Learning Outcomes based Curriculum Framework

(LOCF)

FOR

Master of Computer Application

(MCA)

(W. E. F. 2020-21)

MAULANA AZAD NATIONAL URDU UNIVERSITY
SCHOOL OF TECHNOLOGY
DEPARTMENT OF CS&IT

DURATION

2 years (4 semester)

ELIGIBILITY

1. Urdu as a subject or as a Medium in 10th/10+2/Graduate level or equivalent Madrasa courses with Urdu as medium of Instruction.

2. Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree.

   OR

   Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 level or at Graduation Level (with additional bridge Courses as per the norms of the University).

3. Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying Examination.

PROGRAMME STRUCTURE

Course Type	Abbreviation	Credits
Program Core Course	PCC	54
Discipline Specific Elective	DSE	09
Generic Elective (Interdisciplinary)	GE	04
Foundation Course	FC	03
Ability Enhancement Course	AEC	02
Projects	PROJ	16
Total Credits		**88**

L-T-P stands for number of contact hours as Lecture-Tutorial-Practical in a week.

Semester – I

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MMCA111FCT	Statistical Analysis	FC	30	70	100	3-0-0	3
MMCA111PCT	Software Engineering	PCC	30	70	100	3-1-0	4
MMCA112PCT	Computer Network	PCC	30	70	100	3-1-0	4
MMCA113PCT	Operating Systems	PCC	30	70	100	3-1-0	4
	Generic Elective	GE	30	70	100	3-1-0	4
MMCA160AEP	English Language & Communication Lab	AEC	50	50	100	0-0-4	2
					Total	**15-4-8**	**21**

Generic Elective-1	
PGCS131GET	English for Research Paper Writing
PGCS132GET	Disaster Management
PGCS133GET	Sanskrit for Technical Knowledge
PGCS134GET	Value Education

Semester – II

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MMCA211PCT	Data Structure & Algorithms	PCC	30	70	100	3-1-0	4
MMCA212PCT	Data Base Management System	PCC	30	70	100	3-1-0	4
MMCA213PCT	Java Programming	PCC	30	70	100	3-1-0	4
MMCA214PCT	Computer System Architecture	PCC	30	70	100	3-1-0	4
	DSE – 1	DSE	30	70	100	3-0-0	3
MMCA260PCP	Data Structure & Algorithms Lab	LAB	50	50	100	0-0-4	2
MMCA261PCP	Data Base Management System Lab	LAB	50	50	100	0-0-4	2
MMCA262PCP	Java Programming Lab	LAB	50	50	100	0-0-4	2
					Total	**15-4-8**	**25**

Semester – III

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MMCA311PCT	Data Science	PCC	30	70	100	3-1-0	4
MMCA312PCT	Formal Language & Automata Theory	PCC	30	70	100	3-1-0	4
MMCA313PCT	Blockchain Technology	PCC	30	70	100	3-1-0	4
MMCA314PCT	Machine Learning	PCC	30	70	100	3-1-0	4
	DSE – 2	DSE	30	70	100	3-0-0	3
	DSE – 3	DSE	30	70	100	3-0-0	3
MMCA360PCP	Data Science Lab	LAB	50	50	100	0-0-4	2
MMCA361PCP	Blockchain Technology Lab	LAB	50	50	100	0-0-4	2
					Total	**18-4-12**	**26**

Semester – IV

Course Code	Course Title	Course Type	Marks			L-T-P	Credits
			Internal Assessment	Semester Exam	Total		
MMCA470PCP	Industrial/Major Project	PROJ	200	200	400	0-0-32	16
					Total	**0-0-32**	**16**

Grand Total of Credits = 88

Discipline Specific Electives (DSE)

DSE – 1	
MMCA211PET	Digital Forensics
MMCA212PET	Component based Software Engineering
MMCA213PET	Cryptography & Cyber Security
MMCA214PET	Software Testing & Quality Assurance

DSE – 2	
MMCA311PET	Cloud Computing and Virtualization
MMCA312PET	Distributed Systems
MMCA313PET	Computer Graphics
MMCA314PET	Artificial Intelligence
MMCA315PET	Data Mining
MMCA316PET	Digital Marketing
MMCA317PET	Internet of Things
MMCA318PET	Compiler Design
MMCA319PET	Pattern Recognition

DSE – 3	
MMCA321PET	Web Technology
MMCA322PET	Artificial Neural Network
MMCA323PET	Semantics Web
MMCA324PET	PHP Programming
MMCA325PET	Soft Computing
MMCA326PET	Deep Learning
MMCA327PET	Web Mining
MMCA328PET	Natural Language Processing

Course Code	Course Title	Lecture			Semester:
		L	T	P	
MMCA111FCT	Statistical Analysis	2	1	0	I

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide students with the foundations of statistical analysis, probability and modeling the real life problems.
2. To understand probability distributions and their properties
3. To learn the statistical parameters for different distributions, correlation and regression
4. To understand the concept of hypothesis and significance tests
5. To help the students to develop an intuition and an interest for random phenomena and to introduce both theoretical issues and applications that may be useful in real life.
6. To understand the method of curve fitting, testing of hypothesis, goodness of fit
1.

Course Outcomes:

1. Apply different statistical measures on data
2. Develop problem solving techniques needed to accurately calculate probabilities and describe the properties of discrete and continuous distribution functions.
3. Use statistical tests in testing hypotheses on data.
4. Compute covariance, and correlations, Apply the tests of goodness of fit.
5. Apply concept of probability and statistics to Translate and solve real world problems

Detailed Contents:

Unit: 1	Basic Statistics: Frequency Distribution, Frequency curve and histogram, Measures of Central Tendencies (Mean, Median, Mode, Range, Standard Deviation, Coefficient of Variation, Quartiles), Measures of Dispersion, Skewness, moments and kurtosis,
Unit: 2	Regression Analysis: Correlation and Regression: Karl Pearson's coefficient of Correlation, Correlation of ranks, Tied Ranks, Curve of regression, lines of regression, properties of regression coefficients and angle between two regression lines Curve fitting – Method of least square, Linear and reducible to linear curves
Unit: 3	Random Variables and Probability Distribution: Random Variable – Discrete and Continuous, Probability Distribution of a Random Variable, Probability Mass Function, Probability Density Function, - evaluation of statistical parameters for these distributions, Distribution Functions, Bivariate Random Variable- Discrete and Continuous Bivariate Random Variables with examples, Joint probability distribution, Marginal and conditional distributions and applications, Probability Distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions and applications
Unit: 4	Sampling Distribution: Test of significance for large & small samples: test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations Sampling Distributions: t- distribution, Chi-square distribution, F-distribution, Standard and Probable errors, Different Methods of Estimation, Testing of Hypothesis -Type I and Type II errors, classification of hypothesis tests; large & small sample tests.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Third Edition, Elsevier Academic Press.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics – 1st Edition S Chand

Reference Books

1. S C Gupta, Fundamentals of Statistics: 7th edition Himalaya Publishing house
2. J. Susan Milton, Jesse C. Arnold, Introduction to Probability & Statistics – 4th Edition, Tata McGraw Hill

Course Code	Course Title	Lecture			
		L	T	P	
MMCA111PCT	Software Engineering	3	1	0	Semester: I

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understanding of software process models such as waterfall and evolutionary models.
2. To understanding of software requirements and SRS document.
3. To understanding of different software architectural styles.
4. To understanding of software testing approaches such as unit testing and integration testing.
5. To understanding on quality control and how to ensure good quality software.

Course Outcomes:

1. Ability to identify the minimum requirements for the development of application.
2. Ability to develop, maintain, efficient, reliable and cost effective software solutions.
3. Ability to critically thinking and evaluate assumptions and arguments.

Detailed Contents:

Unit: 1	Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering-Process patterns, process assessment, personal and team process models. Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process.
Unit: 2	Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioral models, Data models, Object models, structured methods.
Unit: 3	Design Engineering: Design process and Design quality, Design concepts, the design model. Creating an architectural design: Software architecture, Data design, Architectural styles and patterns, Architectural Design. Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution. Performing User interface design: Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.
Unit: 4	Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance. Metrics for Process and Products: Software Measurement, Metrics for software quality. Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.
Unit: 5	CASE Tools: An Overview of CASE Tools, Case and its Scope, CASE Support in Software Life cycle, other characteristics of Case Tools Software Maintenance and Software Reuse: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Software Engineering A practitioner's Approach, Roger S Pressman, 6th edition. McGrawHill International Edition.
2	Software Engineering, Ian Sommerville, 7th edition, Pearson education.
3	Rajib Mall, Fundamentals of Software Engineering, PHI Publication

Reference Books:

1	K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
2	PankajJalote, Software Engineering, Wiley

Course Code	Course Title	Lecture			Semester: I
MMCA112PCT	Computer Networks	L	T	P	
		3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfill networking requirements and building the skills of routing mechanisms.
3. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
4. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Outcomes:

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

1. Understand computer network basic, different models used for study of computer networks, ability to identify different designs, understanding of the issues surrounding wired and wireless Networks.
2. Design, calculate, and apply subnet masks to fulfil networking requirements and building the skills of routing mechanisms.
3. Analyse the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
4. Familiarity with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Detailed Contents:

Unit: 1	**Introduction:**Terminology used in Computer Networks, Evolution of computer networks, Goals and Applications of Networks, Basic communications model, types of Connections, Network structure and architecture, The OSI reference model, services, Network Topology Design - Delay Analysis, Back Bone Design, Local Access Network Design, Transmission Media, Coaxial Cable, Fiber Optics, Switching methods, ISDN, Terminal Handling.
Unit: 2	**Data Link Layer:**Framing, medium access control, Token Ring, Wireless LAN; Virtual circuit switching: Frame relay **MAC Sub Layer:** Channel Allocations, LAN protocols: ALOHA protocols - Overview of IEEE standards - FDDI. Elementary Data Link Protocols, Error Handling: Parity, LRC, CRC, Hamming code. Flow Control: stop and wait, Go back-N ARQ, Selective repeat ARQ, Sliding window, HDLC, PPP, LAN, Ethernet IEEE 802.3, IEEE 802.4, IEEE 802.5, IEEE 802.11, Bridges.
Unit: 3	**Network Layer:**Point-to-Pont Networks, routing, Congestion control, Internetworking: – Packet Switching and Datagram approach, IP addressing methods: Subletting, Routing, Distance Vector Routing, Link State Routing, Structure of a router. TCP / IP, IP packet, IPv4, IPv6.
Unit: 4	**Transport Layer:**Design issues, **Duties of transport layer:** Multiplexing, De-multiplexing, connection management, Sockets, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control, Quality of services (QOS), TCP Window Management. Integrated Services. **Session Layer:** Design issues, remote procedure call. **Presentation Layer:** Design issues, Data compression tech
Unit: 5	File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application. Example Networks: Internet and Public Networks. Domain Name Space (DNS), SMTP, FTP, HTTP, WWW, Peer-to-peer file sharing networks **Security:** Symmetric & Public Cryptography, RSA, Digital Signature, Hash Functions, IP Security, Web Security, System Security

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. A.S. Tanenbaum: Computer Networks, Fourth Edition, Pearson Education, 2003.
2. Stallings, W., "Computer Communication Networks", (4th edition). Prentice Hall of India. 1993.

Reference Books:

1. Forouzan: Data Communications and Networks, Fourth Edition, McGraw Hill, 2007.
2. William Stallings: Data and Computer Communications 5/e, PHI.

Course Code	Course Title	Lecture			Semester: I
MMCA113PCT	Operating Systems	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the services and design of an operating system.
2. To understand the structure and organization of file system
3. To understand the process states and various concepts such as scheduling and synchronization related with it.
4. To understand different memory management approaches.
5. Students should be able to use system calls for managing processes, memory and file system.

Course Outcomes:

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

1. Understand functions, structures and history of operating systems.
2. Able to know the design issues associated with operating systems.
3. Master various process management concepts such as scheduling, synchronization, multithreading and deadlocks.
4. Understand the various concepts associated with memory management such as virtual memory, demand paging, page replacements algorithms.

Detailed Contents:

Unit: 1	**Introduction to Operating System:** Definition of Operating System, Functions of Operating System, Multi-user, Multiprocessing, Multiprogramming, Time Sharing, Real Time Systems, Virtual Computer, Operating System Structure, SystemComponents, Services, System Calls, System Programs, System Design and Implementation.
Unit: 2	**Process Management:** Process concept, Context Switching, Process Control Block, Process Scheduling, Operations on Processes, Cooperating Processes, Inter Process Communication, **CPU Scheduling**: Scheduling Concepts, Criteria, Scheduling Algorithms, Multiprocessor Scheduling, Real time Scheduling.
Unit: 3	**Process Synchronization:**Critical Section, Synchronization Hardware, Semaphores, Problems of Synchronization, Critical Regions,Monitors. **Deadlocks**:Characterization, Handling Deadlocks, Deadlock Prevention, Avoidance, Detection, Deadlock Recovery
Unit: 4	**Memory Management:** Storage Hierarchy, Storage Management Strategies: Contiguous, Non-Contiguous Storage Allocation, Single User-Fixed Partition, Variable Partition, Paging, Segmentation, Swapping-Virtual Memory concept, Demand paging and its performance, Need for Page Replacement, Page Replacement Algorithms, Thrashing.
Unit: 5	**File System Interface and Implementation:** Access Methods, Directory Structure, Protection, File system structure, Allocation Methods, Free space Management, Directory Management, Directory Implementation, Efficiency and Performance, RAID Levels **Device management**: Physical characteristics Disk Scheduling: FCFS, SST, and C- SCAN.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Deitel. H.M .. "An Introduction to Operating Systems". Addison Wesley Publishing Company 1984. Milenkovic, M., "Operating Systems· Concepts and Design". McGraw Hill International Edition Computer Science series 1992.
2	Peterson, J.L .. Abraham Silberschatz. "Operating System Concepts". Addison Wesley Publishing Company. 1989.

Reference Books:

1	Tanenbaum, A.S., "Modem Operating Systems", Prentice Hall of India Pvt. Ltd. 1995.
2	H. Brinch, "Operating System Principles," Prentice Hall of India.

Course Code	Course Title	Lecture			Semester: I
PGCS131GET	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	
Version:	Date of Approval:	4	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

Understand that how to improve your writing skills and level of readability
Learn about what to write in each section
Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Course Outcomes:

Understand the English for Writing Research Papers, Thesis.

Detailed Contents:	
Unit: 1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
Unit: 2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
Unit: 3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
Unit: 4	Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,
Unit: 5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2	Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
Reference Books	
1	Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
2	Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Code	Course Title	Lecture			
MMCA160AEP	English Language & Communication Lab	**L**	**T**	**P**	**Semester:** I
Version:	**Date of Approval:**	**0**	**0**	**4**	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	**:**	**60 Hrs.**	**Maximum Score**	**:**	**100**
Periods/ Week	**:**	**4**	**Internal Evaluation**	**:**	**50**
Credits	**:**	**2**	**End Semester**	**:**	**50**
Instruction Mode	**:**	**Practical**	**Exam Duration**	**:**	**3 Hrs.**

Course Objectives:

1. To achieve the perfection of understanding in English language.
2. To understand the spoken English.
3. To understand the written English.

Course Outcomes:

1. Student will be able to understand, comprehend and analyse the professional and soft communication skills
2. Learn the perfection of understanding in English language.
3. Can read, write and communicate effectively in English.

Detailed Contents:	
Unit: 1	Introduction to Phonetics – Speech Sounds – Vowels & Consonants
Unit: 2	Structure of Syllables – weak forms & strong forms
Unit: 3	Minimal pairs – word accent and stress shifts
Unit: 4	Intonation and common errors in pronunciation
Unit: 5	Conversation practice – oral presentation skills a. Greeting and leave taking, introducing oneself and others b. Apologizing, interrupting, requesting and making polite conversation c. Giving instructions and directions: speaking of hypothetical situations d. Narrating, expressing opinions and telephone interactions

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:	
1	"Enjoying Every day English", Published by Sangam Books, Hyderabad
2	Innovate with English: A Course in English for Engineering Students, edited by T Samson, Foundation Books.
Reference Books	
1	English Grammar Practice, Raj N Bakshi, Orient Longman
2	Technical Communication by Daniel Riordan. 2011. Cengage Publications. New Delhi

Course Code	Course Title	Lecture			Semester: II
MMCA211PCT	Data Structures and Algorithms	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write and comparethe algorithms for solving problems with the help of data structures
5. To understand the complexity theory.

Course Outcomes:

1. Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.
2. Discuss the computational efficiency of the sorting and searching algorithms.
3. Implementation of Trees and Graphs and perform various operations on these data structure.
4. Identify the alternative implementations of data structures with respect to its performance to solve a real world problem.
5. Discuss the Greedy, Dynamic, Back-Tracking and Branch & Bound Algorithms
6. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.

Detailed Contents:

Unit: 1	Introduction to Data Structure, Algorithm, Performance Analysis-Space complexity, Time complexity, Asymptotic Notations, Time-Space trade-off.Abstract Data Types (ADT). Arrays: Definition, Single and Multidimensional Arrays, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Array Application of arrays. Linked lists: Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal.
Unit: 2	Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion- Principles of recursion, Tail recursion. Tradeoffs between iteration and recursion. Queues: Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues, Dequeue and Priority Queue. Trees: Binary tree representation, tree traversal, complete binary tree, heap, AVL tree, Huffman Tree, B Tree, B+ Tree.
Unit: 3	Searching with Analysis: Concept of Searching, Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing. Sorting with Analysis: Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort and Heap Sort
Unit: 4	Greedy method: Knapsack problem, Graphs, Graph Traversal: DFS & BFS. Spanning Trees: Prim's and Kruskal's algorithm.Dijkstra's algorithm. Dynamic programming: Multistage Graphs, Floyd–Warshall algorithm, Optimal Binary Search Trees, O/1 Knapsack problem, Travelling Sales Person Problem.
Unit: 5	Back tracking: n-Queen Problem, GraphColouring, Hamiltonian cycles. Branch and Bound: LIFOBB and FIFOBB. NP-Hard and NP-Complete problems: Basic Concepts, Non Deterministic Algorithms, NP - Hard and NP-Complete Classes, Cook's theorem(Language)

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Fundamentals of Data Structures,Horowitz and Sahani, Galgotia Publications Pvt Ltd Delhi India.
2	Algorithms, Coreman, Rivest, Lisserson, PHI, Third Edition

Reference Books:

1	Design and Analysis of Algorithms, ManasRanjanKabat, PHI.
2	Data Structures, Lipschutz, Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

Course Code	Course Title	Lecture			Semester: II
MMCA212PCT	Database Management Systems	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. Understand the concept of data planning and database design for serving different types of users with varying skill levels.
2. Handling different user views of the same stored data, combining interrelated data , setting standards, controlling concurrent updates so as to maintain data integrity.
3. Managing, planning and coordinating restart and recovery operations across multiple users for a large complex systems.

Course Outcomes:

1. Understand the relational database theory, and be able to write relational algebra expressions for queries, logical design of databases, including the E-R method and normalization approach.
2. Understand and analyze the database storage structures and access techniques like file and page organizations, indexing methods including B-tree, hashing, query evaluation techniques and and query optimization.
3. Understand various issues of transaction processing and concurrency control by designing and development of a database application system as part of a team.

Detailed Contents:

Unit: 1	Data base System Applications, data base System VS file System – View of Data – Data Abstraction–Instances and Schemas–data Models –the ER Model–Relational Model–Other Models–Database Languages–DDL–DML–database Access for applications Programs–database Users and Administrator–Transaction Management–database System Structure–Storage Manager–the Query Processor. HistoryofDatabaseSystems.DatabasedesignandERdiagrams–BeyondERDesignEntities, AttributesandEntitysets–RelationshipsandRelationshipsets–AdditionalfeaturesofER Model– Concept Design withtheERModel– ConceptualDesign forLargeenterprises.
Unit: 2	IntroductiontotheRelationalModel–IntegrityConstraintOverrelations–EnforcingIntegrity constraints–Queryingrelationaldata–LogicaldatabaseDesign–IntroductiontoViews– Destroying/alteringTablesandViews. RelationalAlgebra– Selectionandprojectionsetoperations– renaming– Joins–Division–ExamplesofAlgebraoverviews–Relationalcalculus– TuplerelationalCalculus–Domain relationalcalculus–ExpressivePowerofAlgebraandcalculus.Schemarefinement–ProblemsCausedbyredundancy Decompositions–Problemrelatedto decomposition–reasoningaboutFDS–FIRST,SECOND,THIRDNormalforms–BCNF–LosslessjoinDecomposition–DependencypreservingDecomposition–Schemarefinementin DatabaseDesign –MultivaluedDependencies– FORTH NormalForm.
Unit: 3	FormofBasicSQLQuery–ExamplesofBasicSQLQueries–IntroductiontoNestedQueries CorrelatedNestedQueriesSet–ComparisonOperators–AggregativeOperators–NULLvalues –ComparisonusingNullvalues–Logicalconnectivity's–AND,ORandNOT–ImpactonSQL Constructs–OuterJoins–DisallowingNULLvalues–ComplexIntegrityConstraintsinSQL Triggersand ActiveDatabases.
Unit: 4	Transaction Concept- Transaction State- Implementation of Atomicity and Durability Concurrent–Executions–Serializability- Recoverability–ImplementationofIsolation–Testing forserializability- Lock–BasedProtocols–TimestampBasedProtocols- Validation- Base Protocols– MultipleGranularity. RecoveryandAtomicity–Log–BasedRecovery–RecoverywithConcurrentTransactions– Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- RemoteBackup systems.
Unit: 5	DataonExternalStorage–FileOrganizationandIndexing–ClusterIndexes,Primaryand SecondaryIndexes–IndexdataStructures–HashBasedIndexing–TreebaseIndexingComparisonofFileOrganizations–IndexesandPerformanceTuning-IntuitionsfortreeIndexes – Indexed SequentialAccessMethods (ISAM)–B+Trees:A DynamicIndex Structure.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Data base Management Systems, RaghuramaKrishnan, Johannes Gehrke, TATA McGrawHill3rdEdition
2	DatabaseSystemConcepts, Silberschatz, Korth, McGrawhill,Vedition

Reference Books:

1	FundamentalsofDatabaseSystems, ElmasriNavratePearson Education
2	Introduction to DatabaseSystems, C.J.DatePearson Education

Course Code	Course Title	Lecture			Semester: II
MMCA213PCT	Java Programming	L	T	P	
Version:1.0	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To elaborate JAVA programming language with object-oriented programming principles and variable scopes, memory management, and reference versus value types in relation to parameters and arguments in function calls.
2. To demonstrate the principles of object oriented features of Java programming languagewith Data base and security features

Course Outcomes:

1. On completion of the course the student should be able to: Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
2. Can read and make elementary modifications to Java programs that solve real-world problems.

Detailed Contents:

Unit: 1	Java Basics - Review of OOP concepts, History of Java, Java buzzwords, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow-block scope, conditional statements, loops, break and continue statements, simple java program, arrays, input and output, formatting output classes, objects, constructors, methods, parameter passing, static fields and methods, access control, this keyword, overloading methods and constructors, recursion, garbage collection, String Handling. Object oriented analysis, modeling and design: Structural modelling, Behavioural modelling.
Unit: 2	Inheritance – Inheritance concept, benefits of inheritance ,Super classes and Sub classes, Member access rules, Inheritance hierarchies, super keyword, preventing inheritance: final classes and methods, casting, polymorphism - dynamic binding, method overriding, abstract classes and methods, the Object class and its methods. Packages-Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.
Unit: 3	Interfaces – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface, method definition in interface: default, private & static methods, lambda expressions, BigInteger: class hierarchy and example.Inner classes – Uses of inner classes, local inner classes, anonymous inner classes, static inner classes, Diamond Operator.
Unit: 4	Exception handling – Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes, Guide lines for proper use of exceptions. Multi-threading - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, thread groups, daemon threads.
Unit: 5	APPLETS, JAVA GUI AND DATABASE CONNECTIVITY, Networking - Applets – Applet life cycle methods – Applets based GUI – AWT Introduction - GUI components – Basics of Swings –Accessing database with JDBC basics- Types of Drivers – Basics of Networks Programming, Addresses, Ports, Sockets, Simple Client and Server Program, Multiple Clients and Single Server.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Java; the complete reference, 9th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson education.

Reference Books:

1. Head First Java, Kathy Sierra, Bert Bates, O'Reilly Media; 2 edition (9 February 2005)
2. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

Course Code	Course Title	Lecture			Semester: II
MMCA214PCT	Computer System Architecture	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To know about the hardware architecture of Computer System such as Circuit Theories, decoder, Multiplexers, Registers, Accumulator, Processor etc.
2. To understand the Connectivity of System's parts that how they are following instruction.
3. To understand about Organization of Memory, CPU Organization, DMA Controller, Pipelining of Process, Addressing Modes etc

Course Outcomes:

1. Understand the processing of Computer.
2. Know the function of Memory and its types.
3. Know about the function and organization of Input Output devices..

Detailed Contents:

Unit: 1	Digital Logic Circuits, Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits. Digital Components, Decoder, Multiplexers, 'Registers.
Unit: 2	Register Transfer and Micro operations:. Register Transfer language, Register transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations and Arithmetic logic shift. Instruction codes, Computer Registers, Instructions, Instruction Cycles, Input, Output and Interrupts.
Unit: 3	CPU Organization: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control Organization of a control unit-Operations of a control unit, Hardwired control unit, Micro programmed control unit.`
Unit: 4	Input Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA controlled I/O, Direct Memory Access, Input-Output Processor
Unit: 5	Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Computer System Architecture, M. Morris Mano, Pearson Asia / Prentice Hall, Third edition,

Reference Books:

1	Fundamentals of Computer Organization and Design, a P Dandamudi Springer/ Dream Tech Publishers, 2003.
2	William Stallings, "Computer Organization & Architecture", Pearson Education, Sixth: Edition, 2003.

Course Code	Course Title	Lecture			
MMCA260PCP	Data Structures and Algorithms Lab	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	3	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To practice with programming skill and improve the programming logic.
2. To apply various techniques with data such storing, inserting, deleting and traversing of data.
3. To utilize of various data structures such as Linked List Structures, Stack, Queues, Trees and Graphs to implement the algorithms.
4. To understand the complexity of algorithms.
5. To develop skills to apply appropriate data structures and algorithms in problem solving

Course Outcomes:

1. To learn the concepts of data structure and algorithms with respect to practical aspect.
2. To write the code for a large program after overcoming the time and space complexity.
3. To write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.
4. To compare alternative implementations of data structures with respect to performance.
5. To utilize of various algorithms such as searching, sorting, Greedy, Dynamic, Back-Tracking and Branch & Bound.

Detailed Contents:

1. Write a Program to implement a stack using array.
2. Write a Program to implement a stack using linked list.
3. Write a Program to implement a queue using array.
4. Write a Program to implement a queue using linked list.
5. Write a Program to implement a circular queue using array.
6. Write a Program to implement a simple linked list.
7. Write a Program to implement a circular linked list.
8. Write a Program to implement a doubly linked list.
9. Write a Program to count a node in linked list.
10. Write a Program to implement a reversed a linked list.
11. Write a Program to implement the following Searching Algorithms:
    Sequential search, Index Sequential Search, Binary Search.
12. Write a Program to implement the following Sorting Algorithms:
    Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort and Heap Sort
13. Write a program to implement the Minimum Spanning Tree using Kruskal's and Prim's Algorithm.
14. Write a program to implement the TSP problem.

Note: Write the more programs as per prescribed Syllabus

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1. Data Structures and Program Design in C,R. Kruse etal, Pearson Education.
2. Data Structure Using C, Thareja, Oxford Higher Education

Reference Books:

1. Data Structure Using C, AK Sharma, Pearson Education India.
2. Data Structures, Lipschutz, Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

Course Code	Course Title	Lecture			
MMCA261PCP	Database Management Systems LAB	L	T	P	**Semester:** II
Version:	**Date of Approval:**	0	0	4	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Course Objectives:

1. Knowledge of DBMS, in terms of use and implementations.
2. Understand the concept of data planning and database design for serving different types of users with varying skill levels.
3. Handling different user views of the same stored data, combining interrelated data , setting standards, controlling concurrent updates so as to maintain data integrity.

Course Outcomes:

1. Understand the relational database theory, and be able to write relational algebra expressions for queries, logical design of databases, including the E-R method and normalization approach.
2. Illustrate commercial relational database system by writing SQL.
3. Understand and analyze the database storage structures and access techniques like file and page organizations, indexing methods including B-tree, hashing, query evaluation techniques and and query optimization.

Detailed Contents:

1. Writethequeries forDataDefinition and DataManipulationLanguage.
2. WriteSQLqueries usinglogical operations (=,<,>, etc.)
3. WriteSQLqueries usingSQLoperators
4. WriteSQLqueryusingcharacter, number, dateand group functions
5. WriteSQLqueriesforrelational algebra
6. WriteSQLqueriesforextractingdatafrom morethan onetable
7. WriteSQLqueriesforsub queries, nested queries
8. WriteprogrammebytheuseofPL/SQL
9. Concepts forROLL BACK, COMMIT&CHECK POINTS
10. CreateVIEWS, CURSORSand TRIGGERS

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	SQL, PL/SQL the Programming language of Oracle by Ivan Bayross 4th edition
2	SQL & PL/SQL for Oracle 11g Black Book by P.S. Deshpande

Reference Books:

1	Oracle PL/SQL Training GuideBen Forta
2	Oracle Database 12c PL/SQL Programming McLaughlin

Course Code	Course Title	Lecture			Semester: II
MMCA262PCP	Java Programming Lab	L	T	P	
Version:	Date of Approval:	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Course Objectives:

1. To build software development skills using java programming for real world applications.
2. To implement frontend and backend of an application
3. To implement classical problems using java programming.

Course Outcomes:

2. To propose the use of certain technologies by implementing them in the Java programming language to solve the given problem.
3. Able to use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
4. To develop software in the Java programming language, (console application)
5. Can read and make elementary modifications to Java programs that solve real-world problems.

Detailed Contents:

List of Experiments:

1. Write a program to print the Fibonacci series up to a given number.
2. Write a Java Program to find the maximum of two numbers using command line args.
3. Write a Java Program to demonstrate the operation of super keyword in Java.
4. Write a Java Program to demonstrate the concept of method overriding.
5. Write a Java Program to describe about abstract class.
6. Write a Java Program to demonstrate about the final method.
7. Write a Java Program to define and implements an interface.
8. Write a Java Program to describe about try and catch blocks for handling exceptions.
9. Write a Java Program to demonstrate about throw and throws keywords.
10. Write a Java Program to raise and handle custom or user defined exceptions in java.
11. Write a Java Program to demonstrate about switch case.
12. Write a Java Program to find whether the given number is palindrome or not.
13. Write a Java Program on the operation of this keyword.
14. Write a Java Program on concept of method overloading.
15. Write a Java Program to explain single inheritance concept.
16. Write a Java program to demonstrate the operation of Scanner class.
17. Write a Java Program to create threads in java by extending Thread Class.
18. Write a Java Program to create threads in java by implementing Runnable Interface.
19. Write a Java Program to define and import the user defined package.
20. Write a Java program to print a message using applet concept.
21. Write a Java Program to pass the parameters using applet concept.
22. Write a program to generate random numbers sequence in Java.
23. Write a program to swap the numbers without using third variable in Java.
24. Write a Java Program to find the sum and product of digits of a given number.
25. Write a Java Program to display multiplication of an array.
26. Write a java program to perform arithmetical operations using BigInteger class.
27. Write a java program to perform client server communication using Socket programming./

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1. Java; the complete reference, 9th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson education.

Reference Books:

1. Head First Java, Kathy Sierra, Bert Bates, O'Reilly Media; 2 edition (9 February 2005)
2. Introduction to Java programming 6th edition, Y. Daniel Liang, pearson education.

Course Code	Course Title	Lecture			Semester: III
MMCA311PCT	Data Science	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn big data challenges in different domains including social media
2. To learn MAP-REDUCE programming model for better scalability and performance
3. To analyze the capability of No-SQL systems
4. To apply machine learning algorithms for big data analytics

Course Outcomes:

1. Preparing for data summarization, query, and analysis.
2. Applying data modelling techniques to large data sets
3. Creating applications for Big Data analytics
4. Building a complete business data analytic solution

Detailed Contents:

Unit: 1	Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources
Unit: 2	Introduction to Big Data: Big Data - Definition, overview of Big Data, Big Data Characteristics – Volume, Velocity, Variety and other Vs, Issues and challenges of Big Data, Stages of analytical evolution, State of the Practice in Analytics, Big Data Architecture – space of Big Data: Transactions, Interactions, Observations; Big data Technological approaches and Potential use cases for Big Data. The Hadoop Ecosystem–Distributed File Systems basics, Advantages of Hadoop,Query languages for Hadoop,Hadoop Distributed File System (HDFS), Overview of HBase, Hive and PIG. MapReduceFramework ,Introduction to Machine Learning .
Unit: 3	Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.
Unit: 4	NoSQL Databases – Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, working mechanisms of NoSQL Databases – HBase, Cassandra, Couch DB, Mango DB.
Unit: 5	Applications of Data Science, Technologies for visualisation, , recent trends in various data collection and analysis techniques, various visualization techniques, application development methods in data science using g R, Spreadsheet-like analytics.(R in statistical analysis as tutorial) Include Python here

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Big Data – A Primer, H. Mohanty, P. Bhuyan, D. Chenthati (Eds.), Springer , Studies in Big Data, vol. 11, 2015.
2	Big Data Analytics with Rand Hadoop, VigneshPrajapati, PACKT Publishing

Reference Books:

1	Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, Cambridge Universities Press, 2012.
2	Big Data at Work: Dispelling the Myths, Uncovering the OpportunitiesBook by Thomas H. Davenpor

Course Code	Course Title	Lecture			Semester:
MMCA312PCT	Formal Language &Automata Theory	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide introduction to theoretical computer science from the perspective of formal languages.
2. To introduce the fundamental concepts of formal languages, grammars and automata theory.
3. To classify machines by their power to recognize languages.
4. To employ finite state machines to solve problems in computing.
5. To understand deterministic and non-deterministic machines.
6. To understand the differences between decidability and undecidability.

Course Outcomes:

1. Able to understand the concept of abstract machines and their power to recognize the languages.
2. Able to employ finite state machines for modeling and solving computing problems.
3. Able to design context free grammars for formal languages.
   Able to distinguish between decidability and undecidability.
4. Able to gain proficiency with mathematical tools and formal methods.

Detailed Contents:

Unit: 1	Fundamentals : Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non deterministic finite automaton, transition diagrams and Language recognizers. Finite Automata : NFA with ϵ-transitions - Significance, acceptance of languages. Conversions and Equivalence : Equivalence between NFA with and without ϵ- transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.
Unit: 2	Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expression, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets. Grammar Formalism : Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings.
Unit: 3	Context Free Grammars: Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL . Push Down Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion.
Unit: 4	Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines
Unit: 5	Computability Theory : Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar, decidability of problems, Universal Turing Machine, undecidability of posts correspondence problem, Definition of P and NP problems, NP complete and NP hard problems

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Introduction to Automata Theory Languages and Computation. Hopcroft H.E. and Ullman J. D. Pearson Education
2. Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekaran, PHI.

Reference Books:

1. Introduction to Forml languages Automata Theory and Computation Kamala Krithivasan Rama R.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.

Course Code	Course Title	Lecture			
MMCA313PCT	Blockchain Technology	**L**	**T**	**P**	**Semester:** III
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the function of Blockchain as a method of securing distributed ledgers
2. Tounderstand the concept of Cryptocurrencies like BitCoin, ETH, LiteCoin etc.
3. To learn Ethereum framework
4. To Learn the wallets
5. To learn the Smart Contracts
6. To understand the concept of Hyperledger

Course Outcomes:

1. To be able to implement the blockchain
2. To familiarise the functional/operational aspects of cryptocurrency ecosystem.
3. To be able to implement the smart contracts for use cases
4. To identify the major research challenges and technical gaps existing between theory and practice in Blockchain

Detailed Contents:

Unit: 1	Introduction to Cryptography, Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, Euclid's Algorithm, RSA algorithm, Diffie-Hellman key exchange algorithm,ElGamal Encryption, Elliptic curve cryptography, SHA 256, Digital Signature, Zero Knowledge Proof (ZKP)
Unit: 2	Introduction from barter system to Cryptocurrency, fundamental of Blockchain, Block structure, Genesis Block, Orphaned Blocks, Stale Block, Uncle Block, Distributed Ledger Technology (DLT), peer-to- peer network, Merkle Tree, Lifecycle of Blockchain, Evolutions of Blockchain, Fork, double spending money, Transactions and UTXO's, Types of Blockchain. Need of Blockchain, Benefits of Blockchain.
Unit: 3	Cryptocurrencies: BitCoin (BTC), Ethereum (ETH), Ripple (XRP), LiteCoin (LTC), Bitcoin Cash (BCH), Mining pools, Mining, Difficulty Level, Current Target, Nonce, how miners picks transactions, How do mempools work, 51% attack. Consensus Algorithms: Proof of Work (PoW), Asynchronous Byzantine Agreement, Proof of Stake (PoS), Hybrid models (PoW + PoS),
Unit: 4	Wallets, Types of wallets-Hardware, Software, Paper, Web, Desktop. Ethereum - Ethereum network, Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity - Smart Contracts, Truffle, Web3, some attacks on smart contracts, Design and issue Cryptocurrency ICO, Mining,Gas - Transactional Fee &Incentivisations,DApps,Decentralized Autonomous Organizations (DAO).
Unit: 5	Hyperledger- Introduction to Hyperledger, What is Hyperledger, Why Hyperledger, Where can Hyperledger be used, Hyperledger Architecture, Membership, Blockchain, Transaction, Chaincode, Hyperledger Fabric, Features of Hyperledger, Fabric Installation of prerequisite,Architecture of Hyperledger Fabric, Transaction, Ledger, Nodes, Peer, Endorser, Ordering Nodes, Channels, Certificate Authority, Transaction Flow.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Mastering Blockchain, Imran Bashir, Packt Publishing
2	Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten,Andrew Miller, Steven Goldfeder, Princeton University Press. https://bitcoinbook.cs.princeton.edu/

Reference Books:

1	GrokkingBitcoin, Kalle Rosenbaum, Manning Publications. http://rosenbaum.se/book/grokking-bitcoin.html
2	Blockchain Basics, Daniel Drescher, Apress Publication

Course Code	Course Title	Lecture			Semester: III
MMCA314PCT	Machine Learning	**L**	**T**	**P**	
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
Total Duration	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

PRE-REQUISITES: Knowledge of basic data science algorithms

Course Objectives:

1. The course aims to learn about the purpose of Machine Learning and where it applies to the real worlds
2. To become familiar with specific, widely used machine learning algorithms.
3. To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.

Course Outcomes:

1. Develop an appreciation for what is involved in learning from data.
2. How to apply a variety of learning algorithms to data.
3. How to perform the evaluation of learning algorithms and model selection.

Detailed Contents:	
Unit: 1	Introduction to Machine Learning - Defining learning systems, Goals and applications of machine learning in different fields such as health care, banking, telecommunication, and so on. Aspects of developing a learning system: : training data, concept representation, function approximation, A general overview of supervised, semi supervised, unsupervised learning algorithm and the usage of each algorithm.
Unit: 2	**Basics of Python:** Introduction to Python, Why learn Python, Keywords and identifiers, comments, indentation and statements, Variables and data types in Python, Operators, Standard Input and Output, Introduction to IDE such as Sublime, pycharm, spyder and relevant packages installations such anaconda. **Control structure and function:** if-elif-else, while loop, for loop, break and continue,Introduction to function, Types of functions, Function arguments, Lambda functions, File Handling, packages and modules.
Unit: 3	Python Data Structures: Lists, Tuples, Dictionary, Sets, strings, Numpy: Numpy operation, Array and its operation, Matrix and associated operations, Linear algebra and related operations using python. Understand the advantage of using Python libraries for implementing Machine Learning models. Types of data sets.
Unit: 4	**Pandas data frame and data frame related operations on dataset :** Reading data files, pandas dataframes, Exploratory data analysis, Data preparation and preprocessing (Dealing with missing value, cross-validation, classification, performance measure), **Data visualization on dataset using matplotlib and seaborn libraries:** Scatter plot, Line plot, Bar plot, Histogram, Box plot, Pair plot.
Unit: 5	**Introduction to Regression** - Linear, Non-linear, Simple and Multiple regression, and their applications, **Introduction to Classification technique** - KNN, ANN, Decision Trees and SVM. Pros and cons of each method, and different classification accuracy metrics. **Introduction to clustering approaches** - Types of clustering, including Partitioned-based Clustering, Hierarchical Clustering, and Density-based Clustering.

Examination and Evaluation Pattern: It includes both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which mainly ends semester examination.

Text Books:	
1	Mastering Python for data science, Samir Madhavan
2	Introduction to Machine Learning with Python, Andreas C. Mueller
Reference Books:	
1	Machine Learning using Python, U Dinesh Kumar Manaranjan Pradhan
2	McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython.

Course Code	Course Title	Lecture			Semester: III
MMCA360PCP	DATA SCIENCE LAB	L	T	P	
Version:	Date of Approval:	0	0	4	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	30 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	2	End Semester	:	50
Instruction Mode	:	Practical	Exam Duration	:	3 Hrs.

Course Objectives:

1. Optimize business decisions and create competitive advantage with Big Data analytics
2. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
3. Developing Big Data applications for streaming data using Apache Spark

Course Outcomes:

1. To Preparing for data summarization, query, and analysis.
2. To Applying data modelling techniques to large data sets
3. To Creating applications for Big Data analytics and Building a complete business data analytic solution

Detailed Contents:

1. Form setting up and Installing Hadoop in its two operating modes: • Pseudo distributed, • fully distributed.
2. Implement the following file management tasks in Hadoop: • Adding files and directories • Retrieving files • Deleting files ii) Benchmark and stress test an Apache Hadoop cluster
3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm. • Find the number of occurrence of each word appearing in the input file(s) • Performing a MapReduce Job for word search count (look for specific keywords in a file)
4. Stop word elimination problem:
5. Input: o A large textual file containing one sentence per line o A small file containing a set of stop words (One stop word per line)
6. Output: o A textual file containing the same sentences of the large input file without the words appearing in the small file.
7. Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all.
8. Find average, max and min temperature for each year in NCDC data set?
9. Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.
10. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.
11. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)
12. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
13. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.
14. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together. • Write a single Spark application that: o Transposes the original Amazon food dataset, obtaining a PairRDD of the type: → o Counts the frequencies of all the pairs of products reviewed together; o Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1	Big Data – A Primer, H. Mohanty, P. Bhuyan, D. Chenthati (Eds.), Springer , Studies in Big Data, vol. 11, 2015.
2	Big Data Analytics with Rand Hadoop, VigneshPrajapati, PACKT Publishing

Reference Books:

1	Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey D. Ullman, Cambridge Universities Press, 2012.
2	Big Data at Work: Dispelling the Myths, Uncovering the OpportunitiesBook by Thomas H. Davenpor

Course Code	Course Title	Lecture			Semester: III
MMCA361PCP	Blockchain Technology Lab	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	50
Credits	:	3	End Semester	:	50
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn the tools: Python, VS Code, POSTMAN, FLASK, Node.js, Ganache, MyEtherWallet
2. To understand the concept of Blockchain
3. To learn the Cryptocurrencies
4. To understand the concept of smart contract
5. To learn Blockchain platforms: Ethereum, Hyperledger Fabric, IBM Blockchain and Relictum Pro

Course Outcomes:

1. To be able to work with Blockchain required tools.
2. To be able to implement the Blockchain
3. To be able to work with Blockchain platforms.
4. To be able to work with wallets
5. To be able to apply Blockchain in use cases like Real state, Supply chain, voting, ICO, etc.

Detailed Contents:

Software required: Python, VS Code, POSTMAN, FLASK, Node.js, Ganache, MyEtherWallet, MetaMask
Remix IDE:https://remix.ethereum.org/ [For running the smart contract]
Operating System: Windows and Linux/UbuntuInclude some general expts

1. Create a Blockchain
   - 1.1 Create new blocks and add to the chain
     - 1.1.1 Structure of a block: Index, Timestamp, Transaction List, Proof, Previous Block Hash
   - 1.2 Initialize Blockchain
   - 1.3 Adds new transaction
   - 1.4 Hashing a block
   - 1.5 Registering a node to the network
   - 1.6 Validates the chain
   - 1.7 Validates block before submission chain
   - 1.8 Implement Proof of Work Consensus
2. Create a Cryptocurrency
3. Create a Smart Contracts

hadcoins_ico, Calculator ,simplewallets

4. Supply chain smart contract
5. Voting Smart Contract
6. Hands-on Wallets
   Hardware,WebWallets,MobileWallets,DesktopWallets,Paper Wallets
7. Hands-on Hyperledger Fabric Blockchain Platform
8. Hands-on IBM Blockchain Platform: Docker, Docker Compose
9. Hands-on Relictum Pro Blockchain 5.0 Platform,Blockchain Security 2Go starter kit

Note: Write the more programs as per prescribed Syllabus or real time scenario

Examination and Evaluation Pattern: It include both internal evaluation (50 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (50 marks) which is mainly end semester examination.

Text Books:

1. Hands-on Blockchain for Python Developers, Arjuna Sky Kok, Packt Publication
2. Solidity Programming Essentials, RiteshModi, Packt Publication

Reference Books:

1. Ethereum for Web Developers, Santiago Palladino, Apress Publication.
2. Learn Blockchain Programming with JavaScript, Eric Traub, Packt Publication

Discipline Specific Electives (DSE)

Course Code	Course Title	Lecture			
MMCA211PET	Digital Forensics	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. Have an introduction into the process of Digital Forensics.
2. Understand the Environment of forensics & learn process of collecting evidences.
3. Gain working knowledge of analyzing evidences using tools

Course Outcomes:

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

1. Identify the need for cybercrime investigation.
2. Understand the hardware and software components responsible for seeking evidence.
3. Have knowledge on the techniques used for collecting evidences.
4. Analyse the evidence through suitable tools.
5. Examine other sources of evidences.

Detailed Contents:

Unit: 1	DIGITAL FORENSICS PROCESS: Forensic Science, Digital Forensics, Digital Evidence, Digital Forensics Process – Identification, Collection, Examination, Analysis, Presentation Phases. Cyber Crime Law-International Legal Framework of Cybercrime Law, Digital Crime, Investigation Methods for Collecting DigitalEvidence.
Unit: 2	FORENSICS ENVIRONMENTS : Hardware and Software Environments – Storage Devices, Operating System, File Systems, Metadata, Locating evidence in file systems-Password security, Encryption, and Hidden files. Case study – linking the evidence to the user, Data Analysis using forensics tool ILookIX
Unit: 3	COLLECTING EVIDENCES Use of Digital Evidence, File Metadata and Correlation with Other Evidence, Technical Complexities of Digital Evidence. Data carving, Date and time problems, Physical Acquisition and Safekeeping of Digital Evidence. Forensic Imaging Processes. Case Study – IXImager, Understanding .ASB Container
Unit: 4	ANALYZING DIGITAL EVIDENCE : Selecting and Analyzing Digital Evidence - Locating digital evidence, Categorizing files, Eliminating superfluous files, Validating the Evidence. Case study – illustrating the recovery of deleted evidence held in volume shadows.
Unit: 5	OTHER SOURCES OF EVIDENCES : Windows and Other Operating Systems as Sources of Evidence, Examining Browsers, E-mails, Messaging Systems, and Mobile Phones, Internet and Cloud.-Challenges in Digital Forensics.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Richard Boddington, Practical Digital Forensics, PACKT publishing, First Edition, 2016ANDRÉ ÅRNES.
2. Practical Mobile Forensics, PACKT publishing , 2014 SatishBommisetty, RohitTamma, Heather Mahalik

Reference Books:

1. "Guide to Computer Forensics and Investigations" 4e, Nelson, Phillips Enfinger, Steuart, Cengage Learning.
2. Android Forensics Investigation, Analysis, and Mobile Security for Google Android, Andrew Hoog, John McCash.

Course Code	Course Title	Lecture			
MMCA212PET	**Component-Based Software Engineering**	**L**	**T**	**P**	**Semester:** II
Course Type: DSE	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn the essentials of component-based software engineering.
2. To learn the concepts essential for design and development of component based software engineering.

Course Outcomes:

1. Will be able to produce the software from previous available components and also develop new components
2. Will be able to facilitate interaction between components.
3. Will be able to develop large project by combining multiple components.

Detailed Contents:

Unit: 1	Introduction to Component Based Development: Definition of Software Component and its Elements, The Component Industry Metaphor, Component Models and Component Services: Concepts and Principles, An Example Specification for Implementing a Temperature Regulator Software Component.
Unit: 2	Case for Components: The Business Case for Software Components, COTS Myths and Other Lessons Learned in Component-Based Software Development, Roles for Component-Based Development, Common High Risk Mistakes in Component-Based Software Engineering, CBSE Success Factors: Integrating Architecture, Process, and Organization.
Unit: 3	Software Component Infrastructure: Software Components and the UML, Component Infrastructures: Placing Software Components in Context, Business Components, Components and Connectors: Catalysis Techniques for Defining Component Infrastructures, an Open Process for Component-Based Development, Designing Models of Modularity and Integration.
Unit: 4	Management of CBD: Measurement and Metrics for Software Components, The Practical Reuse of Software Components, Selecting the Right COTS Software: Why Requirements are important, Build vs. Buy, Software Component Project Management Processes, The Trouble with Testing Software Components, Configuration Management and Component Libraries, The Evolution, Maintenance and Management of Component-Based Systems
Unit: 5	Component Technologies: Overview of the CORBA Component Model, Transactional COM+ Designing Scalable Applications, The Enterprise JavaBeans Component Model, Choosing Between COM+, EJB, and CCM, Software Agents as Next Generation Software Components.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Component Software ,Clemens Szyperski, Addison-Wesley Professional; 2 edition ,, 2002, ISBN-10: 0201745720, ISBN-13: 978-0201745726
2	

Reference Books:

1	Component-Based Software Engineering: Putting the Pieces Together by George T. Heinemann and William T.Council, Addison-Wesley Professional, 2001 ISBN 1`0: 0201704854,ISBN- 13:9780201704853

Course Code	Course Title	Lecture			Semester: II
MMCA213PET	Cryptography and Cyber Security	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand fundamentals of Cryptography and Cyber Security.
2. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
3. To understand various protocols and cryptographic algorithms for network security to protect against the threats in the networks.
4. To learnthe emerging technologies in the cyber security areas and assess their current capabilities, limitations and potential applications.

Course Outcomes:

After successful completion of the course, the learners would be able to:

1. Provide security of the data over the network.
2. Illustrate various Public and private key cryptographic techniques
3. Do research in the emerging areas of cryptography and cyber security.
4. Implement various networking protocols.
5. Protect any network from the threats in the world.

Detailed Contents:

Unit: 1	Introduction to the Concepts of Security: The need for security, Security Approaches, Principles of Security, Types of Attacks. Symmetric and Asymmetric Key Cryptography, Key Range and Key Size. Classical encryption techniques: substitution ciphers and transposition ciphers, cryptanalysis, stenography, stream and block ciphers. Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard (DES), AES.
Unit: 2	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm,ElGamal Encryption, Elliptic curve cryptography,
Unit: 3	Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MAC, MD5, Secure hash algorithm(SHA). Digital Signatures.
Unit: 4	Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.
Unit: 5	IP Security: Architecture, Authentication header, encapsulating security payloads, Combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic Transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Cryptography and Network Security by Behrouz A. Forouzan, 2nd Edition TMH.
2. Cryptography and Network Security, W. Stallings, Prentice Hall, 5th Edition, 20102.

Reference Books:

1. Network Security Essentials, William Stallings ,Prentice Hall, 5th Edition, 2013.
2. Network Security and Cryptography, Bernard Menezes, Cengage Publication

Course Code	Course Title	Lecture			
MMCA214PET	Software Testing and Quality Assurance	**L**	**T**	**P**	**Semester:** II
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To Study the state-of-the-art and main research challenges of selected topics in softwaretesting
2. ToStudy thestate-of-the-artandmainresearchchallengesofselectedtopicsin softwarequalityassurance.
3. To Introduce various approaches, techniques, technologies, and methodologies used in software testing and qualityassurance

Course Outcomes:

1. Apply software testing knowledge and engineeringmethods.
2. Analyzedifferentapproachestosoftwaretestingandqualityassurance,andselectoptimalsolutionsfordifferent situations andprojects;
3. Evaluatetheworkofpeersconstructivelybyfollowingprovenmethodsofpeer-review,andbyusingthe principles ofethics.

Detailed Contents:

Unit: 1	Introduction: Software Quality, Role of testing, Verification &Validation, objectives and issues of testing, Testing activities and levels, Sources of Information for Test Case Selection, White-Box and Black-Box Testing , Test Planning and Design, Monitoring and Measuring Test Execution, Test Tools and Automation, Test Team Organization and Management. Unit Testing: Concept, Static Unit Testing, Defect Prevention, Dynamic Unit Testing, Mutation Testing, Debugging.
Unit: 2	Control Flow & Data Flow Testing: Outline of CFT, CF Graph, and Paths in a Control Flow Graph, Path Selection Criteria, Generating Test Input, and Examples of Test Data Selection. Overview of DynamicDataFlowTesting,DataFlowGraph,DataFlowTestingCriteria,ComparisonofTesting Techniques, Functional Testing.
Unit: 3	System Integration Testing & Test Design: Concept of Integration Testing, Different Types of Interfaces and Interface Errors, Granularity of System Integration Testing, System Integration Techniques, Test Plan for System Integration, Off-the-Shelf Component Testing, System Test Categories.
Unit: 4	System Test Planning, Automation & Execution: Structure of a System Test Plan, Test Approach, Test Suite Structure, Test Environment, Test Execution Strategy, Test Effort Estimation, Scheduling and Test Milestones, System Test Automation, Selection of Test Automation Tools, Test Selection Guidelines for Automation, Structure of an Automated Test Case, Test Automation Infrastructure Metrics for Tracking System Test, Metrics for Monitoring Test Execution, Beta Testing, System Test Report, Measuring Test Effectiveness. Acceptance Testing:
Unit: 5	Software Quality: Five Views of Software Quality, McCall's Quality Factors and Criteria, Quality Factors Quality Criteria, Relationship between Quality Factors and Criteria, Quality Metrics, ISO 9126 Quality Characteristics, ISO 9000:2000 Software Quality Standard ISO 9000:2000 Fundamentals, ISO 9001:2000 Requirements Maturity Models: Capability Maturity Model, Test Process Improvement, Testing Maturity Model

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Software Testing and Quality Assurance theory and practice byKshiraSagarNaik and PriyadarshiTripathy.

Reference Books:

1	Stephen H.Khan, Metrics and Models in Software Quality Engineering Pearson Education,India.
2	Shari Lawrence Pfleeger,"Software Engineering Theory and Practice Pearson Education,India

Course Code	Course Title	Lecture			Semester: III
MMCA311PET	Cloud Computing and Virtualization	L	T	P	
Version:	Date of Approval:	3	1	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:		Exam Duration	:	3 Hrs.

Course Objectives:

1. To introduce the broad perceptive of cloud architecture andmodel
2. Toapplydifferentcloudprogrammingmodelasperneedandsetupaprivatecloud.
3. TounderstandthedesignofcloudServicesandthetrustedcloudComputingsystem

Course Outcomes:

1. Ability to Identify the architecture, infrastructure and delivery models of cloudcomputing
2. Ability to apply suitable virtualization concept.
3. Design Cloud Services and Set a privatecloud

Detailed Contents:

Unit: 1	Cloud Computing Fundamentals: overview of Cloud Computing , Types of cloud, Cloud services: Benefits and challenges of cloud computing, Evolution of Cloud Computing , Applications cloud computing,BusinessmodelsaroundCloud–MajorPlayersinCloudComputing Titans-IssuesinCloud
Unit: 2	Cluster Computing, Grid Computing, Grid Computing Versus Cloud Computing, Key Characteristics of Cloud Computing. Cloud Models: Benefits of Cloud Models, Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Shared Private Cloud, Dedicated Private Cloud, and Dynamic Private Cloud.
Unit: 3	Cloud Services and File System:Types of Cloud services: Software as a Service - Platform as a Service – Infrastructure as a Service - Database as a Service- Monitoring as a Service – Communication as services. Service providers- Google App Engine, Amazon EC2, Microsoft Azure, Salesforce.
Unit: 4	Virtualization:Basics of Virtualization –Need of Virtualization- Benefits of Virtualization- Limitation of Virtualization- Approaches to Virtualization -Virtualization Structures-Types of Virtualization – Virtual machine - Types of virtual Machine- Virtual Machine software - Virtualization of CPU, Memory, I/O Devices - Resource Virtualization- Virtualization Tools (VMware, Citrix, Microsoft, Oracle virtual Box) – Advance concepts in cloud computing : Data center for cloud, Cloud management . Introduction to MapReduce, GFS, HDFS, Hadoop Framework.
Unit: 5	Security in the Cloud:Security Overview – Cloud Security Challenges and Risks –Identified cloud security Issues-Categorization of cloud security issues– State of the Art solutions, Integrated Solutions : Amazon as Case study– Cloud computing Security Reference Architecture –Identity and Access Management Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:	
1	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
2	John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3	A. Kannammal, "Fundamentals of Cloud Computing",Cengage, 2015
Reference Books:	
1	Cloud Computing "A Practical Approach" Anthony T. Velte, Toby J. Velte, Robert Elsenpeter. McGraw-Hill.
2	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012

Course Code	Course Title	Lecture			Semester:
MMCA314PET	Artificial Intelligence	L	T	P	III
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide a strong foundation of fundamental concepts in Artificial Intelligence
2. To provide a basic exposition to the goals and methods of Artificial Intelligence
3. To enable the student to apply these techniques in applications which involve perception, reasoning and learning
4. Distinguish between a conventional system and an intelligent system.
5. Artificial Intelligent techniques in solving problems of a particular domain

Course Outcomes:

1. Understand different types of AI agents and knows various AI search algorithms
2. Understand the fundamentals of knowledge representation (logic-based, frame-based, semantic nets), inference and theorem proving.
3. Know how to build simple knowledge-based systems
4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information
5. Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems

Detailed Contents:	
Unit: 1	**Introduction:** Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.
Unit: 2	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.
Unit: 3	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in first order logic, Resolution, Unification, Forward & Backward chaining, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.
Unit: 4	**Machine Learning:** Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.
Unit: 5	**Pattern Recognition:** Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbor (NN) Rule, Bayes Classifier, K–means clustering algorithms.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Russell S. and Norvig P., "Artificial Intelligence – A Modern Approach", Pearson Education
2	Rich E. and Knight K., "Artificial Intelligence", Tata McGraw Hill.

Reference Books:

1	CharniakE.and McDermott D., "Introduction to Artificial Intelligence", Pearson Education
2	Patterson D. W., "Artificial Intelligence and Expert Systems", Prentice Hall of India.

Course Code	Course Title	Lecture			
MMCA313PET	**Computer Graphics**	**L**	**T**	**P**	**Semester:** III
Course Type: DSE	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn an overview of interactive computer graphics, two dimensional system and mapping.
2. To learn important drawing algorithm, techniques of 2D transformation.
3. To learn various Clipping, filling algorithm
4. To learn the concepts of 3-D object representation.

Course Outcomes:

1. Student will be able to distinguish the structure of an interactive computer graphics system, and other system components.
2. Student will able to visualize geometrical transformations of 2D and 3D geometrical objects.
3. Student will be able to demonstrate techniques for representing 3D geometrical objects.

Detailed Contents:

Unit: 1	Overview of Graphics Systems – Video display devices, raster-scan systems. Random–scan system, graphics monitors and workstations. Input devices, Hardcopy devices, Graphics software. Output primitives: Line drawing algorithms, Circle generation algorithms, ellipse generating algorithms, pixel addressing, Filled area primitives, Fill area functions, cell array and character generations.
Unit: 2	Attributes of output primitives: Line attributes, curve attributes color and Gray-scale level, Area fill attributes, character attributes, and Bundled attributes Enquiry functions. Two dimensional Geometric transformations: Basic transformations, Homogenous co-ordinates, affine transformations, transformation functions. Raster methods for transformations.
Unit: 3	Two dimensional viewing: Viewing pipeline, viewing transformation, viewing functions, line clipping – Cohen Sutherland line clipping, Liang Barsky line clipping, polygon clipping: Sutherland – Hodgman polygon clipping, Wiler Atherton polygon clipping.
Unit: 4	Structures and Hierarchical Modeling: Structure concepts, editing structures, Basic modeling concepts, hierarchical modeling with structures. Graphical user interfaces and Interactive input methods: The user Dialogue, logical classification of input devices, Input functions and Models Interactive picture construction techniques.
Unit: 5	Three – Dimensional object representations: Poly-surfaces curved lines and surfaces, spline representation, Bezier curves and surfaces, B-Spline curves and surface, CSG Methods: Octrees, BSP Trees. Three Dimensional Transformation : Three dimensional viewing: Viewing coordinates, projections, Visible surface detection methods: Back-face Detection, Depth-buffer methods, scan line methods, Depth-sorting methods, BSP – Tree Methods, Arc sub division methods, Basic illuminations models – Gourand shading phong shading.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Heanry Donald, Pauline Baker M: Computer Graphics, PIH 2nd edn., 1995.
Reference Books:	
1	Harrington S: Computer Graphics A Programming Approach 2nd Edn. McGraw Hill,1987.

Course Code	Course Title	Lecture			Semester: III
MMCA315PET	Data Mining	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture by Analysis	Exam Duration	:	3 Hrs.

Pre-requisites:

1. Basic concepts of Data Base Management Systems.2.Basic Mathematics and statistics.

Course Objectives:

1. Introduce data mining principles and techniques with data mining as a cutting edge business intelligence tool.
2. Develop critical thinking, problem solving and decision making skills with respect to Data warehouse and data mining.
3. Describe various schema model and the Star Schema to design a Data Warehouse.

Course Outcomes:

1. Design a data warehouse or data mart to present information needed by the manager and can be utilized for managing clients.
2. Design and implement a quality data warehouse or data mart effectively and administer the data resources in such a way that it will truly meet management's requirements.
3. Evaluate standards and new technologies to determine their potential impact on your information resource for a large complex data warehouse/data mart.

Detailed Contents:

Unit: 1	**Introduction:** Fundamentals of Data Mining, Kinds of Patterns can be mined, Technologies Used, Applications and Issues in Data Mining.**Types of Data:** Attribute types, Basic Statistical descriptions of Data, Measuring data Similarity and Dissimilarity.**Data Preprocessing:** Need of Preprocessing, DataCleaning, Data Integration, Data Reduction, Data Transformation.
Unit: 2	**Data Warehouse and OLAP:** Data Warehouse, Data Warehouse Modeling, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-oriented induction
Unit: 3	**Mining Frequent Patterns, Associations and Correlations:** Market Basket Analysis, Association rule mining, Frequent Item set mining methods, Pattern Evaluation methods, Constraint based frequent pattern mining,Mining Multilevel and Multidimensional patterns
Unit: 4	**Classification :** General approach to classification, Classification by Decision Tree Induction , Bayes Classification methods, Bayesian Belief Networks, Classification by Backpropogation, Lazy Learners, Other Classification methods , Classification using Frequent patterns, Model Evaluation and selection
Unit: 5	**Cluster Analysis:** Basic Clustering methods, Partitioning methods, Density –Based Methods, Grid- based methods, and Evaluation of Clustering, Outlier Analysis and Detection methods.**Data Mining Trends and Research Frontiers:** Mining Complex Data Types, Data Mining Applications, Data Mining Trends and usage of Data Mining Tools.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	HanJ&KamberM, "DataMining:ConceptsandTechniques", HarcourtIndia,ElsevierIndia, Second Edition.
2	Pang-NingTan.MichaelSteinback,VipinKumar, "Introductionto DataMining",Pearson Education, 2008.

Reference Books:

1	MargaretHDunham,S.Sridhar, "Datamining:Introductoryand AdvancedTopics", Pearson Education,2008.
2	Humphires,hawkins,Dy,"DataWarehousing:Architectureand Implementation", Pearson Education,2009.
3	Anahory, Murray, "DataWarehousingintheRealWorld", PearsonEçiucation, 2008.

Course Code	Course Title	Lecture			Semester: III
MMCA316PET	Digital Marketing	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. Digital Marketing is an umbrella term for the targeted, measurable, and interactive marketing of products or services using digital technologies.
2. To provide the students with the important conceptual insights, perspectives and the tools required for effective digital marketing.

Course Outcomes:

1. Understanding digital marketing along with technical acumen will be an added tool as a problem solver and solution provider.
2. As an analyst he can assist and advice the marketer to take right decision.Will be helpful to work as a consultant for any company or organisation.

Detailed Contents:

Unit: 1	Introduction to Digital Marketing and its Significance Traditional Marketing Vs Digital Marketing Digital Marketing Process. Website Planning and Development : Types of websites Website Planning and Development , Understanding Domain and Webhosting Building Website/Blog using CMS WordPress,UsingWordPress Plug-ins
Unit: 2	Introduction to Search Engine Optimization Keyword P lanner Tools On Page SEO Techniques-Indexing and Key Word Placement, On Page SEO Techniques- Content Optimization On Page SEO : Yoast, SEO Plug-in, Off –Page SEO Techniques, Email Marketing- Introduction and Significance, Designing e-mail marketing campaigns using Mail Chimp
Unit: 3	Building E-mail List and Signup Forms, Email Marketing Strategy and Monitoring Email –Automization. Pay Per Click Advertising: IntroductionPay Per Click Advertising: Google Adword, Types of Bidding strategies Designing and Monitoring search campaigns, Designing and Monitoring Display campaigns
Unit: 4	Designing and Monitoring Video campaigns Designing and Monitoring Universal App Campaigns Google Analytics : Introduction and Significance Google Analytics Interface and Setup Understanding Goals and Conversions. Monitoring Traffic Behavior and preparing Reports Social Media Marketing : Introduction and Significance Facebook Marketing, Types of Various Ad Formats
Unit: 5	Setting up Facebook Advertising Account,Under standing Facebook Audience and its Types Designing Facebook Advertising Campaigns. Working with Facebook Pixel, Twitter Marketing: Basics Designing, Twitter Advertising Campaigns.Introduction to LinkedIn Marketing Developing digital marketing strategy in Integration form

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	1. The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson, Wiley; 1st edition (2016)
2	Digital Marketing For Dummies by Ryan Deiss and Russ Henneberry, For Dummies.

Reference Books:

1	Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation by Damian Ryan, Kogan Page Publisher
2	Digital Marketing by Seema Gupta, McGraw Hill Education

Course Code	Course Title	Lecture			
MMCA317PET	Internet of Things (IoT)	L	T	P	**Semester: III**
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.

Course Outcomes:

1. be able to explain and demonstrate various components of Internet of Things (IoT);
2. be able to analyse the role and importance of IoT in the modern world;
3. be able to investigate and propose various requirements of IoT for real world applications;
4. be able to evaluate a variety of existing and developing architecture technologies for IoT;
5. be able to describe and evaluate different applications of the IoT.

Detailed Contents:

Unit: 1	Introduction to IoT, IOT Architecture, Sensing, Actuation, Basics of Networking, Basics of Networking Communication Protocols.
Unit: 2	Communication Protocols, Sensor Networks, Machine-to-Machine Communications and Introduction to SDN, SDN for IoT.
Unit: 3	Interoperability in IoT, Introduction to Arduino Programming, IoT development tools/platforms, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi.
Unit: 4	IOT based Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Data Handling and Analytics.
Unit: 5	IOT Based Connected Vehicles, Smart Grid, IndustrialIoT. Applications of IOT, Case Study: Agriculture, Healthcare, Activity Monitoring, Implementation of IoT concepts.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press).
2	The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press).

Reference Books:

1	Buyya, R., &Dastjerdi, A. V. (Eds.). (2016). Internet of Things: Principles and paradigms. Elsevier.
2	Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting everything”, 1st Edition, Apress Publications, 2013.

Course Code	Course Title	Lecture			
MMCA318PET	Compiler Design	L	T	P	**Semester: III**
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

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

Course Outcomes:

1. Ability to design, develop, and implement a compiler for any language.
2. Able to design and implement LL and LR parsers.
3. Able to design algorithms to perform code optimization in order to improve the performance of a program in terms of space and time complexity.
4. Ability to design algorithms to generate machine code

Detailed Contents:

Unit: 1	**Introduction to compilers:** Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering –Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.
Unit: 2	**Syntax Analysis :**Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar –Top Down Parsing – General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0)Item Construction of SLR Parsing Table -Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer
Unit: 3	**Intermediate Code Generation :** Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.
Unit: 4	**Run-Time Environment And Code Generation:** Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management – Issues in Code Generation – Design of a simple Code Generator.
Unit: 5	**Code Optimization :**Principal Sources of Optimization – Peep-hole optimization – DAG- Optimization of Basic BlocksGlobal Data Flow Analysis – Efficient Data Flow Algorithm.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson.
2	Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.

Reference Books:

1	Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
2	The Theory and Practice of Compiler writing, J. P. Tremblay and P. G. Sorenson, TMH

Course Code	Course Title	Lecture			
MMCA319PET	Pattern Recognition	**L**	**T**	**P**	**Semester: III**
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To gain knowledge about state-of-the-art algorithms used in pattern recognition research.
2. To understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.
3. To apply pattern recognition techniques in practical problems

Course Outcomes:

1. Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
2. Apply pattern recognition techniques to real-world problems such as document analysis and recognition.
3. Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

Detailed Contents:

Unit: 1	**Pattern recognition fundamentals:** Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.
Unit: 2	**Bayesian decision theory:** Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, Discrete features, Missing and noisy features, Bayesian networks (Graphical models) and inferencing.
Unit: 3	**Maximum-likelihood and Bayesian parameter estimation:** Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Fisher discriminant analysis, PCA Expectation-Maximization method: Missing features
Unit: 4	**Sequential Models:** State Space, Hidden Markov models, Dynamic Bayesian, Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbour method Linear discriminant functions: Gradient descent procedures, Perceptron criterion function, Minimum-squared-error procedures, Ho-Kashyap procedures, Support vector machines.
Unit: 5	**Unsupervised learning and clustering:** Unsupervised maximum-likelihood estimates, Unsupervised Bayesian learning, Criterion functions for clustering, Algorithms for clustering: Kmeans, Hierarchical and other methods, Cluster validation, Low-dimensional representation and multidimensional scaling (MDS).

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addision –Wesley
2	Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006

Reference Books:

1	Pattern classification, Richard O. Duda, Peter E. Hart and David G. Stork, Wiley, 2001
2	Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley.

Course Code	Course Title	Lecture			
MMCA321PET	WEB TECHNOLOGY	**L**	**T**	**P**	**Semester:** III
Version:	**Date of Approval:**	3	0	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand about client-server communication and protocols used during communication.
2. To design interactive web pages using Scripting languages.
3. To learn server side programming using servlets and JSP.
4. To develop web pages using XML/XSLT.

Course Outcomes:

1. Design simple web pages using markup languages like HTML and XHTML.
2. Create dynamic web pages using DHTML and java script that is easy to navigate and use.
3. Program server side web pages that have to process request from client side web pages.
4. Represent web data using XML and develop web pages using JSP.
5. Understand various web services and how these web services interact.

Detailed Contents:

Unit: 1	**Web Essentials**: Clients, Servers, and Communication. The Internet-Basic Internet Protocols –The World Wide Web-HTTP request message-response message-Web Clients Web Servers. **Markup Languages**: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-HTML 5.0., Creating HTML documents, Case studies.
Unit: 2	**Cascading Style Sheets:** CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML- Style Rule Cascading and Inheritance-Text Properties-Box Model Normal Flow Box Layout-Beyond the Normal Flow-CSS3.0.**Client-Side Programming:** The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers. **Web Frameworks**-Node.js, Angular JS
Unit: 3	**Host Objects**: Browsers and the DOM-Introduction to the Document Object Model DOM History and Levels-Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling- Accommodating Noncompliant Browsers Properties of window. **Server-Side Programming**: Java Servlets- Architecture - Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions-Cookies-URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency-Databases and Java Servlets.
Unit: 4	**Separating Programming and Presentation**: JSP Technology Introduction-JSP and Servlets-running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm- Databases and JSP. **Representing Web Data**: XML-Documents and Vocabularies-Versions and Declaration-Namespaces- DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers.
Unit: 5	**AJAX** (Asynchronous Java And XML) : Ajax Client Server Architecture-XML Http Request Object-Call Back Methods. **Web Services:** JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. . Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

Reference Books:

2. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition,Pearson Education, 2007
3. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.

Course Code	Course Title	Lecture			Semester:
MMCA322PET	Artificial Neural Network	L	T	P	III
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.
2. To provide knowledge of types of neural networks
3. To provide knowledge of computation and dynamical systems using neural networks

Course Outcomes:

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

1. The role of neural networks in engineering, artificial intelligence, and cognitive modelling.
2. have an understanding of the concepts and techniques of neural networks through the study of the most important neural network models.
3. have a knowledge of sufficient theoretical background to be able to reason about the behaviour of neural networks.

Detailed Contents:

Unit: 1	General characteristics of the human brain, Introduction to Biological Neural Networks, Nerve structure and synapse, Basic concepts of Neural Networks, Characteristics of Neural Networks, Terminologies, Applications of the artificial neural networks.
Unit: 2	Structure of a neural net (topology), Directed graphs, Models of Neuron, Neural Network Architectures, Artificial Neuron, Activation functions, Threshold function, Piecewise linear function, Sigmoidal function, Supervised learning, Unsupervised learning, Re-inforcement learning.
Unit: 3	Knowledge Representation, Artificial Intelligence, Learning rules, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Single layer perceptron, Multilayer perceptron, Back propagation, Recurrent networks, Network Pruning,
Unit: 4	Adaptive networks, Supervised Learning Neural Networks, Decision-based neural networks, Hierarchical neural networks, Probabilistic neural network, Radial basis function networks, Comparison of RBF Networks and Multilayer perceptron.
Unit: 5	Classification of linearly separable patterns, Boltzmann machine, Sigmoid Belief Networks, Helmholtz machine, Support vector machines, Self-organization maps, Genetic Algorithms, Optimization, Prediction Systems, speech and decision-making.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	S. Haykin, "Neural Networks a comprehensive Foundation" second edition, Prentice-Hall India.
2	LaureneFausett, "Fundamentals of Neural Networks, Architecture, Algorithms, and Applications", Prentice Hall, 1993

Reference Books:

1	Jacek M. Zurada, Introduction to artificial neural systems, Jaico Publ. House, 1994.
2	Anderson, —An introduction to Artificial Neural Networks‖, Prentice Hall.

Course Code	Course Title	Lecture			Semester: III
		L	T	P	
MMCA323PET	Semantic web	3	0	0	
Version:	**Date of Approval:**				

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To Introduce Semantic Web Vision
2. To Understand about XML,RDF,RDFS,OWL
3. To Querying Ontology
4. To form Ontology Reasoning
5. To Migrate from Document to Data Web

Course Outcomes:

1. To understand the semantic web Vision and technologies
2. To understand about ontology
3. To Understand about Data Web

Unit: 1	Foundation of Semantic Web Technologies • Introduction • Current web vs Semantic Web • Semantic Web Technologies • A layered approach Descriptive Logic • Introduction • Definition of the basic formalism • Reasoning algorithms • Language extensions
Unit: 2	Structured Web Documents in XML • Introduction • XML • Structuring • Namespaces • Addressing and querying XML document • Processing
Unit: 3	Describing Web Resources: RDF • Introduction • RDF: Basic Ideas • RDF: XML-Based Syntax • RDF serialization • RDF Schema: Basic Ideas • RDF Schema: The Language • RDF and RDF Schema in RDF Schema
Unit: 4	Web Ontology Language: OWL • Introduction • OWL and RDF/RDFS • Three Sublanguages of OWL • Description of the OWL Language • Layering of OWL • Examples • OWL in OWL
Unit: 5	SPARQL •SPARQL simple Graph Patterns, Complex Graph Patterns, Group Patterns, Queries with Data Values, Filters • OWL Formal Semantics

Text Books:

1	A Semantic Web Primer by Grigoris Antoniou Frank van Harmelen, The MIT Press Cambridge •
2	Linked Data : Evolving the Web into a Global Data space by Tom Heath, Christian Bizer , Morgan & Claypool publication • Basic Description Logic by Franz Baader, Warner Nutt

Reference Books:

1	Foundation of Semantic Web Technologies, Pascal Hitzler, Markus and Sebastian
2	Linked Data : Evolving the Web into a Global Data space by Tom Heath, Christian Bizer , Morgan & Claypool publication • Basic Description Logic by Franz Baader, Warner Nutt

Course Code	Course Title	Lecture			Semester: III
MMCA324PET	PHP Programming	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	3	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To provide the necessary knowledge to design and develop dynamic, database-driven web applications using PHP.
2. To understand how server-side programming works on the web.
3. To Understand POST and GET in form submission and How to receive and process form submission data.
4. To understand how to Read, write cookies and Create a database in phpMyAdmin.

Course Outcomes:

1. After the completion of course, students will get hands on experience on various techniques of web development and will be able to design and develop a website.

Detailed Contents:

Unit: 1	HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms. Style sheets : Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties. introduction to JavaScript : Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes.
Unit: 2	Introduction to PHP, Language Features, PHP Basics, PHP's Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Arrays, Strings and Regular Expressions, Working with the File and Operating System.
Unit: 3	Handling Html Form With PHP: Capturing Form Data, Dealing with Multi-value filed, and Generating File uploaded form, Redirecting a form after submission. Function: What is a function, Define a function, Call by value and Call by reference, Recursive function.
Unit: 4	PHP state management: Using query string (URL rewriting), Using Hidden field, Using cookies, Using session. PHP string matching with regular expression: What is regular expression, Pattern matching in PHP, Replacing text, Splitting a string with a Regular Expression. PHP OOPs concepts, Abstract class, Inheritance, Constructor.
Unit: 5	MySQL:- PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP Myadmin and database bugs.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Beginning PHP and MySQL,W. Jason Gilmore, Apress, 2010, Fourth Edition.
2. Head First PHP & MySQL, Lynn Beighley& Michael Morrison, First Edition, O'Reilly.

Reference Books:

1. Developing Web Applications in PHP and AJAX, Harwani, McGraw Hill
2. PHP6 and MySQL, Steve Suehring, Tim Converse and Joyce Park, Wiley India 2010, Second Edition
3. Learning PHP, MySQL, JavaScript, and CSS: A Step-by-Step Guide to Creating Dynamic Websites – by Robin Nixon.

Course Code	Course Title	Lecture			
MMCA325PET	Soft Computing	L	T	P	Semester: III
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing-based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide student hand-on experience on MATLAB to implement various strategies.

Course Outcomes:

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

1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

Detailed Contents:

Unit: 1	INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics
Unit: 2	Fuzzy logic: Introduction to Fuzzy logic., Fuzzy sets and membership functions., Operations on Fuzzy sets., Fuzzy relations, rules, propositions, implications and inferences., Defuzzification techniques. Fuzzy logic controller design., Some applications of Fuzzy logic.
Unit: 3	Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation
Unit: 4	Artificial Neural Networks: Biological neurons and its working., Simulation of biological neurons to problem solving, Different ANNs architectures., Training techniques for ANNs, Applications of ANNs to solve some real-life problems.
Unit: 5	Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them., Multi-Objective Evolutionary Algorithm(MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2	George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.

Reference Books:

1	Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2	Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd Edition.

Course Code	Course Title	Lecture			Semester: III
MMCA326PET	Deep Learning	**L**	**T**	**P**	
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	4	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Course Outcomes:

1. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. Implement deep learning algorithms and solve real-world problems**.**

Detailed Contents:	
Unit: 1	History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm and Convergence, Multilayer Perceptrons (MLPs), Representation Power of MLPs
Unit: 2	Sigmoid Neurons, Gradient Descent, Feedforward Neural Networks, Representation Power of Feedforward Neural Networks, Feedforward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis, Principal Component Analysis and its interpretations, Singular Value Decomposition Autoencoders and relation to PCA.
Unit: 3	Regularization in autoencoders, Denoisingautoencoders, Sparse autoencoders, Contractive autoencoders, Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout, Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization
Unit: 4	Learning Vectorial Representations Of Words, Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Object Detection, RCNN, Fast RCNN, Faster RCNN, YOLO,
Unit: 5	Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks, Recurrent Neural Networks, Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, Truncated, BPTTGated Recurrent Units (GRUs), Long Short Term Memory (LSTM) Cells, Solving the vanidhing gradient problem with LSTMs

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. https://www.cse.iitm.ac.in/~miteshk/CS7015.html

Reference Books:

1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

Course Code	Course Title	Lecture			Semester: III
MMCA327PET	Web mining	L	T	P	
Version:	Date of Approval:	3	0	0	

Scheme of Instruction			Scheme of Examination		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To describe web mining and understand the need for web mining
2. To differentiate between Web mining and data mining
3. To understand the different application areas for web mining
4. To understand the different methods to introduce structure to web-based data

Course Outcomes:

1. To search engines index and rank web documents.
2. To conduct business intelligence from online resources.
3. To apply Web Mining strategies and algorithms in their workplace or research career

Detailed Contents:

Unit: 1	Introduction to Web Data Mining and Data Mining Foundations, Introduction – World Wide Web (WWW), A Brief History of the Web and the Internet, Web Data Mining-Data Mining, Web Mining. Data Mining Foundations – Association Rules and Sequential Patterns – Basic Concepts of Association Rules, Apriori Algorithm- Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports – Extended Model, Mining Algorithm, Rule Generation, Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP,
Unit: 2	Supervised and Unsupervised Learning Supervised Learning – Basic Concepts, Decision Tree Induction – Learning Algorithm, Impurity Function, Handling of Continuous Attributes, Classifier Evaluation, Rule Induction – Sequential Covering, Rule Learning, Classification Based on Associations, Naïve Bayesian Classification , Naïve Bayesian Text Classification – Probabilistic Framework, Naïve Bayesian Model . Unsupervised Learning – Basic Concepts , K-means Clustering – K-means Algorithm, Representation of Clusters, Hierarchical Clustering, Strength and Weakness.
Unit: 3	Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Methods – Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Preprocessing – Stopword Removal, Stemming, Web Page Preprocessing, DuplicateDetection, Inverted Index and Its Compression – Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing – Singular Value Decomposition, Query
Unit: 4	Link Analysis and Web Crawling: Link Analysis – Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, Community Discovery-Problem Definition, Bipartite Core Communities, Maximum Flow Communities, Email Communities. Web Crawling – A Basic Crawler Algorithm- Breadth First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers,
Unit: 5	Opinion Mining and Web Usage Mining Opinion Mining – Sentiment Classification – Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization – Problem Definition, Web Usage Mining – Data Collection and Preprocessing- Sources and Types of Data, Key Elements of Web usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery

Examination and Evaluation Pattern: It include both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications)
2	Mining the Web: Discovering Knowledge from Hypertext Data by SoumenChakrabarti

Reference Books:

1	Data Mining: Concepts and Techniques, Second Edition Jiawei Han, MichelineKamber (Elsevier Publicatio ns)
2	Web Mining:: Applications and Techniques by Anthony Scime

Course Code	Course Title	Lecture			
MMCA328PET	Natural Language processing	**L**	**T**	**P**	**Semester: III**
Version:	**Date of Approval:**	3	1	0	

Scheme of Instruction			**Scheme of Examination**		
No. of Periods	:	60 Hrs.	Maximum Score	:	100
Periods/ Week	:	4	Internal Evaluation	:	30
Credits	:	3	End Semester	:	70
Instruction Mode	:	Lecture	Exam Duration	:	3 Hrs.

Course Objectives:

1. To learn about basic NLP problems, tasks and methods.
2. To master basic programming tools for NLP

Course Outcomes:

1. Programming skills: implementing a simple NLP systems
2. Analytical skills: define a NLP problem and find a suitable solution to it
3. Presenting skills: demonstrating your own program solution.

Detailed Contents:

Unit: 1	**Introduction:** Introduction to the Morphology, Syntax, Semantics by linking the "linguistics view" (computational linguistics) with the "artificial intelligence view" (natural language processing).
Unit: 2	**Morphology:** Analysis and generation of language on word level: e.g. problems with compounding and idiomatic phrases, homophonous strings as well as loan words and their processing using e.g. finite state automata as well as semantic networks. Ambiguities in words like "pen" and "pipe", but will also discuss some complex strings.
Unit: 3	**Syntax Analysis:** Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues
Unit: 4	**SEMANTIC ANALYSI**S Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus. Representing Linguistically Relevant Concepts -SyntaxDriven Semantic Analysis - Semantic Attachments -SyntaxDrivenAnalyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word SenseDisambiguation -Information Retrieval
Unit: 5	**Applications of NLP**: Machine Translation, Grammar Checkers Dictation, Automatic Document Generation, NL Interfaces.

Examination and Evaluation Pattern: It includes both internal evaluation (30 marks) comprising two class sessional exams/ assignments/ quiz/ seminar presentation etc. and external evaluation (70 marks) which is mainly end semester examination.

Text Books:

1	Daniel Jurafsky, James H. Martin "Speech and Language Processing" Second Edition, Prentice Hall, 2008.
2	Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary

Reference Books:

1	Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2	C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA:,1999