP25012	Speech Processing and Synthesis	45	3	0	0	3
13	CP25013	Advanced Software Engineering	45	3	0	0	3
14	CP25014	Mobile Network Systems	45	3	0	0	3
15	CP25015	Information Retrieval Techniques	45	3	0	0	3
16	CP25016	Full Stack Web Application Development	45	3	0	0	3
17	CP25017	Software Architecture and Design Patterns	45	3	0	0	3
18	CP25018	Data Visualization Techniques	45	3	0	0	3
19	CP25019	Social Network Analysis	45	3	0	0	3
20	CP25020	Cognitive Science	45	3	0	0	3
21	CP25021	Natural Language Processing	45	3	0	0	3
22	CP25022	Quantum Computing	45	3	0	0	3
23	CP25023	Generative AI	45	3	0	0	3
24	CP25024	Mobile Application Development	45	3	0	0	3
25	CP25025	GPU Computing	45	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP25302	Project Work - Phase I	180	0	0	12	6
2	CP25401	Project Work - Phase II	360	0	0	24	12
3		Value Added Course	Two Weeks				1
4		Internship	Two Weeks				1

AUDIT COURSE (AC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AC25201	Constitution of India		2	0	0	0
2	AC25202	Value Education		2	0	0	0
3	AC25203	Pedagogy Studies		2	0	0	0
4	AC25204	Stress Management by Yoga		2	0	0	0
5	AC25205	Personality Development Through Life Enlightenment Skills		2	0	0	0
6	AC25206	Unnat Bharat Abhiyan		2	0	0	0
7	AC25207	Essence of Indian Knowledge Tradition		2	0	0	0
8	AC25208	Sanga Tamil Literature Appreciation		2	0	0	0

CREDIT SUMMARY

S.No	SUBJECT AREA	I	II	III	IV	CREDITS TOTAL	PERCENTAGE
1	**FC**	4				**4**	**5.71**
2	**PCC**	15	15	3		**33**	**47.14**
3	**PEC**		6	6		**12**	**17.14**
4	**RMC**	3				**3**	**4.28**
5	**EEC**			6	12	**18**	**25.71**
Total		**22**	**21**	**15**	**12**	**70**	**100**

MA25151	ADVANCED MATHEMATICS FOR COMPUTING	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queueing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems

UNIT I	TESTING OF HYPOTHESIS	12
Sampling distributions – Estimation of parameters – Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion.		CO1
UNIT II	**RANDOM VARIABLES**	**12**
Random variables-Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions–Function of Random variable-Moments, Moment generating function.		CO2
UNIT III	**QUEUING MODELS**	**12**
Poisson Process – Markovian Queues – Single and Multi-server Models – Model 1: (M/M/1): FIFO/∞/∞)-Model 2: (M/M/1): FIFO/N/∞)- Model 3: (M/M/C): FIFO/∞/∞)- Model 4: (M/M/C): FIFO/N/∞)- Little"s formula –Machine Interference Model – Steady State analysis – Self Service Queue		CO3
UNIT IV	**SIMULATION**	**12**
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation –Applications to Queuing systems.		CO4
UNIT V	**LINEAR PROGRAMMING**	**12**
Formulation – Graphical solution – Simplex method – Two phase method –Transportation and Assignment Problems.		CO5
		TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund"s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Hamdy A. Taha, “Operations Research: An Introduction”, Prentice Hall of India Pvt., Ltd. New Delhi, Eighth Edition, 2008.
3. Jay L. Devore, ”Probability and Statistics for Engineering and the Sciences”, Cengage Learning, Seventh Edition, 2011.
4. Winston, W .L., “Operations Research”, Thomson–Brooks / Cole, Fourth Edition, 2003.
5. Gross, D., Thompson, J. M., Shortle, J. F., Harris, C. M. Fundamentals of Queueing Theory. Wiley. First Edition. 2018
6. J. Medhi, ”Stochastic models of Queuing Theory”, Academic Press, Elsevier, Amsterdam, 2003

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Gain the knowledge on testing of hypotheses on data from biological, economical and social experiments and all kinds of generalizations based on information from samples.
CO2	Identify the type of random variable and distribution for a given operational conditions /scene
CO3	The course gives ideas on Queueing models modeling through Markovian Queues through which students will be able to Design appropriate queuing model for a given problem / system situation.
CO4	Handle the real life situation through discrete event simulation and do the analysis.
CO5	Learn an optimization technique by learning the solution procedures of linear programming.

CP25101	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To analyze time complexity using asymptotic notations for iterative and recursive algorithms.
- To design optimal algorithms using tree data structures.
- To select algorithms based on graph data structures.
- To apply suitable design techniques for problem-solving.
- To understand NP problems and their reductions.

UNIT I	ROLE OF ALGORITHMS IN COMPUTING	9+3
Algorithms - Analyzing algorithms - Growth of functions: Asymptotic notation – Standard notations and common functions; Recurrences - Methods for solving recurrences.		CO1
UNIT II	**HIERARCHICAL DATA STRUCTURES**	**9+3**
Binary search trees: Basics -- Query, Insertion and Deletion; Red-black trees: Properties of Red-black trees -- Rotations -- Insertion -- Deletion; B-Trees: Basic operations on B-Trees; Binomial heaps: Structure -- Mergeable-heap operations; Disjoint-set operations -- Disjoint-set forests.		CO2
UNIT III	**GRAPHS**	**9+3**
Representations of graphs - Breadth-first search - Depth-first search - Topological sort – Strongly connected components; Single-source shortest paths: Bellman-Ford algorithm; Single-source shortest paths in directed acyclic graphs: Dijkstra's algorithm; All-pairs shortest paths: Floyd-Warshall algorithm.		CO3
UNIT IV	**ALGORITHM DESIGN TECHNIQUES**	**9+3**
Greedy Algorithms: The job/event scheduling problem - Minimum-spanning-tree - Prim's and Kruskal's algorithms; Recursive backtracking: N-queens problem - Map Colouring problem; Dynamic programming - Longest common subsequence problem - Knapsack problem		CO4
UNIT V	**NP COMPLETENESS**	**9+3**
Reductions and NP -- Completeness -- Satisfiability – Proving NP-Completeness -- Circuit SAT, CNFSAT, 3SAT problems.		CO5

TOTAL : 60 PERIODS

TEXT BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms", Third Edition, Prentice-Hall, 2012
2. Jeff Edmonds, ``How to Think about Algorithms'', Cambridge University Press, 2008.

REFERENCES

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ``Data Structures and Algorithms'', Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ``Algorithms'', Fourth Edition, Pearson Education, 2012.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply asymptotic notations and methods to find the time complexity of iterative and recursive algorithms.
CO2	Develop optimal algorithms using tree data structures.
CO3	Choose algorithms using graph data structures.
CO4	Determine suitable design techniques for solving problems.
CO5	Explain NP type problems and their reductions.

CP25102	ADVANCED DATABASE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To design relational, distributed, active, and temporal databases for enterprises.
- To gain knowledge in advanced database systems and their applications.
- To comprehend the use of XML, web, spatial, multimedia, and deductive databases.
- To develop proficiency in using MongoDB and NoSQL databases for enterprise data management.
- To apply advanced database technologies to meet enterprise data needs.

UNIT I	RELATIONAL MODEL	9
Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization – First Normal Form – Second Normal Form – Third Normal Form – Boyce Codd Normal Form – Fourth Normal Form – Fifth Normal Form.		CO1
UNIT II	**PARALLEL AND DISTRIBUTED DATABASES**	**9**
Parallel Databases – I/O Parallelism - Inter-Query and Intra-Query Parallelism– Inter-Operation and Intra-operation Parallelism – Performance evaluation for Parallel DB Systems –Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Load balancing tools for DDB – DDB Security.		CO2
UNIT III	**ADVANCED DATABASES**	**9**
XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity – Java Database Connectivity – Accessing Relational Database using PHP – Analytical Operations involved in Processing Spatial Data –Spatial Data Types and Models– Spatial Operators and Spatial Queries–Spatial Data Indexing–Multimedia Database Concepts - Introduction to Deductive Databases–Prolog/Datalog Notation– Clausal Form and Horn Clauses–Interpretations of Rules.		CO3
UNIT IV	**ACTIVE TEMPORAL AND DEDUCTIVE DATABASES**	**9**
Event Condition Action Model – Design and Implementation Issues for Active Databases – Termination, Confluence, Determination and Modularization – Temporal Databases – Interpreting Time in Relational Databases – Deductive Databases – Data log Queries		CO4
UNIT V	**NOSQL DATABASES**	**9**
NoSQL Database vs.SQL Databases – CAP Theorem –Migrating from RDBMS to NoSQL – MongoDB – CRUD Operations– MongoDB Sharding – MongoDB Replication – Web Application Development using MongoDB with PHP and Java.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2016.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Seventh Edition, McGraw Hill Education 2020.
3. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams Publishing, 2014.
4. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007

REFERENCES

1. V.S.Subramanian, “Principles of Multimedia Database Systems”, Harcourt India Pvt. Ltd., 2001.
2. C.J.Date, A.KannanandS.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design a Relational Database for an Enterprise.
CO2	Design a Distributed Database, Active Database and Temporal Database for an Enterprise.
CO3	Gain the knowledge in advanced databases.
CO4	Comprehend the use of XML Database, Web Database, Spatial Database, Multimedia Database and Deductive Database.
CO5	Use MongoDB NoSQL Database to Maintain Data of an Enterprise.

CP25103	NETWORKING PRINCIPLES AND PROTOCOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify features of integrated and differentiated services in networks.
- To demonstrate the functionality of protocols in wireless networks.
- To analyze the implementation of next-generation networks.
- To design protocols for efficient cellular network communication.
- To explore 5G networks and their diverse applications.

UNIT I	NETWORK ARCHITECTURE AND QoS	9
Overview of TCP/IP Network Architecture –High Speed Networks – Frame Relay – Asynchronous Transfer Mode – High-Speed LANs –Integrated Services Architecture – Approach – Components – Services – Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.		CO1
UNIT II	**CELLULAR NETWORKS**	**9**
GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN – Core and Radio Network Mobility Management – UMTS Security.		CO2
UNIT III	**WIRELESS NETWORKS**	**9**
IEEE 802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX – 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth –Protocol Stack – Security – Profiles.		CO3
UNIT IV	**4G NETWORKS**	**9**
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) – 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modeling for 4G.		CO4
UNIT V	**5G NETWORKS**	**9**
Introduction – Pillars – IoT and Context Awareness – Networking Reconfiguration and Virtualization Support – Mobility – QoS Control – Approach for resource over-provisioning – Smart Cells – Capacity limits and achievable gains with densification – Mobile data demand – Next Generation Wireless Networks – Mobile clouds – Technologies and Services for Future Communication Platforms – Cognitive Radio for 5G Wireless Networks.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, “High Speed Networks and Internets: Performance and Quality of Service”, Prentice Hall, Second Edition, 2002.
2. Martin Sauter, “From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband”, Wiley, 2014.

REFERENCE BOOKS

1. Savo G Glisic, “Advanced Wireless Networks – 4G Technologies”, John Wiley & Sons, 2007.
2. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the different features of integrated and differentiated services
CO2	Demonstrate various protocols of wireless networks
CO3	Analyze the use of next generation networks
CO4	Design protocols for cellular networks
CO5	Explore 5G networks and applications

CP25104	MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamental concepts of machine learning.
- To analyze linear and non-linear techniques for solving classification problems.
- To apply unsupervised, reinforcement, probabilistic, and evolutionary algorithms to real-world problems.
- To analyze the role of neural networks in machine learning and deep learning.
- To identify suitable machine learning applications, implement appropriate algorithms, and evaluate results.

UNIT I	INTRODUCTION	9
Machine Learning – Types of Machine Learning: Supervised Learning, Unsupervised Learning – Machine Learning process - Testing machine learning algorithms - Parametric Vs non-parametric models - Mathematical Basics for Machine Learning: Probability and Statistics for Machine Learning – Probability Distributions – Decision Theory – Information theory – Bias Variance tradeoff.		CO1
UNIT II	**SUPERVISED LEARNING METHODS**	**9**
Regression: Introduction - Linear Regression - Least Squares - Under fitting and Overfitting - CrossValidation - Lasso Regression - Logistic Regression; Classification: Linear and Non-linear models - Support Vector Machines - Kernel Methods; K-Nearest Neighbours; Learning with Trees: constructing Decision Tree using ID3 - Classification and regression trees (CART); Decision by Committee: Ensemble Methods – Bagging - Boosting - Random Forest; Evaluation of Classification Algorithms.		CO2
UNIT III	**UNSUPERVISED AND REINFORCEMENT LEARNING**	**9**
Clustering- K-means – Mixtures of Gaussians – Vector Quantization – The Self Organizing Feature Map- Dimensionality Reduction, Linear Discriminant Analysis, Principal Components Analysis, Independent Components Analysis - Reinforcement Learning : Q learning, Deterministic and Nondeterministic Rewards and Actions Temporal Difference Learning - Markov Decision Process.		CO3
UNIT IV	**PROBABILISTIC GRAPHICAL MODELS**	**9**
Graphical Models – Undirected Graphical Models : Markov Random Fields – Directed Graphical Models : Bayesian Networks – Conditional Independence properties – Markov Random Fields, Hidden Markov Models – Conditional Random Fields(CRFs)		CO4
UNIT V	**NEURAL NETWORKS AND DEEP LEARNING**	**9**
Neural Networks: The Brain and the Neuron - Perceptron learning algorithm; Multi-Layer Perceptron: Back propagation algorithm - Multi-layer perceptron in Practice, Deep Learning: Introduction - Convolution Neural Networks - Recurrent Neural Networks – Stochastic Neurons: the Boltzmann Machine – Deep Belief Networks.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRC Press, Second Edition, 2014
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012

REFERENCE BOOKS

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
3. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the basic concepts of machine learning
CO2	Analyze linear and non-linear techniques for classification problems
CO3	Apply unsupervised and reinforcement algorithms, probabilistic and evolutionary approaches for the given problems
CO4	Analyze importance of neural networks in machine learning and deep learning
CO5	Identify applications suitable for different types of Machine Learning and to Implement appropriate learning algorithm for an application and to analyze the results.

RM25101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

OBJECTIVES

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I	RESEARCH DESIGN	9
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.		CO1
UNIT II	**DATA COLLECTION AND SOURCES**	**9**
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.		CO2
UNIT III	**DATA ANALYSIS AND REPORTING**	**9**
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.		CO3
UNIT IV	**INTELLECTUAL PROPERTY RIGHTS**	**9**
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.		CO4
UNIT V	**PATENTS**	**9**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.		CO5
		TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the concept of research methods and apply in problem solving.
CO2	To analyze the data using statistical tools to solve practical problems.
CO3	To understand the guidelines for effective report writing
CO4	To understand and acquire the knowledge on Intellectual Property Rights
CO5	To acquire knowledge on patent and copyright, trademark, and industrial design

CP25105	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ The course serves as a comprehensive introduction to various topics in machine learning.
- ❖ Students should be able to design and implement machine learning solutions to classification, regression, and clustering problems
- ❖ Students should able to evaluate and interpret the results of the algorithms.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	**CO1**
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**CO2**
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	**CO3**
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems,O'reily,Second edition,2019

WEB REFERENCES
1. https://github.com/profthyagu/Python--Candidate-Elimination-Algorithm 2. https://machinelearningmastery.com/tutorial-to-implement-k-nearest-neighbors-in-python-from-scratch/ 3. https://www.geeksforgeeks.org/ml-locally-weighted-linear-regression/

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the implementation procedures for the machine learning algorithms. Design Java/Python programs for various Learning algorithms.
CO2	Apply appropriate data sets to the Machine Learning algorithms.
CO3	Identify and apply Machine Learning algorithms to solve real world problems.

CP25201	ADVANCED OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify the features and functionalities of distributed operating systems.
- To demonstrate various protocols used in distributed operating systems.
- To understand and analyze the features of real-time operating systems.
- To discuss the characteristics of mobile operating systems.
- To explore and discuss the features of cloud operating systems.

UNIT I	INTRODUCTION	9
Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages		CO1
UNIT II	**DISTRIBUTED OPERATING SYSTEMS**	**9**
Distributed Mutual Exclusion Algorithms – Classification – Preliminaries – Simple Solution – Lamport's Algorithm – Ricart-Agrawala Algorithm – Suzuki-Kasami's Broadcast Algorithm – Raymond's Tree-Based Algorithm – Distributed Deadlock Detection – Preliminaries – CentralizedDeadlock Detection Algorithms – Distributed Deadlock Detection Algorithms – Path Pushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms – AgreementProtocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak- Pease Algorithm		CO2
UNIT III	**DISTRIBUTED RESOURCE MANAGEMENT**	**9**
Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System– Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory – LoadDistributing Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – FaultTolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol		CO3
UNIT IV	**REAL TIME OPERATING SYSTEMS**	**9**
Basic Model of Real - Time Systems – Characteristics – Application of Real - Time Systems – Real - Time Task Scheduling – Handling Resource Sharing		CO4
UNIT V	**MOBILE AND CLOUD OPERATING SYSTEMS**	**9**
Android – Overall Architecture – Linux Kernel – Hardware Support – Native User-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems		CO5
TOTAL : 45 PERIODS		

TEXT BOOKS

1. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems”, Tata MC Graw-Hill, 2001.

REFERENCE BOOKS

1. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.
2. Karim Yaghmour, “Embedded Android”, O’Reilly, First Edition, 2013.
3. Nikolay Elenkov, “Android Security Internals: An In-Depth Guide to Android’s Security Architecture”, No Starch Press, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the features of distributed operating systems
CO2	Demonstrate the various protocols of distributed operating systems
CO3	Identify the different features of real time operating systems
CO4	Discuss the features of mobile operating systems
CO5	Discuss the features of cloud operating systems

CP25202	BIG DATA MINING AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyze and interpret streaming data
- To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data

UNIT I	DATA MINING AND LARGE SCALE FILES	9
Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.		CO1
UNIT II	**SIMILAR ITEMS**	**9**
Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.		CO2
UNIT III	**MINING DATA STREAMS**	**9**
Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.		CO3
UNIT IV	**LINK ANALYSIS AND FREQUENT ITEMSETS**	**9**
Page Rank – Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.		CO4
UNIT V	**CLUSTERING**	**9**
Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
2. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001.

REFERENCE BOOKS

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
2. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.

WEB REFERENCES	
1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf 2. https://swayam.gov.in/nd2_arp19_ap60/preview 3. https://www.tutorialspoint.com/big_data_analytics/index.htm	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Design algorithms by employing Map Reduce technique for solving Big Data problems
CO2	Design algorithms for Big Data by deciding on the apt Features set
CO3	Design algorithms for handling petabytes of datasets
CO4	Design algorithms and propose solutions for Big Data by optimizing main memory consumption
CO5	Design solutions for problems in Big Data by suggesting appropriate clustering techniques

CP25203	SOFT COMPUTING	L	T	P	C
		3	1	0	4

OBJECTIVES

- Understand Soft Computing concepts, technologies, and applications
- Understand the underlying principle of soft computing with its usage in various applications.
- Understand neural networks and its functionalities.
- Understand different fuzzy tools to solve real life problems.
- Understand Genetic algorithms and implement in case studies.

UNIT I	SOFT COMPUTING INTRODUCTION	9+3
Overview of Soft Computing, Difference between Soft and Hard computing, Brief descriptions of different components of soft computing including Artificial intelligence systems Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE		CO1
UNIT II	**LEARNING TECHNIQUES**	**9+3**
Artificial Neural Networks: Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.		CO2
UNIT III	**NEURAL NETWORKS**	**9+3**
Neural Networks as Associative Memories - Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks – Competitive Learning, Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.		CO3
UNIT IV	**FUZZY LOGIC**	**9+3**
Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference System Fuzzy Logic Crisp & fuzzy sets fuzzy relations fuzzy conditional statements fuzzy rules fuzzy algorithm. Fuzzy logic controller.		CO4
UNIT V	**GENETIC ALGORITHMS**	**9+3**
Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA case studies. Introduction to genetic programming- basic concepts.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Eiben A. E. and Smith J. E., ―Introduction to Evolutionary Computing‖, Second Edition, Springer, Natural Computing Series, 2007.
2. Engelbrecht A. P., ―Fundamentals of Computational Swarm Intelligence‖, John Wiley & Sons, 2006.
3. Konar. A, ―Computational Intelligence: Principles, Techniques and Applications‖, Springer Verlag, 2005.

REFERENCE BOOKS

1. Kumar S., —Neural Networks - A Classroom Approach‖, Tata McGraw Hill, 2004.
2. Ross T. J., —Fuzzy Logic with Engineering Applications‖, McGraw Hill, 1997.
3. S. Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall of India, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop application on different soft computing techniques.
CO2	Develop application on different soft computing techniques in Neural network
CO3	Develop application techniques based on classification algorithms.
CO4	Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system
CO5	Develop application on different soft computing techniques in GA.

CP25204	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
- To identify the architecture, infrastructure, and delivery models of cloud computing.
- To explain core issues of cloud computing such as security, privacy, and interoperability.
- To choose appropriate technologies, algorithms, and approaches for addressing cloud computing issues.
- To set up and use cloud platforms and services effectively

UNIT I	DISTRIBUTED SYSTEMS AND ENABLING TECHNOLOGIES	9
Technologies for network based systems - System Models for Distributed and Cloud Computing - Clustering for Massive Parallelism - Design Principles of Computer Clusters - Cluster Job and Resource Management.		CO1
UNIT II	**VIRTUALIZATION**	**9**
Implementation Levels of Virtualization - Virtualization Structures, Tools and Mechanisms - Virtualization of CPU, Memory, and I/O Devices - Virtual Clusters and Resource Management - Virtualization for Data-Center Automation.		CO2
UNIT III	**CLOUD COMPUTING**	**9**
Characteristics - Service Models: IaaS, PaaS, SaaS - Deployment Models: Public, Private, Community, Hybrid Clouds - Data-Center Design and Interconnection Networks - Architectural Design.		CO3
UNIT IV	**EXPLORING CLOUD PLATFORMS AND SERVICES**	**9**
Compute Services – Storage Services – Database Services – Application Services – Content Delivery Services – Analytics Services – Deployment and Management Services – Identity and Access Management Services – Open Source Private Cloud Software.		CO4
UNIT V	**SECURITY AND INTER-CLOUD**	**9**
Trust Management - Defence Strategies - Distributed Intrusion/Anomaly Detection - Data and Software Protection Techniques - Reputation-Guided Protection of Data Centers - Inter-cloud Resource Management.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C Fox, Jack J Dongarra, “Distributed and Cloud Computing From Parallel Processing to the Internet of Things”, Morgan Kauffman imprint of Elsevier, 2012.
2. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-On Approach”, Universities Press (India) Private Limited, 2014.
3. James E Smith and Ravi Nair, “Virtual Machines”, Elsevier, 2005

REFERENCE BOOKS

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, “Cloud Computing, Concept, Technology & Architecture”, Prentice Hall, 2013.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, Tata McGraw-Hill, 2013.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, “Cloud Computing, A Practical Approach”,Tata McGraw-Hill Edition, 2010.
4. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Media, 4th Edition, 2015.
5. John Rittinghouse and James Ransome, “Cloud Computing Implementation, Management and Security”, CRC Press, 2010.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Explain the core issues of cloud computing such as security, privacy and interoperability.
CO4	Choose the appropriate technologies, algorithms and approaches for the related issues.
CO5	Set up and use cloud platforms and services.

CP25205	BIG DATA MINING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ To understand the fundamentals of data mining and implement scalable algorithms for large-scale data processing.
- ❖ To explore techniques for similarity search, stream data mining, and frequent pattern analysis.
- ❖ To apply clustering, link analysis, and machine learning techniques to solve real-world data mining problems.

LIST OF EXPERIMENTS

1. Implement a basic linear regression model on a dataset using Python.	**CO1**
2. Write a simple Map-Reduce program to count word frequencies in a text file.	
3. Extract features from a dataset using TF-IDF and visualize the results.	
4. Compare the performance of local file storage and distributed file systems (e.g., HDFS) using a small dataset.	**CO2**
5. Implement a basic nearest neighbor search for finding similar documents based on text content.	
6. Create a basic document shingling program and calculate document similarity.	**CO3**
7. Use reservoir sampling to estimate the average of a data stream.	
8. Implement the K-Means clustering algorithm and visualize the clusters on a 2D dataset.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley & Sons

WEB REFERENCES

1. https://www.thedatalab.com/skills-talent/online-learning/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to implement distributed data processing techniques like Map-Reduce and apply feature extraction methods to datasets.
CO2	Able to design and implement algorithms for similarity search, mining data streams, and discovering frequent itemsets.
CO3	Able to use clustering and link analysis techniques such as K-Means and PageRank for data organization and ranking.

CP25301	CYBER SECURITY STRATEGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To analyze and assess organizational cybersecurity requirements and implement effective solutions.
- To evaluate network and system vulnerabilities to ensure secure infrastructure.
- To design and develop cybersecurity policies and operational strategies for organizations.
- To apply critical thinking and problem-solving techniques to identify and mitigate cyber threats.
- To understand and utilize various cybersecurity tools for safeguarding systems and networks.

UNIT I	INTRODUCTION	9
Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security Standards - CIA Triad – Cyber security Framework		CO1
UNIT II	**ATTACKS AND COUNTERMEASURES**	**9**
Malicious Attacks, Threats, and Vulnerabilities – Scope of cyber-attacks – Tools used to attack computer systems – security breach – Risks, vulnerabilities and threats. Malware – malicious software attack – social engineering attack – wireless network attack – web application attack Access control - Audit – Authentication - Biometrics - Denial of Service Filters - Ethical Hacking – Firewalls - Scanning, Security policy, Threat Management - Applying software update and patches - Intrusion Detection Systems -Virtual Private Networks –Cryptographic Techniques		CO2
UNIT III	**SECURING THE INFRASTRUCTURE**	**9**
Infrastructure Security in the Real World - Understanding Access-Control and Monitoring Systems - Understanding Video Surveillance Systems - Understanding Intrusion-Detection and Reporting Systems		CO3
UNIT IV	**SECURING LOCAL HOSTS AND NETWORKS**	**9**
Local Host Security in the Real World - Securing Devices - Protecting the Inner Perimeter - Protecting Remote Access Local Network Security in the Real World - Networking Basics - Understanding Networking Protocols - Understanding Network Servers - Understanding Network Connectivity Devices - Understanding Network Transmission Media Security		CO4
UNIT V	**TOOLS**	**9**
Zenmap – Hydra –Kismet – John the Ripper – Airgeddon – Deauther Board – Aircrack-ng – EvilOSX		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Effective Cybersecurity: A Guide to Using Best Practices and Standards, 1st edition, 2019.
2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.

REFERENCE BOOKS

1. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers, 2018.
2. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Addison-Wesley, 2016.
3. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, CRC Press, 2015.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Analyze and evaluate the cyber security needs of an organization.
CO2	Analyze the security issues in networks and computer systems to secure an infrastructure.
CO3	Design operational cyber security strategies and policies
CO4	Apply critical thinking and problem-solving skills to detect current and future attacks on an organization’s computer systems and networks.
CO5	Understand the functionality of cyber security tools.

CP25001	DESIGN AND ANALYSIS OF PARALLEL ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand different parallel structures and models of computation.
- To introduce the various classes of PRAM algorithms.
- To study MIMD algorithms for basic problems.
- Design and analyse parallel algorithms for matrix operations
- To learn about parallel computing models, design and analyze parallel algorithms Interconnection networks.

UNIT I	STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS	9
Structures and algorithms for array processors: SIMD Array Processors, Interconnection networks, Parallel algorithms for Array processors. Multiprocessor architecture- Interconnection networks-multiprocessor control and algorithms- parallel algorithms for multiprocessors.		CO1
UNIT II	**PRAM ALGORITHMS**	**9**
Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting – Merging Two Sorted Lists – Matrix Multiplication- Selection - broadcast- all sums - parallel selection. Searching a random sequence, sorted sequence on PRAM models		CO2
UNIT III	**MIMD**	**9**
Merging - A network for merging - merging on PRAM models. Sorting on a linear array, EREW, CREW and CRCW SIMD models, MIMD Enumeration sort.		CO3
UNIT IV	**MATRIX OPERATIONS**	**9**
Matrix operations- Transposition, Matrix by matrix multiplication, matrix by vector multiplication. Numerical problems- solving systems of linear equations, finding roots of non-linear equations on PRAM models.		CO4
UNIT V	**GRAPHS**	**9**
Graphs - Connected components- dense graphs- sparse graphs. Minimum spanning tree-Solli's algorithm, Disconnected components, Ear decomposition, Directed graphs.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

3. Michael J. Quinn, —Parallel Computing: Theory & Practice‖, Tata McGraw Hill Edition, Second edition, 2017.
4. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, —Fundamentals of Computer Algorithms‖, University press, Second edition , 2011
5. V Rajaraman, C Siva Ram Murthy,‖ Parallel computers- Architecture and Programming —, PHI learning, 2016.

REFERENCE BOOKS

1. Kai Wang and Briggs, —Computer Architecture and Parallel Processing‖, McGraw Hill, 1985.
2. S. G. Akl, —Designa and Analysis of Parallel Algorithms‖, Prentice Hall Inc., 1992.
3. Joseph Jaja, — An Introduction to parallel Algorithms‖, Addison Wesley, 1992.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop structures and algorithms for standard problems and applications.
CO2	Analyse efficiency of different parallel algorithms
CO3	Develop parallel algorithms for standard problems and applications.
CO4	Understand matrix operations in parallel algorithms
CO5	To enable the student to design and analyse parallel algorithms

CP25002	OPEN SOURCE PROGRAMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the difference between open-source programming and familiarity with Linux operating system.
- To build applications based on Open-Source web technology like PHP
- To understand web database applications
- Understanding and development of web applications using open source web technologies like MySql, PERL, TCL, and Python.

UNIT I	INTRODUCTION	9
Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System – Ubuntu Linux – Introduction to shell programming.		CO1
UNIT II	**PHP**	**9**
PHP Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state.		CO2
UNIT III	**WEB DATABASE APPLICATIONS**	**9**
Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL - querying web databases, writing to web databases, validation with Javascript, Form based authentication, protecting data on the web.		CO3
UNIT IV	**MSQL,PERL, TCL, AND PYTHON**	**9**
MySQL - MySQL Functions - Inserting Records Selecting Records - Deleting Records - Update Records –PERL: Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. TCL: Introduction to TCL/TK, Python: Introduction to Python.		CO4
UNIT V	**SECURITY IN WEB APPLICATIONS**	**9**
Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with Javascript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, —Programming PHP‖, O'Reilly Media, 2012.
2. Michael Cross, —Developer's Guide to Web Application Security‖, Syngress Publishers, 2007
3. Hugh E. Williams, David Lane, —Web Database applications with PHP and MYSQL‖, Second Edition, O'Reilly Media, 2004.

REFERENCE BOOKS

1. Tom Christiansen, Brian D Foy, Larry Wall, Jon Orwant, —Programming Perll, Fourth Edition, O'Reilly Media, 2012.
2. Mark Lutz, —Programming Pythonll, Fourth Edition, O'Reilly Media, 2010.
3. Online Tutorials and Recent IEEE/ACM Journal Papers

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and use the concepts of open-source programming
CO2	Usage of PHP in web applications
CO3	Develop codes in open-source web applications
CO4	Usage of open-source languages like MYSQL, PERL, TCL and Python
CO5	Understand the risks associated with the open-source codes and write secure CGI scripts.

CP25003	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand modern programming language features and constructs for efficient software development.
- To identify and apply appropriate code optimization techniques for performance improvement.
- To design both program-specific and generic optimization strategies for various scenarios.
- To manage and optimize procedures to minimize execution time and resource overheads.
- To apply performance enhancement techniques in large-scale software projects.

UNIT I	ANALYSIS OF PROGRAMS USING INTERMEDIATE LANGUAGE	9
Structure of an Optimizing Compiler – Compiler Construction tools – Intermediate Languages: LIR, MIR, HIR, DAG, Syntax Tree, and Postfix Notation. Analysis: Control Flow Analysis, Iterative Data Flow Analysis, Static Single Assignment – A Linear Time Algorithm for Placing φ-Nodes, Basic Block Dependence, Alias Analysis. Introduction to LLVM and program compilation.		**CO1**
UNIT II	**LOCAL AND LOOP OPTIMIZATIONS**	**9**
Early Optimizations: Constant-Expression Evaluation – Scalar Replacement of Aggregates – Algebraic Simplifications and Re-association – Value Numbering – Copy Propagation – Sparse Conditional Constant Propagation. Redundancy Elimination: Common – Subexpression Elimination – Loop-Invariant Code Motion – Partial-Redundancy Elimination – Redundancy Elimination and Reassociation – Code Hoisting. Loop Optimizations: Induction Variable Optimizations – Unnecessary Bounds Checking Elimination. LLVM and testing optimizations.		**CO2**
UNIT III	**PROCEDURE OPTIMIZATION AND SCHEDULING**	**9**
Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination – Procedure Integration – In-Line Expansion – Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling – Speculative Loads and Boosting – Speculative Scheduling – Software Pipelining – Trace Scheduling – Percolation Scheduling. Control-Flow and Low-Level Optimizations: Unreachable-Code Elimination – Straightening – If Simplifications – Loop Simplifications –Loop Inversion Un-switching – Branch Optimizations – Tail Merging or Cross Jumping – Conditional Moves – Dead-Code Elimination – Branch Prediction – Machine Idioms and Instruction Combining. LLVM and procedure level optimization.		**CO3**
UNIT IV	**INTER PROCEDURAL OPTIMIZATION**	**9**
Symbol table Runtime Support – Interprocedural Analysis and Optimization: Interprocedural ControlFlow Analysis – The Call Graph – Interprocedural Data-Flow Analysis – Interprocedural Constant Propagation – Interprocedural Alias Analysis – Interprocedural Optimizations – Interprocedural Register Allocation – Aggregation of Global References. LLVM – Interprocedural Analyses.		**CO4**
UNIT V	**OPTIMIZING FOR MEMORY**	**9**
Register Allocation: Register Allocation and Assignment – Local Methods – Graph Colouring Priority Based Graph Colouring. Computations on Iteration Spaces – Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches – Instruction Cache Optimization – Scalar Replacement of Array Elements – Data Cache Optimization – Scalar vs. Memory-Oriented Optimizations. Software Prefetching – Parallelization – Instruction Level Parallelism – Automatic Parallelization. LLVM and Parallel execution of data parallel and task parallel programs.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Steven. S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufman Publishers, First Edition, 1997.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques, and Tools, Addison Wesley, Second Edition, 2007.

REFERENCE BOOKS

1. Y. N. Srikant, Priti Shankar, The Compiler Design Handbook – Optimizations and Machine Code Generation, CRC Press, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, Modern Compiler Implementation in Java, Cambridge University Press, Second Edition, 2002.
3. Andrew W. Appel, Jens Palsberg, Modern Compiler Implementation in Java, Cambridge University Press, Second Edition, 2002.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand modern programming language features and constructs.
CO2	Identify the different optimization techniques that are possible for any specific block of code.
CO3	Design program specific and generic optimization techniques.
CO4	Manage procedures to reduce execution and resource overheads.
CO5	Learn to work and apply performance enhancement on any larger software project.

CP25004	COMPUTER GRAPHICS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand basic algorithms for computer graphics and image processing.
- To understand various filters, Point processing, and Arithmetic operations in image processing.
- To understand different applications of graphics and image processing.

UNIT I	GRAPHICS SYSTEMS AND GRAPHICAL USER INTERFACE	9
Pixel, Resolution, Video display devices - Types – Graphical devices – Direct screen interaction – Logical input function –GKS. User dialogue – Interactive picture construction techniques.		CO1
UNIT II	**GEOMETRIC DISPLAY PRIMITIVES AND ATTRIBUTES**	**9**
Geometric display primitives: Points, Lines and Polygons. Point display method – Line drawing: DDA 2D Transformations and Viewing: Transformations - types – matrix representation – Concatenation - Scaling, Rotation, Translation, Shearing, Mirroring. Homogeneous coordinates – Window to view port transformations. Windowing and Clipping: Point, Lines, Polygons - boundary intersection methods.		CO2
UNIT III	**DIGITAL IMAGE FUNDAMENTALS**	**9**
Image Formation and types – Basic geometric transformations – Fourier Transforms – Walsh – Hadamard – Discrete Cosine – Hotelling Transforms.		CO3
UNIT IV	**IMAGE ENHANCEMENT AND RESTORATION**	**9**
Histogram Modification Techniques – Image Smoothening – Image Sharpening – Image Restoration – Degradation Model – Noise Models – Spatial Filtering – Frequency Domain Filtering.		CO4
UNIT V	**IMAGE SEGMENTATION AND RECOGNITION**	**9**
Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Morphology operations. Pattern classification - Clustering and Matching - Knowledge representation and use for scene analysis and image understanding (2D and 3D) - Object recognition and identification – Case study of various applications.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Donald Hearn & M. Pauline Baker , and warren R. Carithers, —Computer Graphicsǁ, Prentice-Hall of India, Fourth edition 2011. (UNIT I & II)
2. Rafael C. Gonzalez, Richard E. Woods, —Digital Image Processingǁ, Pearson Education, Third edition, 2011. (UNIT III, IV &V)

REFERENCE BOOKS

1. Newmann W.M. and Sproull R.F., "Principles of Interactive Computer Graphics", Tata McGraw-Hill, Second edition, 2008
2. Foley J.D., Van Dam A, Fiener S.K. and Hughes J.F., —Computer Graphics", Second edition, Pearson education, 2008.
3. Anil Jain K, —Fundamentals of Digital Image Processingll, Prentice-Hall of India, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Usage of Graphical systems and GUI
CO2	Develop simpler games using geometric display primitives
CO3	Usage of Digital Image fundamentals.
CO4	Usage off image enhancement and restoration in creation of Animation
CO5	Use image segmentation in pattern recognition applications

CP25005	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low-cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario

UNIT I	INTRODUCTION TO IoT	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology		CO1
UNIT II	**IoT ARCHITECTURE**	**9**
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture		CO2
UNIT III	**IoT PROTOCOLS**	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols — Unified Data Standards — Protocols — IEEE 802.15.4 — BACNet Protocol — Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security		CO3
UNIT IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO**	**9**
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		CO4
UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.

REFERENCE BOOKS

1. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols‖, Wiley, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze various protocols for IoT
CO2	Develop web services to access/control IoT devices.
CO3	Design a portable IoT using Rasperry Pi
CO4	Deploy an IoT application and connect to the cloud.
CO5	Analyze applications of IoT in real time scenario

CP25006	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know how to analyze and consider user's need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human – machine interaction

UNIT I	INTRODUCTION	9
Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output		CO1
UNIT II	**DESIGN PROCESS**	**9**
Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centered Design - Methods for User-Centered Design		CO2
UNIT III	**IMPLEMENTATION AND EVALUATION PROCESS**	**9**
Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support		CO3
UNIT IV	**MODELS**	**9**
Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction.		CO4
UNIT V	**APPLICATIONS**	**9**
Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, —Human Computer Interaction‖, Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. —Human – Computer Interaction‖, Second edition, Prentice Hall,1998.

REFERENCE BOOKS

1. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. —Human – Computer Interaction‖, Addison Wesley, 1994.
2. John M.Carrol, —Human Computer Interaction in the New Millenium‖, Pearson Education, 2002.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To develop good design for human machine interaction syste
CO2	Analyze the user"s need in interaction system
CO3	To design new interaction model to satisfy all types of customers
CO4	Evaluate the usability and effectiveness of various products
CO5	To know how to apply interaction techniques for systems

CP25007	IMAGING AND MULTIMEDIA SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To understand the basics of image processing and image security techniques
- ❖ To study various compression and file formats used in imaging and multimedia systems
- ❖ To analyse different media and design issues related to multimedia systems

UNIT I	INTRODUCTION	9
Introduction to Image Processing: Steps in Image Processing Systems –Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models. Introduction to Multimedia: Multimedia Elements – Multimedia applications – Multimedia System Architecture – Evolving technologies for Multimedia – Defining objects for Multimedia systems – Multimedia Data interface standards – Multimedia Databases		CO1
UNIT II	**COMPRESSION AND FILE FORMATS**	**9**
Compression and Decompression: Need for Data Compression – Types of Compression – Binary Image Compression Schemes – Image Compression – Video Compression – Audio Compression. Data and File Format Standards: Rich Text Format – TIFF File Format – Resource Interface File Format – MIDI File Format - JPEG DIB File Format – AVI Indeo File Format – MPEG Standards –TWAIN.		CO2
UNIT III	**IMAGE COMPUTING AND SECURITY**	**9**
Image computing: The basics of processing 2D images- Thresholding -Convolution-Edge Detection-Mathematical Morphology and Shape Descriptors-Noise Reduction- Image Fusion. Image Security: Image Forensics - Steganography -Image Cryptography Techniques-Chaos based and Non-Chaos based methods.		CO3
UNIT IV	**I/O TECHNOLOGIES**	**9**
Input and Output Technologies: Multimedia I/O Technologies: Image Scanners – Digital Voice and Audio – Digital Camera – Video Images and Animation – Full Motion Video -Video Motion Analysis.		CO4
UNIT V	**APPLICATION DESIGN**	**9**
Multimedia Application Classes – Types of Multimedia Systems – Virtual Reality – Components of Multimedia Systems -Multimedia Authoring Systems – Multimedia Authoring Tools - User Interface Design- Mobile Messaging – Hypermedia Message Components -Hypermedia Linking and embedding.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education, 2011.
2. Ralf Steinmetz, Klara Steinmetz, ―Multimedia Computing, Communications & Applications‖, Pearson education, 2009.

REFERENCE BOOKS

1. A.K. Jain, Fundamentals of Digital Image Processing, PHI, New Delhi, 2001.
2. William K Pratt, Digital Image Processing, John Willey, 2012.
3. Prabat K Andleigh and Kiran Thakrar, —Multimedia Systems and Design‖, Prentice Hall India, 2007,New Delhi.
4. Tay Vaughan, —Multimedia Making It Work‖, McGraw Hill, 2011.
5. Parekh R —Principles of Multimedia‖ Tata McGraw-Hill, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know to basics of image processing Systems
CO2	Technics to develop new compression standard
CO3	Understand image computing and secuity
CO4	Acquire skill set to handle all multimedia components efficient
CO5	Develop Integrated and Collaborative multimedia system

CP25008	AGENT BASED INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basics of Problem-Solving Agents.
- To study the concepts of Knowledge representation.
- To learn the planning techniques.
- To enable the students to know uncertainty techniques to support real-time applications
- To understand the knowledge of higher-level agents

UNIT I	INTRODUCTION	9
Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics - Constraint Satisfaction Problems - Game playing.		CO1
UNIT II	**KNOWLEDGE REPRESENTATION AND REASONING**	**9**
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events		CO2
UNIT III	**PLANNING AGENTS**	**9**
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events		CO3
UNIT IV	**AGENTS AND UNCERTAINITY**	**9**
Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.		CO4
UNIT V	**HIGHER LEVEL AGENTS**	**9**
Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Stuart Russell and Peter Norvig, —Artificial Intelligence - A Modern Approach‖,2nd Edition, Prentice Hall, 2002

REFERENCE BOOKS

1. Michael Wooldridge, —An Introduction to Multi Agent System‖, John Wiley, 2002.
2. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.
3. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand basics of intelligent agents.
CO2	Represent knowledge and implement reasoning techniques.
CO3	Understand various categories of multi agents.
CO4	Explore the deep learning applications
CO5	Analyze optimization and generalization in Higher Level Agents

CP25009	DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the role of Applied Mathematics and the need of Deep learning.
- To optimize and generalize deep neural networks for better performance.
- To design and implement Convolutional and recurrent Neural Networks and Critically Analyze in Image and text related Projects.
- To design and implement Deep Learning Applications.
- To learn deep generative networks implications in unsupervised learning.

UNIT I	BASICS FOR DEEP LEARNING	9
Mathematical Preliminaries of Deep learning: Linear Algebra, Probability and Information Theory, Numerical Computations – Machine Learning Basics: Learning Algorithms, Overfitting Vs Under fitting, maximum likelihood estimation - MSE, Activation functions and Cost functions –Challenges motivating Deep Learning.		CO1
UNIT II	**INTRODUCTION TO DEEP LEARNING**	**9**
Basic concept of Neurons – Perceptron Learning – Multilayer Perceptrons -Deep Feed Forward Networks - Back Propagation – Data representation for Neural Networks - Datasets for deep learning- cross validation - Bias-Variance Tradeoff- Gradient based optimization – Regularization for Deep learning : Parameter norm Penalties, data set augmentation, Dropout, Multi task learning, Early stopping – Hyperparameters for deep learning.		CO2
UNIT III	**CONVOLUTIONAL NEURAL NETWORKS**	**9**
CNN Architectures – Convolution – Pooling – Training a Convnet: weights initialization - batch normalization - hyper parameter optimization and batch normalization - Transfer Learning – Pretraining, fine-tuning – Pretrained CNN networks – Visualizing CNN Learning – Case Study : Image Classification using CNNs .		CO3
UNIT IV	**SEQUENCE MODELING USING RECURRENT NETS**	**9**
Recurrent Neural Networks (RNN) - Bidirectional RNN - Long Short-Term Memory (LSTM) - GRU – Attention and Applications -GPT, BERTs and Variants -Encoder-decoder sequence to sequence architectures – Recursive Neural Networks - Performance metrics for text processing- Case Study – Text generation with LSTM, Speech Processing and Image Captioning using RNNs.		CO4
UNIT V	**UNSUPERVISED AND DEEP GENERATIVE MODELS**	**9**
Types of Autoencoder - Variational Autoencoders - Generative Adversarial Networks : GAN framework , Generator training, Discriminator training, Convergence of GAN, KL-Divergence for GAN– Boltzmann Machines– Restricted Boltzmann Machine-Deep Boltzmann Machines- Deep Belief Networks-Boltzmann Machine for Real valued data Case Study: Text-to-Image Synthesis using GAN, Image generation with Generative Adversarial Networks.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.

REFERENCE BOOKS

1. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
2. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018.
3. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the mathematical foundations of deep learning.
CO2	Apply optimization and regularization techniques to enhance model performance.
CO3	Design and implement CNNs and RNNs for image and text tasks.
CO4	Develop and deploy deep learning applications in real-world scenarios.
CO5	Implement generative models (GANs, VAEs) for unsupervised learning.

CP25010	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose learners to software quality factors, Quality Assurance (SQA) architecture, and SQA components.
- To understand the integration of SQA components into the project life cycle.
- To gain familiarity with the software quality infrastructure.
- To explore the management components of software quality.
- To understand quality standards, certifications, and assessments.

UNIT I	INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE	9
Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall's quality model – SQA system components – Pre project quality components – Development and quality plans.		CO1
UNIT II	**SQA COMPONENTS AND PROJECT LIFE CYCLE**	**9**
Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participants' contribution – CASE tools for software quality Management.		CO2
UNIT III	**SOFTWARE QUALITY INFRASTRUCTURE**	**9**
Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.		CO3
UNIT IV	**SOFTWARE QUALITY MANAGEMENT & METRICS**	**9**
Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model.		CO4
UNIT V	**STANDARDS, CERTIFICATIONS & ASSESSMENTS**	**9**
Quality management standards – ISO 9001 and ISO 9000-3 –Capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – Organization of Quality Assurance – Role of management in SQA – SQA units and other actors in SQA systems.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009.
2. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, 2011.

REFERENCE BOOKS

1. Kshirasagar Naim and Priyadarshi Tripathy," Software Testing and Quality Assurance Theory and Practice", John Wiley & Sons Inc., 2008
2. Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 2014

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Utilize the concepts of SQA in software development life cycle
CO2	Demonstrate their capability to adopt quality standards.
CO3	Assess the quality of software products.
CO4	Apply the concepts in preparing the quality plan & documents.
CO5	Ensure whether the product meets company's quality standards and client's

CP25011	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Understand how blockchain systems (mainly Bitcoin and Ethereum) work
- ❖ To securely interact with them,
- ❖ Design, build, and deploy smart contracts and distributed applications,
- ❖ Integrate ideas from blockchain technology into their own projects

UNIT I	BASICS	9
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.		CO1
UNIT II	**BLOCKCHAIN**	**9**
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.		CO2
UNIT III	**DISTRIBUTED CONSENSUS**	**9**
Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		CO3
UNIT IV	**CRYPTOCURRENCY**	**9**
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin		CO4
UNIT V	**CRYPTOCURRENCY REGULATION**	**9**
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

REFERENCE BOOKS

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, ―ETHEREUM: A Secure Decentralized Transaction Ledger,‖Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Design principles of Bitcoin and Ethereum. and Nakamoto consensus
CO2	Learn the simplified Payment Verification protocol and describe differences between proof-of-work and proof-of-stake consensus.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO4	Evaluate security, privacy, and efficiency of a given blockchain system.

CP25012	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I	SPEECH PROCESSING AND SYNTHESIS	9
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		CO1
UNIT II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	**9**
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.		CO2
UNIT III	**SPEECH RECOGNITION**	**9**
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		CO3
UNIT IV	**TEXT ANALYSIS**	**9**
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		CO4
UNIT V	**SPEECH SYNTHESIS**	**9**
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Joseph Mariani, —Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, —Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.

REFERENCE BOOKS

1. Sadaoki Furui, —Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
2. Thomas F.Quatieri, —Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
2. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, —Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the various temporal, spectral and cepstral features required for identifying speech units — phoneme, syllable and word
CO2	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
CO3	Justify the use of formant and concatenative approaches to speech synthesis
CO4	Identify the apt approach of speech synthesis depending on the language to be processed
CO5	Determine the various encoding techniques for representing speech.

CP25013	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re -engineering

UNIT I	SOFTWARE ENGINEERING PROCESS AND FORMAL METHODS	9
Software Process models – Software Life Cycle – Development Activities – Managing Software Development – Unified Modeling Language – Requirement elicitation and specification – Understanding formal methods – motivation for formal methods – informal requirements to formal specifications – validating formal specifications – Overview of Z specification		CO1
UNIT II	**AGILE AND ASPECT ORIENTED SOFTWARE ENGINEERING**	**9**
Agile Development: Agility – agile principles- Extreme Programming -– Agile process models – Agile modeling – Agile unified Process – tools set for agile process – Complex Projects: SCRUM – basics, SCRUM Process, Development using SCRUM – Aspect Oriented Software Development: Aspect-Orientation in the Software Lifecycle – Generic Aspect-Oriented Design with UML – Modeling for Aspect-Oriented Software Development - Developing Secure Applications Through Aspect-Oriented Programming.		CO2
UNIT III	**COMPONENT-BASED SOFTWARE ENGINEERING**	**9**
Engineering of component-based systems, the CBSE process – Designing class based components – component design for Web Apps – Component-based development – Component-level design patterns – Classifying and retrieving components, and economics of CBSE.		CO3
UNIT IV	**ADVANCED SOFTWARE TESTING TECHNIQUES**	**9**
Software Review – Testing Strategies - Testing Conventional Applications – Testing Object-Oriented Applications – Testing Web Applications – Formal Modeling and verification – Metrics : Product, process, project, testing and quality metrics – Software Test Automation		CO4
UNIT V	**SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING**	**9**
SPI process – CMMI – SPI frameworks – SPI Trends – Emerging trends ion Software Engineering – identifying soft trends – Technology directions – Tool-related trends – Software Maintenance and Reengineering: software reengineering, reverse reengineering, restructuring, forward reengineering.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Roger S. Pressman, —Software Engineering – A Practioner"s Approachǁ, MCGraw Hill, 7thedition, 2009.
2. Ian Sommerville, —Software Engineeringǁ, Addison-Wesley 9th Edition, 2010.
3. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.

REFERENCE BOOKS

1. Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, —Aspect-Oriented Software Developmentǁ, Addison-Wesley Professional, 2004.
2. Renu Rajni, Pradeep Oak, —Software Testing: Effective Methods, Tools and Techniquesǁ, TataMcGraw Hill, 2004.
3. Jonathan Bowen, "Formal Specification and Documentation using Z - A Case Study Approach",Intl Thomson Computer Press, 1996.
4. Antoni Diller, —Z: An Introduction to Formal Methodsǁ, Wiley, 1994.
5. James Shore, Shane Warden —The Art of Agile Development - Pragmatic guide to agile software developmentǁ, O'Reilly Media, October 2007.
6. Ken Schwaber, —Agile Project Management with SCRUMǁ, Microsoft Press, 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analytically apply general principles of software development in the development of complex software and software- intensive systems
CO2	Usage of Agile technology in SCRUM Development
CO3	Discuss methods and techniques for advanced software development and also to be able to use these in various development situations
CO4	Apply testing techniques for object-oriented software and web-based systems
CO5	Apply re-engineering concepts in software development process

CP25014	MOBILE NETWORK SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of Mobile communication systems.
- To understand the different multiplexing scheme.
- To understand the significance of different layers in mobile system.

UNIT I	INTRODUCTION	9
Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems- frequency reuse, co-channel interference.		CO1
UNIT II	**MAC**	**9**
Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls-initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff.		CO2
UNIT III	**COMMUNICATION SYSTEMS**	**9**
Mobile Telecommunication standards, GSM, DECT, TETRA, IMT-2000, CTEO, satellite systems – GEO, LEO and MEO, and broadcast systems –Digital audio and video broadcasting, IEEE 802.11, HIPERLAN, Bluetooth, Wireless ATM, WATM services.		CO3
UNIT IV	**MOBILE NETWORK LAYER**	**9**
Network support for mobile systems – Mobile IP- IP packet delivery- Agent discovery- tunnelling and encapsulation, reverse tunnelling, IPV6, DHCP.		CO4
UNIT V	**MOBILE TRANSPORT LAYER**	**9**
Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, WWW, WAP.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jochen Sciiiller, "Mobile Communications ", Pearson Education India, 2009.

REFERENCE BOOKS

1. Theodore S. Rappaport, —Wireless Communications: Principles and Practicell, 2/e, Pearson Education, 2010.
2. William C.Y Lee, "Mobile Cellular Telecommunications ", McGraw Hill International Editions, 1995

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts of mobile and wireless communications.
CO2	Understand the concepts of MAC in mobile and wireless communication
CO3	Understand the concepts of Communication systems in mobile and wireless communications
CO4	Understand the concepts of packet delivery in mobile and wireless communications
CO5	Apply the knowledge gained in exploring, application and protocol development

CP25015	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing.
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the concepts of digital libraries.

UNIT I	INTRODUCTION: MOTIVATION	9
Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR —IR Versus Web Search–Components of a Search engine.		CO1
UNIT II	**MODELING**	**9**
Taxonomy and Characterization of IR Models – Boolean Model – Vector Model – Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.		CO2
UNIT III	**INDEXING**	**9**
Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations – Query Languages – Query Processing - Relevance Feedback and Query Expansion – Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency		CO3
UNIT IV	**EVALUATION AND PARALLEL INFORMATION RETRIEVAL**	**9**
Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria – Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce		CO4
UNIT V	**SEARCHING THE WEB**	**9**
Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.

REFERENCE BOOKS

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Build an Information Retrieval system using the available tools.
CO2	Identify and design the various components of an Information Retrieval system.
CO3	Categorize the different types of IR Models.
CO4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO5	Design an efficient search engine and analyze the Web content structure.

CP25016	FULL STACK WEB APPLICATION DEVLOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Develop TypeScript Application
- ❖ Develop Single Page Application (SPA)
- ❖ Able to communicate with a server over the HTTP protocol
- ❖ Learning all the tools need to start building applications with Node.js
- ❖ Implement the Full Stack Development using MEAN Stack

UNIT I	FUNDAMENTALS & TYPESCRIPT LANGUAGE	9
Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.		CO1
UNIT II	**ANGULAR**	**9**
About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.		CO2
UNIT III	**NODE.js**	**9**
About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.		CO3
UNIT IV	**EXPRESS.Js**	**9**
Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router.route(path). Router Class. Request Object. Response Object. Error Handling. RESTful.		CO4
UNIT V	**MONGODB**	**9**
Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018

REFERENCE BOOKS

1. Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
2. Pro Express.js, Azat Mardan, Apress, 2015
3. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop basic programming skills using Javascript
CO2	Implement a front-end web application using Angular.
CO3	Will be able to create modules to organise the server
CO4	Build RESTful APIs with Node, Express and MongoDB with confidence.
CO5	Will learn to Store complex, relational data in MongoDB using Mongoose

CP25017	SOFTWARE ARCHITECTURE AND DESIGN PATTERNS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the creational and structural patterns.
- Be able to explain the role of analyzing architectures.
- Be capable of applying his knowledge to create an architecture for given application.
- Be able to identify different structural and behavioral patterns.
- To know the usage of design patterns by solving a case study

UNIT I	ENVISIONING ARCHITECTURE	9
The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Creating an Architecture- Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.		CO1
UNIT II	**ANALYZING ARCHITECTURES**	**9**
Architecture Evaluation, Architecture design decision making, ATAM, CBAM. Moving from one system to many: Software Product Lines, Building systems from off the shelf components, Software architecture in future.		CO2
UNIT III	**CREATIONAL AND STRUCTURAL PATTERNS**	**9**
Patterns: Pattern Description, Organizing catalogs, role in solving design problems, Selection and usage. Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy.		CO3
UNIT IV	**BEHAVIORAL PATTERNS**	**9**
Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.		CO4
UNIT V	**CASE STUDIES**	**9**
A-7E – A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Len Bass,Paul Clements&Rick Kazman, Software Architecture in Practice, 2nd Edition, Pearson Education, 2003.
2. Erich Gamma, Design Patterns, 1st Edition, Pearson Education,1995
3. http://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Architecture/Design_Patterns.

REFERENCE BOOKS

1. Luke Hohmann , Beyond Software architecture, Addison wesley, 2003.
2. David M. Dikel, David Kane and James R. Wilson, Software architecture, 1st Edition, Prentice Hall,2001
4. F.Buschmann , Pattern Oriented Software Architecture, Wiley&Sons,1st Edition,2001

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the architecture, creating it and moving from one to any, different structural patterns.
CO2	Analyze the architecture and build the system from the components.
CO3	Design creational and structural patterns.
CO4	Learn about behavioural patterns.
CO5	Do a case study in utilizing architectural structures.

CP25018	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand technological advancements of data visualization
- To understand various data visualization techniques
- To understand the methodologies used to visualize large data sets

UNIT I	INTRODUCTION AND DATA FOUNDATION	9
Basics - Relationship between Visualization and Other Fields -The Visualization Process – Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets		CO1
UNIT II	**FOUNDATIONS FOR VISUALIZATION**	**9**
Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.		CO2
UNIT III	**VISUALIZATION TECHNIQUES**	**9**
Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data – Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.		CO3
UNIT IV	**INTERACTION CONCEPTS AND TECHNIQUES**	**9**
Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.		CO4
UNIT V	**RESEARCH DIRECTIONS IN VISUALIZATIONS**	**9**
Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.
2. Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.

REFERENCE BOOKS

1. Robert Spence “Information visualization – Design for interaction”, Pearson Education, 2nd Edition, 2007.
2. Alexandru C. Telea, “Data Visualization: Principles and Practice,” A. K. Peters Ltd, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Visualize the objects in different dimensions.
CO2	Design and process the data for Visualization.
CO3	Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences.
CO4	Apply the virtualization techniques for research projects.
CO5	Identify appropriate data visualization techniques given particular requirements imposed by the data.

CP25019	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the components of the social Network
- To model and visualize the social network
- To mine the users in the w4
- To understand the evolution of the social Network
- To know the applications in Real Time Systems

UNIT I	INTRODUCTION	9
Introduction to Web - Limitations of current Web — Development of Semantic Web — Emergence of the Social Web – Statistical Properties of Social Networks - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks		CO1
UNIT II	**MODELING AND VISUALIZATION MODELING AND VISUALIZATION**	**9**
Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data **–** Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.		CO2
UNIT III	**MINING COMMUNITIES**	**9**
Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.		CO3
UNIT IV	**EVOLUTION**	**9**
Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks – Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models		CO4
UNIT V	**APPLICATIONS**	**9**
A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, —Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012
2. Charu C. Aggarwal, —Social Network Data Analytics‖, Springer; 2014
3. Peter Mika, —Social networks and the Semantic Web‖, Springer, 2007.
4. Guandong Xu,Yanchun Zhang, and Lin Li, —Web Mining and Social Networking Techniques and Applications‖, Springer.

REFERENCE BOOKS

1. Borko Furht, —Handbook of Social Network Technologies and Applications‖, Springer, 1st edition, 2011
2. Peter Mika, —Social Networks and the Semantic Web‖, Springer, 1st edition, 2007.
3. Przemyslaw Kazienko, Nitesh Chawla,‖Applications of Social Media and Social Network Analysis‖, Springer,2015

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Work on the internals components of the social network
CO2	Model and visualize the social network
CO3	Mine the behavior of the users in the social network
CO4	Predict the possible next outcome of the social network
CO5	Apply social network in real time application.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	1	3	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	2	2	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	2	1	2	2	1	1	2	3	3	2

CP25020	COGNITIVE SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To know the basic concepts, approaches and issues in the field of cognitive science
- ❖ To increase the awareness of the students to the questions raised in the disciplines of computer science, linguistics, philosophy and psychology;
- ❖ To focus on the interaction of these disciplines in approaching the study of the mind – brain language.
- ❖ Specialization on topics central to cognitive development such as the nature of mental representation, reasoning, perception, language use, learning as well as other cognitive processes of humans and other intelligent systems.
- ❖ To focus on memory and social cognition

UNIT I	INTRODUCTION TO COGNITIVE SCIENCE	9
Introduction to the study of cognitive sciences. A brief history of cognitive science. Methodological concerns in philosophy, artificial intelligence and psychology. Structure and constituents of the brain; Brief history of neuroscience; Mathematical models; Looking at brain signals		CO1
UNIT II	**REPRESENTATION OF SENSORY INFORMATION**	**9**
Processing of sensory information in the brain- Neural Network Models; Processing of sensory information in the brain; motor and sensory areas; Brain Imaging, fMRI, MEG, PET, EEG-Multisensory integration in cortex; information fusion; from sensation to cognition, cybernetics		CO2
UNIT III	**LANGUAGE AND LATERALIZATION**	**9**
Linguistic knowledge: Syntax, semantics, (and pragmatics); Generative linguistics; Brain and language; Language disorders; Lateralization; Cognitivist and emergent standpoints ; A robotic perspective		CO3
UNIT IV	**COGNITIVE DEVELOPMENT**	**9**
Introduction to Psychology- Attention and related concepts; Human visual attention; Computational models of attention; Applications of computational models-Learning: Categories and concepts; Concept learning; Logic ; Machine learning		CO4
UNIT V	**MEMORY AND SOCIAL COGNITION**	**9**
Constructing memories; Explicit vs. implicit memory; Information processing (three-boxes) model of memory; Sensory memory; Short term memory; Long term memory- Rationality; Bounded rationality; Prospect theory ; Heuristics and biases; Reasoning in computers- social cognition; Context and social judgment; Schemas; Social signals		CO5
TOTAL : 45 PERIODS		

TEXT BOOKS

1. Gardner, The Mind‘s New Science, chapters 2,3,4. Gardner, Howard E. The mind's new science: A history of the cognitive revolution. Basic books, 2008.
2. Wallace, Mark T., and Barry E. Stein. "Sensory organization of the superior colliculus in cat and monkey." Progress in brain research 112 (1996): 301-311.
3. Fromkin, Rodman, and Hyams. An Introduction to Language, Boston, MA: Thomson Wadsworth, 9th edition, 2011.

REFERENCE BOOKS

1. "Language and the Brain", https://web.stanford.edu/~zwicky/language-and-the-brain-ch4-8.pdf
2. Simon, Bounded Rationality in Social Science: Today and Tomorrow, Mind & Society, 1, 2000, 25-39

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the basics of Cognitive science.
CO2	Use the sensory information and neural network models in real time.
CO3	Apply Linguistic knowledge in terms of robots perspective
CO4	Learn the computational models
CO5	Apply the knowledge of Memory and Social cognition.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	1	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	2	1	2	2	1	1	2	3	3	2

CP25021	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals in language processing.
- To understand syntactic parsing in language processing.
- To understand language modeling using vector semantics.
- To understand semantics of words and sentences in languages.
- To understand information extraction techniques.

UNIT I	INTRODUCTION	9
Knowledge in language processing -- Ambiguity; Text Normalization -- N-grams -- Evaluation -- Sampling -- Generalization -- Smoothing.		CO1
UNIT II	**WORD LEVEL AND SYNTACTIC ANALYSIS**	**9**
English Word Classes -- Part-of-Speech Tagging; Constituency Grammar: Context-Free Grammar -- Grammar rules for English -- Treebanks; Dependency Parsing: Dependency Relations – Formalisms -- Dependency Treebanks.		CO2
UNIT III	**LEXICAL AND VECTOR SEMANTICS**	**9**
Lexical Semantics -- Vector Semantics -- Words and vectors -- Cosine similarity -- TF-IDF – PPMI -- Word2Vec -- Semantic properties of embeddings -- Evaluating vector model.		CO3
UNIT IV	**SEMANTIC ANALYSIS**	**9**
Word Senses: Senses Relations -- WordNet -- Word Sense Disambiguation; Semantic Roles: Diathesis Alternations -- Problems -- Proposition Bank -- Semantic Role Labeling.		CO4
UNIT V	**INFORMATION EXTRACTION AND COREFERENCE**	**9**
Named Entities -- Named Entity Tagging; Relation Extraction -- Algorithms -- Extracting Times -- Extracting Events and their Times -- Template Filling; Coreference: Linguistic Background – Tasks and Datasets.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 3rd Edition.
2. Christopher D. Manning, Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.

REFERENCE BOOKS

1. Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python”, O'Reilly, 2009.
2. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply the text normalization techniques.
CO2	Apply syntactic analysis in language processing.
CO3	Apply vector semantics for word embeddings.
CO4	Apply semantic analysis for words and sentences.
CO5	Apply extraction techniques to extract the information.

CP25022	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the foundational principles of quantum computing and its distinction from classical computing.
- To explore the fundamentals of quantum mechanics that underpins quantum computation.
- To analyze various quantum computation models and their applications.
- To design and simulate quantum circuits using computation environments and frameworks.
- To comprehend quantum operations, including noise handling and error correction techniques.

UNIT I	QUANTUM MECHANICS AND QUANTUM COMPUTATION	9
The postulates of quantum mechanics, The density operator, The Schmidt decomposition and purifications, EPR and the Bell inequality, Quantum circuits : Quantum algorithms, Single qubit operations, Controlled operations. Measurement, Universal quantum gates, Summary of the quantum circuit model of computation, Simulation of quantum systems.		CO1
UNIT II	**QUANTUM COMPUTERS AND ALGORITHMS**	**9**
Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics, Ion traps, Nuclear magnetic resonance, Other implementation schemes, The quantum Fourier transform and its applications, Quantum search algorithms		CO2
UNIT III	**QUANTUM INFORMATION**	**9**
Quantum noise and quantum operations: Classical noise and Markov processes, Quantum operations, Examples of quantum noise and quantum operations, Applications of quantum operations, Limitations of the quantum operations formalism, Distance measures for quantum information: Distance measures for classical information.		CO3
UNIT IV	**QUANTUM ERROR-CORRECTION**	**9**
Introduction, The Shor code, Theory of quantum error-correction, Constructing quantum codes, Stabilizer codes, Fault-tolerant quantum computation.		CO4
UNIT V	**ENTROPY AND INFORMATION THEORY**	**9**
Entropy : Shannon Entropy, Basic properties of entropy, Von Neumann entropy, Strong sub additivity, Quantum information theory : Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels, Entanglement as a physical resource, Quantum cryptography		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael A. Nielsen, Issac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, Tenth Edition 2010.
2. Parag K Lala, Quantum Computing, A Beginners Introduction, Mc Graw Hill Education, First edition 2020.

REFERENCE BOOKS

1. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Reprint edition 2020.
2. Jack D. Hidary's Quantum Computing: An applied approach, Springer, 2019.
3. Eric Johnston, Nic Harrigan, and Mercedes Gimeno Segovia, Programming Quantum Computers: Essential Algorithms and Code, O'reilly, 2019.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basics of quantum computing.
CO2	Understand the background of Quantum Mechanics.
CO3	Analyse the computation models.
CO4	Model the circuits using quantum computation. Environments and frameworks.
CO5	Understand the quantum operations such as noise and error-correction.

CP25023	GENERATIVE AI	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Understand the fundamentals of generative AI and its applications in software development.
- ❖ Learn about different types of generative models and their architectures.
- ❖ Gain hands-on experience in implementing generative AI models for text generation.
- ❖ Explore advanced techniques for improving the quality and diversity of generated text.
- ❖ Apply generative AI techniques to real-world software development tasks.

UNIT I	INTRODUCTION TO GENERATIVE AI	9
Overview of Generative AI - Applications in Software Development - Probability Theory for Generative Modeling.		CO1
UNIT II	**Recurrent Neural Networks (RNNs) and Long Short-Term Memory Networks (LSTMs)**	**9**
Understanding RNNs and LSTMs-Training RNNs/LSTMs for Text Generation-Challenges and Techniques		CO2
UNIT III	**Generative Adversarial Networks (GANs) & Transformers**	**9**
Introduction to GANs-Components of GANs-Training GANs for Text Generation-Evaluation and Improvement-Transformer Architecture-Self-Attention Mechanism-Training Transformers for Text Generation.		CO3
UNIT IV	**Advanced Techniques in Text Generation**	**9**
Transfer Learning for Text Generation-Reinforcement Learning for Text Generation-Ensembling and Diversity Techniques.		CO4
UNIT V	**Applications of Generative AI in Software Development**	**9**
Text-Based Chatbots and Conversational Agents-Code Generation and Auto-Completion-Content Generation for Websites and Marketing.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
2. "Generative Deep Learning" by David Foster
3. "Natural Language Processing with PyTorch" by Delip Rao and Brian McMahan.

REFERENCE BOOKS

1. "Attention is All You Need" by Ashish Vaswani et al. (Research Paper)
2. "Generative Adversarial Networks: An Overview" by Antonia Creswell, Tom White, Vincent Dumoulin, Kai Arulkumaran, Biswa Sengupta, and Anil A. Bharath (Research Paper)
3. "Deep Reinforcement Learning Hands-On" by Maxim Lapan
4. "Deep Learning for Natural Language Processing" by Palash Goyal, Sumit Pandey, Karan Jain, and Karan Batra.
5. "Practical Natural Language Processing" by Sowmya Vajjala, Bodhisattwa Majumder, and Anuj Gupta
6. "The Definitive Guide to Conversational AI" by Amit Kumar and Suman Deb Roy

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Develop insights into probability theory as applied to generative modeling.
CO2	Learn how to train RNNs and LSTMs specifically for text generation tasks.
CO3	Gain expertise in Transformers, including the Transformer architecture and self-attention mechanism.
CO4	Understand ensembling and diversity techniques to improve the quality and diversity of generated texts.
CO5	Develop solutions for content generation in websites and marketing, demonstrating practical applications of Generative AI.

CP25024	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the features and architecture of the Android operating system.
- To gain knowledge of GUI design principles for developing Android applications.
- To apply data persistence mechanisms in Android app development.
- To develop mobile applications with web access and location-based services.
- To integrate telephony and Google Map services into Android applications.

UNIT I	INTRODUCTION	9
Mobile applications – Characteristics and Benefits – Application Model – Frameworks and Tools – Mobile OS: Android, iOS – versions with its features – Android architecture –ART(Android Runtime) – ADB(Android Debug Bridge) – Application framework basics		CO1
UNIT II	**USER INTERFACE DESIGN**	**9**
Designing the right UI – GUI for Android – activity and its lifecycle – Material Design: new themes, new widgets, Cardlayouts – Backward compatibility – v7 appcompat library – Intent object, intent filters, adding categories – Menus – fragment and its lifecycle		CO2
UNIT III	**DATA PERSISTENCE**	**9**
Different Data persistence schemes – content provider and resolver – shared preferences – saved instance – file read/write operations – SQLite database – Android in build content providers – user content provider		CO3
UNIT IV	**ANDROID SERVICE COMPONENT**	**9**
Intent Service – Remote service – Service handlers – communication between service and Activity – BroadcastReceivers: Local BroadcastManager, Dynamic BroadcastReceiver – System Broadcast – Pending Intent, Notifications – Packaging and deployment		CO4
UNIT V	**ANDROID APPLICATION DEVELOPMENT**	**9**
Communication via the web – Telephony Manager: Sending SMS and making calls – Google maps service using API – Publishing Android Apps: Guidelines, policies and process of uploading Apps to Google Play		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Reto Meier, “Professional Android 4 Application Development”, Wiley, 2012 2.
2. Wei-Meng Lee, “Beginning Android Application Development”, Wiley Publishing, 2011.

REFERENCE BOOKS

1. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, “Programming Android”, O’Reilly, 201.
2. Rick Rogers, John Lombardo, Zigurd Mednieks, Blake Meike, “Android Application Development”, O’Reilly, 2010.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Acquire the knowledge on Android OS and its features
CO2	Acquire knowledge on GUI design required for Android App development
CO3	Apply the knowledge of persistence Data storage mechanism in Android Apps
CO4	Develop web based mobile application that accesses internet and location data
CO5	Apply the knowledge in App development using telephony and Google Map services

CP25022	GPU COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the architecture of GPUs and their relevance in parallel programming.
- To develop programs using CUDA, debug issues, and optimize performance.
- To implement efficient algorithms for common computational problems using GPUs.
- To write and execute simple programs using OpenCL for parallel computing tasks.
- To identify and apply efficient parallel programming patterns to solve real-world problems.

UNIT I	GPU ARCHITECTURE	9
Evolution of GPU Architectures – Understanding Parallelism with GPU – Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.		CO1
UNIT II	**CUDA PROGRAMMING**	**9**
CUDA Basics – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.		CO2
UNIT III	**PROGRAMMING ISSUES**	**9**
Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors		CO3
UNIT IV	**OPENCL BASICS**	**9**
OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.		CO4
UNIT V	**ALGORITHMS ON GPU ALGORITHMS ON GPU**	**9**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Shane Cook, “CUDA Programming: A Developer’s Guide to Parallel Computing with GPUs”, Morgan Kaufmann, 2013.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous Computing with OpenCL 2.0”, Morgan Kauffman, 2015.
3. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors – A Hands-on Approach”, Third Edition, Morgan Kaufmann, 2016.

REFERENCE BOOKS

1. Nicholas Wilt, “CUDA Handbook: A Comprehensive Guide to GPU Programming”, Addison Wesley, 2013. 5. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming”, Addison Wesley, 2011.
2. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming”, Addison Wesley, 2011.

WEBSITE REFERENCES

1. https://developer.nvidia.com/language-solutions
2. https://www.khronos.org/opencl/

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Describe GPU Architecture.
CO2	Write programs using CUDA identify issues and debug them.
CO3	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.
CO4	Write simple programs using OpenCL.
CO5	Given a problem, identify efficient parallel programming patterns to solve it.

AUDIT COURSES

AC25201	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	INTRODUCTION	6
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		CO1
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**6**
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		CO2
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		CO3
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Emergency Provisions - National Emergency, President Rule, Financial Emergency		CO4
UNIT V	**LOCAL ADMINISTRATION**	**6**
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		CO5
		TOTAL : 30 PERIODS

TEXT BOOKS

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

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

AC25202	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop knowledge of self-development
- ❖ Explain the importance of Human values
- ❖ Develop the overall personality through value education
- ❖ Overcome the self-destructive habits with value education
- ❖ Interpret social empowerment with value education

UNIT I	INTRODUCTION TO VALUE EDUCATION	6
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		CO1
UNIT II	**IMPORTANCE OF VALUES**	**6**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		CO2
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**6**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth.		CO3
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		CO4
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**6**
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		CO5
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Chakroborty , S.K. —Values and Ethics for organizations Theory and practicell, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

AC25203	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	INTRODUCTION AND METHODOLOGY	6
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		CO1
UNIT II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		CO2
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches -Teachers' attitudes and beliefs and Pedagogic strategies.		CO3
UNIT IV	**PROFESSIONAL DEVELOPMENT**	**6**
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment — Barriers to learning: limited resources and large class sizes		CO4
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		CO5

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

AC25204	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do‘s and Don‘t‘s in life through Yam
- Categorize Do‘s and Don‘t‘s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I	INTRODUCTION TO YOGA	6
Definitions of Eight parts of yog.(Ashtanga)		CO1
UNIT II	**YAM**	**6**
Do`s and Don‘t‘s in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		CO2
UNIT III	**NIYAM**	**6**
Do`s and Don‘t‘s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		CO3
UNIT IV	**ASAN**	**6**
Various yog poses and their benefits for mind & body		CO4
UNIT V	**PRANAYAM**	**6**
Regularization of breathing techniques and its effects-Types of pranayam		CO5
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. —Rajayoga or conquering the Internal Naturell by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. _Yogic Asanas for Group Tarining-Part-Ill : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do‘s and Don‘t‘s in life through Yam
CO3	Learn Do‘s and Don‘t‘s in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

AC25205	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop basic personality skills holistically
- ❖ Develop deep personality skills holistically to achieve happy goals
- ❖ Rewrite the responsibilities
- ❖ Reframe a person with stable mind

UNIT I	NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I	6
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) — Verses- 26,28,63,65 (virtue)		CO1
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**6**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		CO2
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		CO3
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		CO4
UNIT V	**LOCAL ADMINISTRATION**	**6**
Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63		CO5
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

AC25206	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	6
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of —Soul of India lies in villages‖ – (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.		CO1
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	**6**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **Assignment:** Describe your analysis of rural household economy, it‘s challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		CO2
UNIT III	**RURAL INSTITUTIONS**	**6**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		CO3
UNIT IV	**RURAL DEVELOPMENT PROGRAMMES**	**6**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		CO4

UNIT V	FIELD WORK	6
Each student selects one programme for field visit Field based practical activities: ❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities ❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site ❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures ❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) ❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization ❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps ❖ Participate in Gram Sabha meetings, and study community participation ❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries ❖ Attend Parent Teacher Association meetings, and interview school drop outs ❖ Visit local Anganwadi Centre and observe the services being provided ❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. ❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys ❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness ❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants ❖ Formation of committees for common property resource management, village pond maintenance and fishing.		**CO5**
		TOTAL : 30 PERIODS

TEXT BOOKS

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community

AC25207	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	INTRODUCTION TO CULTURE	6
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		CO1
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**6**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2
UNIT III	**RELIGION AND PHILOSOPHY**	**6**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**6**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		CO4
UNIT V	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Kapil Kapoor, —Text and Interpretation: The India Tradition‖,ISBN: 81246033375, 2005
2. —Science in Samskrit‖, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, —Position paper on Arts, Music, Dance and Theatre‖, ISBN 81-7450 494-X, 200
4. Narain, —Examinations in ancient India‖, Arya Book Depot, 1993
5. Satya Prakash, —Founders of Sciences in Ancient India‖, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, —Essentials of Indian Philosophy‖, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Understand education systems in India

AC25208	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Introduction to Sanga Tamil Literature.
- ‗Agathinai' and ‗Purathinai' in SangaTamil Literature.
- ‗Attruppadai' in SangaTamil Literature.
- ‗Puranaanuru' in SangaTamil Literature.
- ‗Pathitrupaththu' in SangaTamil Literature.

UNIT I	SANGA TAMIL LITERATURE – AN INTRODUCTION	6
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's GrammarTamil Sangam Literature's parables.		CO1
UNIT II	**'AGATHINAI'AND'PURATHINAI'**	**6**
Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		CO2
UNIT III	**'ATTRUPPADAI'**	**6**
Attruppadai Literature – Attruppadaiin ‗Puranaanuru' – Attruppadaiin ‗Pathitrupaththu'- Attruppadaiin ‗Paththupaattu'.		CO3
UNIT IV	**'PURANAANURU'**	**6**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		CO4
UNIT V	**'PATHITRUPATHTHU'**	**6**
Pathitrupaththuin ‗Ettuthogai' – Pathitrupaththu's Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		CO5

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‗Agathinai' and ‗Purathinai'in their personal and societal life.
CO3	Appreciate and apply the messages in‗ Attruppadai' in their personal and societal life.
CO4	Appreciate and apply the messages in‗ Puranaanuru' in their personal and societal life.
CO5	Appreciate and apply the messages in‗ Pathitrupaththu' in their personal and societal life.