Master in Computer Application
(MCA)

STRUCTURE & SYLLABUS

(2024 -2026)

P.G. Department of Computer Science
Fakir Mohan University
Vyasa Vihar, Balasore – 756019

ProgrammeOutcomes(POs)

PO1 Apply the knowledge of mathematics and computing fundamentals to various real life applications for any given requirement.

PO2 Design and develop applications to analyse and solve all computer science related problems.

PO3 Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.

PO4 Analyse and review literatures to invoke the research skills to design, interpret and make inferences from the resulting data.

PO5 Integrate and apply efficiently the contemporary IT tools to all computer applications.

PO6 Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

PO7 Involve in perennial learning for a continued career development and progress as a computer professional.

PO8 Function effectively both as a team leader and team member on multi-disciplinary projects to demonstrate computing and management skills.

PO9 Communicate effectively and present technical information in oral and written reports.

PO10 Utilize the computing knowledge efficiently in projects with concern for societal, environmental, and cultural aspects.

PO11 Function competently as an individual and as a leader in multidisciplinary Projects.

PO12 Create and design innovative methodologies to solve complex problems for the betterment of the society.

Programme Specific Outcomes(PSOs)

PSO1 To prepare graduates who will create systems through software development to solve problems in Industry domain areas.

PSO2 To Prepare Graduates who will contribute to societal growth through research in their chosen field.

PSO3 To prepare graduates who will perform both as an individual and in a team through good analytical, design and implementation skills.

PSO4 To prepare graduates who will be lifelong learners through continuous professional development.

P.G. DEPARTMENT OF COMPUTER SCIENCE
Fakir Mohan University

Curriculum for
Master of Computer Application (MCA)
(Applicable for 2024-2025 onwards)
Program Code: PG-MCA

First Semester				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-T100	Indian Knowledge System	2	0	2
CS-T101	Discrete Mathematics	4	0	4
CS-T102	Programming in C	4	0	4
CS-T103	Computer Organization and Architecture	4	0	4
CS-T104	Operating System	4	0	4
CS-T105	Computer Networks	4	0	4
CS-T106	Data Structures	4	0	4
CS-L107	Data Structures Laboratory	0	4	4
CS-L108	Operating Systems and Computer Architecture Laboratory	0	4	4
			Total Credits	34

Second Semester				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-T201	Database Management Systems	4	0	4
CS-T202	Computer Graphics and Multimedia	4	0	4
CS-T203	Probability and Statistics	4	0	4
CS-T204	OOP using JAVA	4	0	4
CS-T205	Design and Analysis of Algorithms	4	0	4
CS-T206	Software Engineering	4	0	4
CS-L207	DBMS and JAVA Laboratory	0	4	4
CS-L208	CGM Laboratory	0	4	4
CS-VAC20?	Value Added Course			2
			Total Credits	34

- The students who have successfully appeared the second Semester examinations are required to undergo for a minimum of one-month internship to Industry/Reputed Institution. They are also required to submit a report of their internship to the office of the Head, Department of Computer Science before the commencement of 3rd Semester classes.
- Serial No. VAC 1,2, 3…….

Third Semester				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-T301	Compiler Design	4	0	4
CS-T302	Elective –I	4	0	4
CS-T303	Web Technology	4	0	4
CS-T304	AI and Machine Learning	4	0	4
CS-T305	Data Mining and SC	4	0	4
CS-T306	Elective –II (SWAYAM MOOC)	4	0	2/3/4
CS-L307	Web Technology Laboratory	0	4	4
CS-L308	Data Mining and SC Laboratory	0	4	4
Fakir Mohan Studies (Non-Credit course)				
			Total Credits	30*
• Total credit may vary depending on the credit transferred through CS-T306				

Fourth Semester				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-PL401	Technical Seminar	4	0	4
CS-PL402	Major Project	0	0	12
			Total Credits	16

List of Electives

Elective – I		**Elective – II(MOOC substitute)**	
A	Data Analytics using Python	**A**	Big Data Analysis
B	Wireless Sensor Network	**B**	Cyber Security and Digital Forensics
C	Mobile Computing	**C**	Object Oriented analysis and Design using UML
D	Bioinformatics	**D**	Digital Image Processing
E	Theory of Computation	**E**	Cloud Computing
F	Embedded Systems	**F**	Internet of Things
G	Cryptography & Network Security	**G**	Financial Engineering

Elective – II

A student may choose any course from the list of approved PG courses offered by the SWAYAM board, provided it is of a minimum of 2 credits(preferably in July semester courses of SWAYAM board). SWAYAM credit transfer is compulsory for every P.G. student of the University. If a student fails in the opted SWAYAM course or if the course is cancelled with proctorial examination, they have two choices:

a) Repeat the SWAYAM course or opt for another SWAYAM course of equivalent credit in the next semester.

b) Opt for the exempted course (List of course from Elective-II) offered by the university. A student can undertake this course under mentorship in the immediate succeeding semester to avoid any loss of semester.

MCA
1ST Semester Syllabus

Code	Subject	Lectures	Practical	Credits
CS-T100	Indian Knowledge System	2	0	2
CS-T101	Discrete Mathematics	4	0	4
CS-T102	Programming in C	4	0	4
CS-T103	Computer Organization and Architecture	4	0	4
CS-T104	Operating System	4	0	4
CS-T105	Computer Networks	4	0	4
CS-T106	Data Structures	4	0	4
CS-L107	Data Structures Laboratory	0	4	4
CS-L108	Operating Systems and Computer Architecture Laboratory	0	4	4
			Total Credits	32

Indian Knowledge System
CS-T100

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T100	Indian Knowledge System	2	20	30

Objectives	This course explores the integration of traditional Indian knowledge systems with modern computer science concepts. It provides an understanding of ancient Indian texts, philosophies, and methodologies, and examines how these can influence and enrich contemporary computing practices. Students will engage with both historical and contemporary perspectives, fostering a multidisciplinary approach to technology that incorporates ethical, cultural, and cognitive dimensions.
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Indian Knowledge Systems - Overview of Indian Knowledge Systems (IKS) - Historical evolution of IKS and its significance in contemporary contexts - Major Indian philosophies (Vedanta, Samkhya, Yoga) and their influence on cognitive processes and knowledge creation.	6
II	Traditional Indian Texts and Knowledge - Overview of significant texts (Vedas, Upanishads, Puranas, Sutras) - Manuscript preservation and digital archiving - Contributions of ancient Indian mathematicians (Aryabhata, Bhaskara, Brahmagupta) - Algorithms and computational methods described in ancient text.	6
III	Application of IKS in Computing - Traditional Indian models of knowledge representation - Modern applications in ontology development and the semantic web - Integration of Indian philosophical concepts with artificial intelligence - Ethical considerations and the impact of IKS on AI development.	6

IV	Interdisciplinary Approaches - Insights from Indian cognitive science and its impact on modern computing - Influence of ancient theories on cognitive models and human-computer interaction - Examining cross-cultural aspects of computing - Case studies of IKS integration in global computing practices.	6
V	History of cryptography: Aspects of Cryptography in the Context of Indian Perspective. Ethical, moral and societal dimensions of cryptography. Cultural sensitivity in cryptographic practices. Case studies of successful integration in tech startups and research - Research directions inspired by Indian Knowledge Systems	6
	Total	30

Recommended Reading: -

- Vedic Mathematics by Bharati Krishna Tirthaji
- The Essentials of Indian Philosophy by M. Hiriyanna
- Computing with Indian Knowledge Systems by Ganesh Ramakrishnan et al.

Course Outcome	At the end of the course, the students will be able to: I. Understand the foundational concepts of Indian Knowledge Systems (IKS) and their relevance to modern computing. II. Analyze the influence of ancient Indian philosophies and texts on cognitive processes and knowledge creation. III. Explore the application of traditional Indian knowledge in modern computing fields such as artificial intelligence, ontology development, and cryptography. - To encourage critical thinking about the ethical implications of technology through the lens of Indian philosophical traditions. IV. Examine case studies and future innovations inspired by the integration of IKS with computer science.

Discrete Mathematics
CS-T101

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T101	Discrete Mathematics	4	40	60

Objectives	The objective of this course is to introduce students the ideas and techniques of elementary discrete mathematics that are widely used in science and engineering.
Pre-Requisites	Basic knowledge of sets and matrices is required.
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Propositional Calculus and Predicate Calculus, Rules of inference.	10
II	Proofs and proof strategies, Summation of sequences, Mathematical induction. Basics of counting techniques, Recurrence relation and its solutions, Principle of inclusion and exclusion and its applications.	12
III	Set Theory, Relation, Equivalence relation and Partial Order relation, Hasse-Diagram. Binary operation, semigroup, monoid, group and ring, group codes.	12
IV	Graphs, paths and connectivity in a graph, planar graph, Trees, Application of Graphs.	14
V	Finite-state Machines with or without output, Equivalence of DFA & NFA, Regular Expressions	12
	Total	60

Text Books:

T1. K. H. Rosen, Discrete Mathematics and its Application, 7th Edition, McGraw-Hill, 2017.

T2. C. L. Liu, Elements of Discrete Mathematics, 2nd Revised Edition, Tata McGraw-Hill, 1985.

Reference Books:

R1. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Indian Edition, McGraw-Hill Education, 2017.

R2. T. Koshy, Discrete Mathematics and Applications, 1st Edition, Academic Press (Elsevier), 2003.

R3. J. R. Mott, A. Kandel, and T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, 2nd Edition, Pearson Education India, 2015.

Course Outcome	At the end of the course, the students will be able to: i) Define & describe various logical connectives and expressions along with rules of inferences. ii) Construct various counting techniques using recurrence relations, generating functions for future applications. iii) Interpret the knowledge on sets, relations and functions. iv) Develop the concepts and applications of graphs. v) Identify & define algebraic structures like group, ring, Boolean algebra and its applications. vi) Develop the skill for learning compilers and interpreters.

Programming in C
CS-T102

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T102	Programming in C	4	40	60

Objectives	i) To acquire problem solving skills ii) To be able to develop flowcharts iii) To understand structured programming concepts iv) To be able to understand the fundamentals of programming in C Language v) To be able to write programs in 'C' Language
Pre-Requisites	Formulate simple algorithms for arithmetic and logical problems. Translate the algorithms to programs (in C language) Test and execute the programs and correct syntax and logical errors. Implement conditional branching, iteration and recursion. Decompose a problem into functions and synthesize a complete program using divide and conquer approach Use arrays, pointers and structures to formulate algorithms and programs Apply programming to solve matrix problems and searching and sorting problems Apply programming to solve simple numerical method
Teaching Scheme	Theory - 4 Hours (Each week) Practical – 6 Hours (Each week) Total – 10 Hours (Each Week)

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. Number Systems: Binary, Octal, Decimal, Hexadecimal Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.	12

II	Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do While and Examples. Continue, Break and Goto statements Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. Recursion- Recursive Functions.	12
III	Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers. Preprocessors: Preprocessor Commands Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.	12
IV	Pointers–Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures. dynamic memory allocation. Strings - Concepts, C Strings, String Input/output Functions, Arrays of Strings, String Manipulation Functions.	12
V	Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self-Referential Structures, Unions, Type Definition (typedef), Enumerated Types. Input and Output: Introduction to Files, Modes of Files, Concept of Files, File opening in various modes and closing of a file, Reading from a file,Writing onto a file.	12
	Total	60

Text Books:

T1. B.A. Forouzan and R.F. Gilberg, “A Structured Programming Approach in C”, Cengage Learning, 2007

T2. Kernighan BW and Ritchie DM, “The C Programming Language”, 2nd Edition, Prentice Hall of India, 2006

T3.Rajaraman V, “The Fundamentals of Computer”, 4th Edition, Prentice-Hall of India, 2006.

Reference Books:

R1.JeriHanly and Elliot Koffman, “Problem Solving and Program Design in C”, 6th edition Copyright 2011, ISBN: 0-321-53542-1 Publisher: Addison Wesley

R2. Byron S Gottfried “Programming with C” Second edition, Tata McGrawhill, 2007(Paper back)

R3. R.G. Dromey, “How to solve it by Computer”, Pearson Education, 2008.

R4.Kanetkar Y, “Let us C”, BPB Publications, 2007.

R5.Hanly J R &Koffman E.B, “Problem Solving and Program design in C”, Pearson

Education, 2009.

R6. E. Balagurusamy, “Programming with ANSI-C”, Fourth Edition,2008, Tata McGraw Hill.

R7.Venugopal K. R and Prasad S. R, “Mastering ‘C’”, Third Edition, 2008, Tata McGrawHill.

R8. ISRD Group, “Programming and ProblemSolving Using C”, Tata McGraw Hill,2008.

R9.PradipDey ,Manas Ghosh, “Programming in C”, Oxford University Press, 2007.

Course Outcome	i) After completion of this course the student is expected to analyze the problems. ii) The main emphasis of the course will be on problem solving aspect i.e. developing proper algorithms, able to write, compile and debug programs in C. iii) Use the various constructs of a programming language viz. conditional, iteration and recursion. iv) Able to formulate problems and implement the algorithms in`C` language. v) Able to effectively choose programming components to solve computing problems in real-world.

Computer Organization & Architecture
CS-T103

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T103	Computer Organization & Architecture	4	40	60

Objectives	• To know the basic working principles of a computer system. • To gain knowledge on working of a Control unit and ALU operations. • To know the current state of art in memory system design and working. • To know the principles and working of I/O devices along with I/O interface unit. • To gain knowledge on the working of a Cache memory. • To provide the knowledge on Instruction Level Parallelism • To know the Concepts of pipelining techniques.
Pre-Requisites	Prerequisites: Basic electronics, Computer fundamentals, Basic Programming knowledge
Teaching Scheme	Teaching By providing lectures. By discussion case studies. By providing references for related white papers and articles. By motivating to participate in the competitions like presenting papers. Daily class room interaction. Assessment By regular and surprise class tests. By mid-term and semester exams. By quiz and colloquial.

Detailed Syllabus

Unit	Topics	Hours
I	**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, types of instructions, instruction set, CISC & RISC, Big-endian & Little-endian representation.	12
II	**CPU control unit design& ALU operations:** Single bus organization, Multi bus organization, hardwired and micro-programmed design approaches, Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, multiplication – shift-and addition	12

	approach, Booth multiplier, Division- restoring and non-restoring techniques, floating point arithmetic, IEEE floating point representation	
III	**Memory organization:** Semiconductor memory technologies, Memory interleaving, concept of hierarchical memory organization, Cache memory, Cache size vs. block size, Cache mapping functions, Cache replacement algorithms, Cache write policies, Cache Performance, Secondary memory.	12
IV	**Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, software interrupts and exceptions.	12
V	**Pipelining:** Basic concepts of pipelining, efficiency, throughput and speedup, pipeline hazards and type. **Parallel Processors**: Introduction to parallel processors, FLYNN's classification, Cache Coherence problem, Multiprocessors.	12
	Total	60

Text / Reference Books:

T1: Computer Organization: Carl Hamacher, Zvonkovranesic, SafwatZaky, McGraw Hill

T2: Computer Architecture and Organization, 3rd Edition by John P. Hayes, WCB/McGraw-Hill

T3: Computer Organization and Design: The Hardware/Software Interface, 5th Edition by David A. Patterson and John L. Hennessy, Elsevier

T4: Computer Organization and Architecture: Designing for Performance, 10th Edition by William Stallings, Pearson Education.

Online Resources:

https://nptel.ac.in/courses/106/103/106103206/

Course Outcome	1. To draw the functional block diagram of single bus architecture of a computer. 2. To describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. 3. To know the design concept of Control unit and operation of ALU. 4. To Analyze cache performance, cache optimizations, memory technologies, Protection via virtual memory and virtual machine 5. To assess the performance of a given CPU organization, and apply design techniques to enhance performance using pipelining and parallelism.

Operating System
CS-T104

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T104	Operating System	4	40	60

Objectives	Operating systems are an essential part of any computer system and any computer-science education. This field is undergoing rapid change, as computers are now prevalent in virtually every application. The objective of this course is to have clear knowledge on basic concepts and algorithms of operating system.
Pre-Requisites	Basic knowledge of computer hardware and software
Teaching Scheme	Classroom teaching and use of power point presentations and demonstrations as and when required.

Detailed Syllabus

Unit	Topics	Hours
I	Operating System Introduction- Functions, Characteristics, Structures - Simple Batch, Multi programmed, timeshared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems.Operating-System services, System Calls, types of system calls. Process Management: Process concepts, Threads, operations on processes, process control block.	12
II	Scheduling: Types of schedulers, process scheduling criteria, CPU scheduling algorithms (FCFS, SJF, SRTF, Priority, Round-Robin). Deadlocks: Reusable and Consumable Resources, Characterization of Deadlock, Deadlock Prevention, Deadlock Avoidance,Deadlock Detection and Recovery from Deadlocks.	12
III	Inter Process Communication & Synchronization: Basic Concepts of Concurrency, Co-operating process and independent process, Advantage of Cooperating process, Bounded- Buffer - Shared-Memory Solution, Inter-process Communication (IPC), Basic Concepts of Inter-Process Communication and Synchronization, Mutual Exclusion, Semaphores. Classic Problems of Synchronization: Readers-Writers, Producer-Consumer, and Dining Philosopher problem.	12

IV	Memory Management: Basic Hardware, Logical Versus Physical Address Space, Address Binding, Swapping, Contiguous Memory Allocation, Paging, Segmentation Virtual Memory Management: Demand Paging, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.	12
V	Storage Management: File concepts, access methods, directory structure, file system implementation, directory implementation, disk space management, disk structure and disk scheduling algorithms. I/O systems: I/O Hardware, polling, interrupt driven I/O, direct memory access.	12
	Total	60

Text Books:

T1.AviSilberschatz, Peter Baer Galvin, and Greg Gagne, Operating System Concepts, 8th Ed., Addition Wesley.

T2. William Stallings: Operating Systems, PHI, Latest Edition.

Reference Books:

R1. Milan Milenkovic, Operating Systems: Concept and Design, 3rd Ed., McGraw Hill Inc.

R2. Andrew S. Tanenbaum, “Modern Operating Systems", PHI, latest edition.

Course Outcome	After completion of the course, students should be able to apply algorithms and concepts in real life applications.

Computer Networks
CS-T105

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T105	Computer Networks	4	40	60

Objectives	i. To understand the various components required to build different networks. ii. To learn about different types of networks, Networking models and services provided by various layers. iii. To learn the functions of different protocols
Pre-Requisites	Concepts of Graph Theory, basics of data representation and signals
Teaching Scheme	ICT enabled regular classroom lectures with an emphasis on interactive learning.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction: Data Communications, Components, Data representation, Data Flow, Network Criteria, Types of connection, Physical Topologies, Network models, The Internet, Protocols and standards. OSI reference model. TCP/IP Protocols Suite, Addressing.	12
II	Digital Signals, Transmission of digital signals, Transmission impairment, Data rate limits, performance. Digital Transmission: Line coding Schemes, Transmission modes: Parallel and serial transmission, Transmission media: Guided media (twisted pair, coaxial, Fiber-optic cable), Unguided media. Multiplexing: FDM, TDM, WDM	12
III	Switching: Circuit switched. Packet switched, message switched networks.Error Detection and Correction: Types of errors, Error Detection, Block coding, Redundancy checks and checksum, Error correction methods: Single-bit error correction, Hamming code, Burst error correction.	12
IV	Data link Control: Framing, Flow & Error control: Stop-and Wait ARQ, Sliding window ARQ. Data link protocols: Asynchronous and synchronous protocols, Character and bit oriented protocols, Local Area Networks: Traditional Ethernet, Fast Ethernet, IEEE802 standards, Token Bus, Token Ring, Fiber Distributed Data Interface (FDDI). Routing Algorithms.	12

V	Congestion control and Quality of Service: Traffic descriptor, traffic profiles, open-loop and closed-loop congestion control, techniques to improve QoS, Networking and Internetworking devices: Repeaters, Bridges, Routers, Gateways,Application layer: Client-server model, BOOTP, DHCP, Domain Name Space(DNS), Telnet, File Transfer Protocol (FTP), Simple Mail Transfer protocol (SMTP), Simple network management protocol (SNMP), HTTP.	12
	Total	60

Text Books:

T1. Behrouz A. Forouzan, "Data Communication and Networking", 5th Edition, 2017, Tata McGraw Hill

T2. Andrew S. Tanenbaum, "Computer Networks", Third Edition, Prentice-Hall India, 1996.

Reference Books:

R2. Alberto Leon-Garcia &,Indra Widjaja, "Communication Networks Fundamental Concepts and Key Architectures", McGraw-Hill, 2000.

R3. W. Stallings, "Data & Computer Communication", 5th Edition, Prentice Hall

India, 1998

R4. S Keshav, "An Engineering Approach to Computer Networking", Addition Wesley, 1998

Course Outcome	Students will be able to i. Describe the functions of each layer in OSI and TCP/IP model. ii. Explain the types of transmission media iii. Classify the routing protocols and analyze how to assign the IP addresses for the given network iv. Explain how to control congestion, improve service quality, switching and multiplexing techniques.

Data Structures
CS-T106

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T106	Data Structures	4	40	60

Objectives	The objective of the course is to introduce the fundamentals of Data Structures, Abstract concepts and how these concepts are useful in problem solving. After completion of this course student will be able to – Analyze step by step and develop algorithms to solve real world problems. Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs. Understanding various searching & sorting techniques
Pre-Requisites	One programming language -loop, array, stack, recursion. Math-proof by induction and contradiction. The Algorithmic Design and Techniques class.
Teaching Scheme	Theory - 4 Hours (Each week) Practical – 6 Hours (Each week) Total – 10 Hours (Each Week)

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Data Structure: Data types – primitive and non-primitive, Types of Data Structures- Linear & Non Linear Data Structures. Array: Representation of arrays, Applications of arrays. Stack: Stack-Definitions & Concepts, Operations on Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression	12
II	Queue: Representation of Queue, Operations on Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue,	12
III	Linked List: Singly Linked List, Doubly Linked list, Circular linked list, Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	12
IV	Tree: Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, Postorder, preorder), Binary	12

	search trees, Conversion of General Trees to Binary Trees, Applications of Trees.	
V	Graph: Matrix Representation of Graphs, Elementary Graph operations (Breadth First Search, Depth First Search) Sorting and Searching, Hashing: Hashing Functions, Collision-Resolution Techniques.	12
	Total	60

Text Books:

T1. Ellis Horowitz and SartajSahni, "Fundamentals of Data Structures in C", 2nd Ed, Universities Press, 2014

T2. Seymour Lipschutz, "Data Structures Schaum's Outlines", Revised 1st Ed, McGraw Hill, 2014

Reference Books:

R1. Jean-Paul Tremblay & Paul G. Sorenson "An Introduction to Data Structures with Applications", @nd Ed, Publisher-Tata McGraw Hill.

R2. Reema Thareja, "Data Structures using C", 3rd Ed, Oxford press, 2012

R3. A. M Ten Baum Publisher "Data Structures using C & C++ "– Prenctice-Hall International, 1989

R4. Robert Kruse, Data Structures and Program Design in C", 2nd Ed, PHI, 1996

Course Outcome	On successful completion of the course, the student will: i) Be able to compare functions using asymptotic analysis and describe the relative merits of worst-, average-, and best-case analysis. ii) Be able to solve recurrences using the master, the iteration, and the substitution method. iii) Be able to understand and identify the performance characteristics of fundamental algorithms and data structures and be able to trace their operations for problems such as sorting, searching, selection, operations on numbers, polynomials and matrices, and graphs.

Data Structures laboratory
CS-1107

Subject Code	Subject Name	Credit
CS-L107	Data Structures Laboratory	4

Detailed Syllabus

Write C/ C++ Program for the followings

1. To find average of n numbers using an array.
2. To insert and delete elements from appropriate position in an array.
3. To search an element and print the total time of occurrence in the array.
4. To delete all occurrence of an element in an array.
5. Array implementation of Stack.
6. Array implementation of Linear Queue.
7. Array implementation of Circular Queue.
8. Implementation of linear linked list and perform different operation such as node insert and delete, search of an item, reverse the list.
9. Implementation of circular linked list and perform different operation such as node insert and delete.
10. Implementation of double linked list and perform different operation such as node insert and delete.
11. Linked list implementation of Stack.
12. Linked list implementation of Queue.
13. Polynomial representation using linked list.
14. To represent a Sparse Matrix.
15. Implementation of searching algorithms.
16. Implementation of sorting algorithms (Bubble sort, Selection sort, Quick sort, Merge sort, Heap Sort).

Operating system and computer architecture laboratory
CS-L108

Subject Code	Subject Name	Credit
CS-L108	Operating System and Computer Architecture Laboratory	4

Detailed Syllabus

Operating System:

1. Basics of UNIX commands
2. Write programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write C programs to simulate UNIX commands like cp, ls, grep, etc.
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Implementation of Semaphores
6. Implementation of Shared memory and IPC
7. Implementation of Bankers Algorithm for Deadlock Avoidance
8. Implementation of Deadlock Detection Algorithm
9. Write C program to implement Threading & Synchronization Applications
10. Implementation of paging and page replacement algorithms

Computer Architecture:

Recognition of various components of Personal Computer (PC), dismantling and assembling a PC.

Some experiments using Hardware trainer kits for SMPS, CPU, Hard disk, Motherboard, printer, real time clock, etc.

Simulation of simple fundamental units like half adder, full adder, multiplexer, de-multiplexer, Arithmetic logic Unit, Simple processor (CPU) etc using VHDL code.

MCA
2ND Semester
Syllabus

Code	Subject	Lectures	Practical	Credits
CS-T201	Database Management Systems	4	0	4
CS-T202	Computer Graphics and Multimedia	4	0	4
CS-T203	Probability and Statistics	4	0	4
CS-T204	OOP using JAVA	4	0	4
CS-T205	Design and Analysis of Algorithms	4	0	4
CS-T206	Software Engineering	4	0	4
CS-L207	DBMS and JAVA Laboratory	0	4	4
CS-L208	CGM Laboratory	0	4	4
CS-VAC20?	Value Added Course			2
Total Credits				34

- The students who have successfully appeared the second Semester examinations are required to undergo for a minimum of one-month internship to Industry/Reputed Institution. They are also required to submit a report of their internship to the office of the Head, Department of Computer Science before the commencement of 3rd Semester classes.
- Serial No. VAC 1,2, 3…….

Database Management Systems
CS-T201

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T201	Database Management Systems	4	40	60

Objectives	To study the fundamental concepts of database management system, like aspects of database design, database languages, and database-system implementation.
Pre-Requisites	Basic knowledge of data structures, computer organization, and programming.
Teaching Scheme	Classroom teaching, use of power point presentations, experimental work in laboratories, submission and evaluation of assignments.

Detailed Syllabus

Unit	Topics	Hours
I	Database System Architecture–Introduction to Database Systems, Data Abstraction, Data Independence, Three Schema Architecture, Database administrator, Users, Database languages, Overall system structure. Data Models-Hierarchical, Network, Relational Model and Object Oriented Data models, Entity-Relationship (E-R) Model.	12
II	E-R Diagram, keys, Reduction of E-R Diagram to tables. Relational Query Languages: Relational algebra, extended relational algebra operations, tuple and domain relational calculus basic operations, SQL – basic query structure, set operations, aggregate functions, nested sub queries, Integrity Constraints.	12
III	Relational Database Design: Functional dependencies, Armstrong's axioms, decomposition, Normalization using Functional, Multi-valued, Join dependencies, Normal forms, decomposition using functional dependency and normal forms, algorithms for decomposition, Dependency Preservation Property of a Decomposition, lossless (Non-additive) Join Property of a Decomposition.	12
IV	Query processing and Optimization: Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query optimization.	12

	Transaction Processing: Transaction concept, Transaction state, ACID properties and their necessity,Concurrent executions, Serializability.	
V	Concurrency Control and Recovery: Concurrency control, Locking and Time-stamp based schedules, Multi-version and Optimistic Concurrency control schemes, Recovery System, Deadlock handling. Database System Architectures: Centralized Systems, Client server systems, Parallel databases, Distributed databases, Data Mining and Warehousing concepts.	12
	Total	60

Text Books:

T1. Henry F. Korth and Abraham Silberschatz, S. Sudarshan, "Database System Concepts", 6th edition, McGraw-Hill, 2012.

T2. RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", 6th edition, Pearson Education.

Reference Books:

R1. Bipin C. Desai, "An Introduction to Database Systems", West Publications, 8th edition, 2006.

R2. C. J. Date, "An introduction to Database Systems", Addison Wesley Publications, latest edition.

R3. Gary W. Hansen and James V. Hansen, "Database Management and Design", Prentice Hall, latest edition.

R4. Jeffrey A. Hoffer, Mary B. Prescott, Fred R. Mcfadden, Modern Database Management, Prentice Hall, 6th edition, 7th edition, 2002.

R5. Ronald J. Norman, Object Oriented Systems Analysis and Design, Prentice Hall, latest edition.

Course Outcome	Create database and small projects using database languages.

Computer Graphics and Multimedia
CS-T202

Subject Code	Subject Name	Credits	Mid-Semester Marks	Semester Exam Marks
CS-T202	Computer Graphics and Multimedia	4	40	60

Objectives	To understand i) how to scan convert the basic geometrical primitives. ii) mapping from a world coordinate system to device coordinates system, clipping, and projections. iii) Two and three dimensional geometric transformations. iv) Parallel and perspective projections v) Technical aspect of Multimedia Systems.
Pre-Requisites	2D and 3D Geometry, Trigonometry, Algebra of Matrices
Teaching Scheme	ICT enabled regular classroom lectures with an emphasis on interactive learning and programming.

Detailed Syllabus

Unit	Topics	Hours
I	Applications of computer graphics, Elements of pictures created in computer graphics, Graphics display devices, Basic raster graphics algorithms for drawing 2D primitives: Characteristics of good line drawing algorithms, Simple DDA, Symmetrical DDA and Bresenham's Line Drawing Algorithms. Circle drawing algorithms.	12
II	2D geometric transformations and 2D viewing: Basic transformations, Matrix representations and homogeneous coordinates, Composite transformations, window-to-viewport coordinate transformation.	12
III	Clipping Algorithms: Need for clipping, midpoint subdivision, Cohen-Sutherland, Cyrus-Beck and Liang-Barsky line clipping algorithms, Sutherland-Hodgeman, Weiler-Atherton polygon clipping algorithms. Fill area primitives: scan-line polygon filling, boundary and flood-fill.	12

IV	3D concepts and 3D object representations: Polygon surfaces, Curved lines and surfaces, Bezier & B-spline curves. 3D geometric transformations: Translation, Rotation, Scaling, Composite transformations, Three dimensional viewing – viewing pipeline, Parallel and perspective Projections.	12
V	Introduction to Multimedia, Hardware elements, applications, data interface standards of Multimedia, Non Temporal Media: Text, Hypertext, Images. Multimedia Input/ output technologies, Digital Audio, Digital video. Multimedia Authoring. Compression and decompression structure: Lossless & Lossy compression, Huffman coding, arithmetic coding, LZW, JPEG.	12
	Total	60

Text Books:

T1. Donald Hearn & M. Pauline Baker, Computer Graphics C Version, Second Edition, Pearson Education.

T2. Fred T. Hofstetter, Multimedia Literacy, Tata McGraw Hill, 1995.

Reference Books:

R1. Roy A. Plastock & Zhigang Xiang, Schaum's Outline of Computer Graphics, Second Edition, Tata McGraw-Hill.

R2. Ranjan Parekh, Principles of Multimedia, McGraw-Hill

R3. James D. Foley, A. van Dam, Steven K. Feiner & John F. Hughes, Computer Graphics Principles & Practice, Second Edition in C, Pearson Education.

Course Outcome	Students will be able to i. implement various algorithms to scan convert the basic geometrical primitives ii. implement 2D and 3D transformations iii. Area filling iv. Line and polygon clipping v. Implement the Compression/Decompression algorithms

Probability and Statistics CS-T203

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T203	Probability and Statistics	4	40	60

Objectives	The objective of this course is to learn the basic concepts of probability and statistics including various methods of estimations & statistical testing useful for analysis of data.
Pre-Requisites	Basic knowledge of sets, coordinate geometry, and calculus is required.
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Basic Notions of Probability, Finite Sample Space, Conditional Probability and Independence, Bayes' Rule and its Applications, Random Variables. Discrete and Continuous probability distribution functions, Mean, Variance and Co-Variance of random variables.	12
II	Binomial distribution, Poisson distribution, Hypergeometric distribution, Normal distribution, Uniform distribution, Joint distribution.	10
III	Fundamental Sampling Distributions and Data Description: Random sampling, Single sample – estimation of mean and variance, Two samples – estimating the difference between two means and ratio of two variances, Maximum likelihood estimation, Confidence interval.	12
IV	Hypothesis Testing: One and two tailed test, Single sample – test concerning single mean, two means, test of single and two proportions, Goodness of fit test.	14
V	Simple Linear Regression and Correlation: Least square method, Correlation, Multiple linear regression, Analysis of variance.	12
Total		60

Text Books:

T1. R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, Probability & Statistics for Engineers & Scientists, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. W. Mendenhall, R. J. Beaver, and B. M. Beaver, Probability and Statistics, 1st Edition, Cengage Learning, 2009.

R2. R. A. Johnson, I. Miller, and J. E. Freund, Probability and Statistics for Engineers, 9th Edition, Pearson Education, 2016.

Course Outcome	At the end of the course, the students will be able to: i) Solve problems on probability of discrete nature. ii) Solve problems on probability of continuous nature. iii) Infer on mean and variance of a data set. iv) Categorize the distribution type of a data set. v) Fit a curve using regression model.

OOP Using Java
CS-T204

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T204	OOP Using Java	4	40	60

Objectives	The objective of this course is to introduce the key concepts of object-oriented programming (OOP) using Java as the programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with a programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	**Introduction to Java:** Java Overview: Java Virtual Machine, Java buzz words, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.	12
II	**Object oriented concepts:** Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, StringBuffer, this reference., Overloading, Access modifiers.	12
III	**Inheritance and Polymorphism**: Basics of Inheritance, using super and final keyword, method overriding Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, using super and final keyword, method overriding Abstract class, Interface in java, Package in java, UTIL package, defining and importing packages, access protection, interfaces.	12
IV	**Introduction to GUI Programming**: working with windows, frames, graphics, color, and font. AWT Control fundamentals. **Applet basics** its life cycle.	12
V	**Multithreading in java**: Threads: thread model, use of Thread class, Thread life cycle and methods, Runnable interface, Thread synchronization.	12

	Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling.	
	Total	60

Text Books:

T1. H. Schildt, Java: The Complete Reference, 10th Edition, McGraw-Hill, 2017.
T2. E. Balagurusamy, Programming with Java, 3rd Edition, Tata McGraw-Hill, 2017
T3: Y. D. Liang, Introduction to Java Programming, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. B. Bates, K. Sierra, Head First Java, 2nd Edition, O'Reilly Media, 2005.
R2. T. Budd, An Introduction to Object-Oriented Programming, 3rd Edition, Pearson
R3. I. Horton, Beginning Java, 7th Edition, Wrox Publications, 2011.

Course Outcome	Apply object oriented principles in software design process to develop Java programs for real life applications.

Design and Analysis of Algorithms
CS-T205

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T205	Design and Analysis of Algorithms	4	40	60

Objectives	Algorithms lie at the heart of computing. Algorithms are key to write a good program. Hence, clear understanding of the concepts is essential.
Pre-Requisites	Basic knowledge of mathematics and computer application
Teaching Scheme	Classroom teaching, use of ICT tools and demonstrations as and when required.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction: Introduction to Design and Analysis of Algorithm, Growth of Functions, Recurrences. Sorting and Selection: Insertion sort, Selection Sort, Sorting in Linear Time, Heapsort.	12
II	Algorithm Design & Analysis Techniques (I): Divide and Conquer & Randomization (Examples: Quick Sort, Merge Sort, Miller-Robin Primality Test, and Strassen's algorithm for Matrix Multiplication). Data Structure: Binomial Heaps.	12
III	Algorithm Design & Analysis Techniques (II): Dynamic Programming (Examples: Traveling Salesperson Problem, Matrix chain multiplication), Greedy Method (Example: Activity-Selection Problem, Job Sequencing with Deadlines, Knapsack problem, Huffman codes),	12
IV	Backtracking (Examples: 8-Queens Problem & Subset sum Problem).Graph Algorithms: Data Structure for Disjoint Sets, Minimal Spanning Tree (Algorithms Kruskal & Prim), Single Source Shortest Paths (Dijkstra"s Algorithm), All Pairs of Shortest Paths (Floyd- Warshall Algorithm),	12

V	String Matching Algorithms (The naive string-matching algorithm, the Rabin-Karp algorithm), NP-Completeness and Introduction to Approximation Algorithms, Hamiltonian cycles**,** the vertex-cover problem.	12
	Total	60

Text Books:

T1. T. H. Cormen, C. E. Leiserson& R. L. Rivest, Introduction to Algorithms, PHI, 3rd Edition.

T2. E. Horwitz, S. Sahani, S. Rajasekharn, Fundamentals of Computer Algorithms, Galgotia Publication, latest edition.

Reference Books:

R1. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Addison Wesley Longmans, latest edition.

R2. G. Brassard, P. Bratley, Fundamentals of Algorithmic, PHI, latest edition.

Course Outcome	Convert algorithms to programs and apply them to real life situations, analyzing time and space complexity of algorithms.

Software Engineering
CS-T206

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T206	Software Engineering	4	40	60

Objectives	i) Develop methods and procedures for software development that can scale up for large system. ii) Demonstrate the procedure of converting a valid software design into efficient code. iii) Systematic approach to develop software within specified time and budget to produce high quality product. iv) Focus on project management and software risk management
Pre-Requisites	Algorithm and data structure: These are most important field of computer science. Being good at Algorithm and data structure is always a plus point. Knowing how to implement a particular solution in the most efficient way is key for a software developer working out problems alongside on platforms.
Teaching Scheme	Teaching By providing lectures. By discussion case studies. By providing references for related white papers and articles. By motivating to participate in the competitions like presenting papers. Daily class room interaction. Assessment By regular and surprise class tests. By mid-term and semester exams. By quiz and colloquial.

Detailed Syllabus

Unit	Topics	Hours
I	**Software Models:** Software Engineering: Definition. Phases in Software Engineering. Software Characteristics, Classification of Software. Software Process, Software Life Cycle Models Selection Criteria of Software Process Models	12
II	**Requirements analysis & Design:** Software Requirement:	12

	Types of Requirements, Feasibility Study, Types of Feasibility. Requirements Analysis Structured Analysis Requirements Specification, purpose of SRS, characteristics of SRS, structure of SRS. Software Design: Data Design, Architectural Design, Component-level Design, Cohesion & Coupling, User Interface Design.	
III	**Coding, Testing & Maintenance:** Coding & Testing: Coding Guidelines, Coding Methodology, Code verification Techniques, Coding Tools. Software Testing Strategies, V Model of Software Testing, Black Box & white box Techniques. Debugging. Types of Software Maintenance, Software Maintenance Life Cycle, Software Maintenance Models, Techniques for Maintenance, Tools for Software Maintenance	12
IV	Cost Estimation: Software Cost Estimation Process, Decomposition Techniques, Software Estimation Models. Basics of Software Configuration Management.	12
V	Software quality: SEI CMM and ISO-9001. Software reliability and fault-tolerance, software project planning, monitoring, and control. Computer-aided software engineering (CASE), Component model of software development, Software reuse.	12
	Total	60

Text / Reference Books:

T1: Roger S. Pressman, Software Engineering, MCGr and –Hill International.
T2: Rajib Mall, Fundamental of Software Engineering, Prentice Hallo India.
T3: IVAN Sommerville, Software Engineering, Person education Asia.
T4: Pankaj jalote, Software Engineering, A precise Approach wiley.
T5: Ali Behhforoz and Frederick Hudson, Software Engineering Fundamental, OXFORD

Course Outcome	1. Prepare SRS document. 2. Apply the concept of functional oriented and objective oriented approach for software design. 3. Recognize how to ensure the quality of software products different quality standards and software review techniques. 4. Apply various testing techniques and test plan in. 5. Able to understand modern Agile development.

DBMS & JAVA laboratory
CS-l207

Subject Code	Subject Name	Credit
CS-L207	DBMS & JAVA laboratory	4

Detailed Syllabus

Creating, Altering, Dropping tables with Constraints, Insert Table.
Experiment 1: Create Tables, Alter table with changes in columns
Experiment 2: Alter table with constraints, Dropping Tables
Experiment 3: Inserting Data into Tables.
Inserting, Simple Select, Char, Number, Date functions
Experiment 4: Simple Select
Experiment 5: Select with conditions.
Experiment 6: Using character functions.
Experiment 7: Using number functions.
Experiment 8: Using date functions.
Detailed SELECT with sub-queries, EQUI-JOINS, correlated sub-queries.
Experiment 9: Single row sub-queries., Multiple row sub-queries, Equal joins, Correlated sub-queries.
GROUPING, SET, UPDATE, DELETE, VIEWS
Experiment 10: Aggregate functions & Grouping clauses.
Experiment 11: Introduction, Compiling & executing a java program.
Experiment 12: Program with data types & variables.
Experiment 13: Program with decision control structures: if, nested if etc.
Experiment 14: Program with loop control structures: do, while, for etc.
Experiment 15: Program with classes and objects.
Experiment 16: Implementing data abstraction & data hiding.
Experiment 17: Implementing inheritance.
Experiment 18: Implementing and polymorphism.
Experiment 19: Implementing packages.
Experiment 20: Implementing generics.
Experiment 21: Program with modern features of java.
Experiment 22: Implementing interfaces and inner classes
Experiment 23: Implementing wrapper classes
Experiment 24: Implementing generics.
Experiment 25: Implementing cloning.
Experiment 26: Implementing Reflections
Experiment 27: Working with files.
Experiment 28: Implementing a Lexical Analyzer
Experiment 29: Implementing a parser
Experiment 30: Implementing a code generator

Computer Graphics and Multimedia Laboratory
CS-l208

Subject Code	Subject Name	Credit
CS-L208	Computer Graphics and Multimedia Laboratory	4

Detailed Syllabus

Introduction to OpenGL Programming.

Implementing line drawing algorithms.

Implementing circle drawing algorithms.

Implementing ellipse drawing algorithms.

Implementing Line Clipping Algorithms.

Implementing Polygon Clipping Algorithms.

Implementing 2-d Transformations.

Implementing 3-d Transformations.

Implementing scan fill, boundary fill algorithms.

Implementing seed fill, flood fill algorithm.

Writing program on B-Splines, Bezier Curves

Writing program on Mandelbrot set & Julia set.

Writing program on Sierpinski gasket, Koch curve.

Writing program on Fractal trees & forest.

Writing program on wire frame model & terrain generation.

Implementing Ray tracing algorithm.

Writing program on Animation & Morphing techniques.

MCA 3RDSEMESTER SYLLABUS				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-T301	Compiler Design	4	0	4
CS-T302	Elective -I	4	0	4
CS-T303	Web Technology	4	0	4
CS-T304	AI and Machine Learning	4	0	4
CS-T305	Data Mining and SC	4	0	4
CS-T306	Elective-II(SWAYAM MOOC)	4	0	4
CS-L307	Web Technology Laboratory	0	4	4
CS-L308	Data Mining and SC Laboratory	0	4	4
Total Credits				32

Elective - I		**Elective – II(MOOC Substitute)**	
A	Data Analytics using Python	**A**	Big Data Analysis
B	Wireless Sensor Network	**B**	Cyber Security and Digital Forensics
C	Mobile Computing	**C**	Object Oriented analysis and Design using UML
D	Bioinformatics	**D**	Digital Image Processing
E	Theory of Computation	**E**	Cloud Computing
F	Embedded Systems	**F**	Internet of Things
G	Cryptography and Network Security	**G**	Financial Engineering

Compiler Design
CS-T301

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T301	Compiler Design	4	40	60

Objectives	To understand more deeply how a compiler translates the program into machine language. To become more skilled at writing effective code, debugging it when things go wrong.
Pre-Requisites	Basic knowledge of automata, programming and translators.
Teaching Scheme	Classroom teaching, use of ICT tools and demonstrations as and when required.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Compiling and Lexical Analysis: Compilers, Analysis of the source program, the phases of a compiler, Cousins of the compiler, the grouping of phases, Compiler-construction tools. Lexical Analysis -The role of the lexical analyzer, Input buffering, Specification of tokens, Recognition of tokens.	12
II	A language for specifying lexical analyzers, Design of a lexical analyzer generator. Syntax Analysis: The role of the parser, Context-free grammar, writing a grammar, ambiguous grammar, regular expression - Recognizing of patterns - finite automation concepts (deterministic & non deterministic) Conversion of NDFA to DFA.	12
III	Top- down parsing, Bottom-up parsing, Operator-precedence parsing, LR parsers, Parser generators. Syntax-Directed Translation: Syntax-directed definitions, Construction of syntax trees, Bottom-up evaluation of S-attributed definitions, L-attributed definitions, Bottom-up evaluation of inherited attributes.	12
IV	Run-Time Environments: Source language issues, Storage organization, Storage allocation strategies, Access to nonlocal names, Parameter passing, Symbol tables, Dynamic storage	12

	allocation techniques. Intermediate Code Generation: Intermediate languages, Declarations, Assignment statements, Boolean expressions, Case statements.	
V	Code Generation: Issues in the design of a code generator, The target machine, Run-time storage management, Basic blocks and flow graphs, Next- use information, A simple code generator, Register allocation and assignment, The Dag representation of basic blocks. Code Optimization: Introduction, The principle source of optimization, Optimization of basic blocks, Loops in flow graphs.	12
	Total	60

Text Books:

T1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers - Principles, Techniques and Tools", Addison Wesley.

T2. John E. Hopcraft& Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", Narosa Publishing House, New Delhi.

Reference Books:

R1. Lex and Yacc by Johan R. levine, Tonny Mason, et. al. O" Reilly and Assosiates.

R2. "Compilers Design in C" Allen I. Holub, PHI eastern economy edition 2003.

Course Outcome	Write a parser for a given language, create tools for debugging and translating

Data Analytics usingPython
(Elective-I)
CS-T302(A)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(A)	Data Analytics using Python	4	40	60

Objectives	• Demonstrate basic data analytics principles and techniques • Apply control structures the concepts of inheritance and overloading for a given problem • Perform essential operations using Numpy and Pandas • Structuring the data in the dataset for a given problem Demonstrate the concepts of data visualization
Pre-Requisites	Basic knowledge of programming and data structure.
Teaching Scheme	Blended learning with traditional and use of technology to emphasize on detailed implementation.

Detailed Syllabus

Unit	Topics	Hours
I	**Python Basic Concepts and Programming** Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type( ) Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.	12
II	Python Collection Objects Classes Strings- Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting	12

	Strings, Lists-Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files. Class Definition – Constructors – Inheritance – Overloading	
III	**Introduction to Numpy and Pandas** Numpy:-Understanding datatypes in python, basics of NumPy arrays, computation on NumPy arrays: universal functions. Pandas:-Introducing to pandas data structures, essential functionality, summarizing and computing descriptive statistics, handling missing data.	12
IV	**Data Loading and Data Wrangling** Reading and writing data in text format, interacting with databases, combining and merging data sets, reshaping and pivoting, data transformation, string manipulation	12
V	**Visualization with Matplotlib and Seaborn** General Matplotlib tips, simple line plots, simple scatter plots, visualizing errors, density and contour plots, histograms, binning, and density, customizing plot legends and colorbars, customizing matplotlib, visualization with seaborn.	12
	Total	60

Text Books:

T1. Jake Vander plas, "Python Data Science Handbook: Essential tools for working with data", O'Reilly Publishers, I Edition

T2. Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010

T3. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition,Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)

Reference Books:

R1. Core Python Programming, W.Chun, Pearson.

R2. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010.

Course Outcome	Understand and comprehend the basics of python programming and Identify real-world applications for data analytics.

Wireless Sensor Network
(Elective-I)
CS-T302 (B)

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T302(B)	Wireless Sensor Network	4	40	60

Objectives	To study about the fundamental concepts, design issues, solutions to the issues, architectures and protocols and the state-of-the-art research developments in sensor networks and ad hoc wireless networks.
Pre-Requisites	Basic knowledge of wireless ad-hoc networks and sensors.
Teaching Scheme	Power point presentations, demonstrations using videos, animations as per the requirements.

Detailed Syllabus

Unit	Topics	Hours
I	Routing Cellular and Ad hoc wireless networks; Issues of MAC layer and outing; Proactive, Reactive and Hybrid Routing protocols; Multicast Routing; Tree based and Mesh based protocols; Multicast with Quality of Service Provision.	12
II	Quality of Service: Real-time traffic support; Issues and challenges in providing QoS; Classification of QoS Solutions; MAC layer classifications; QoS Aware Routing Protocols; Ticket based and Predictive location based Qos Routing Protocols.	12
III	Energy Management Ad Hoc Networks: Need for Energy Management; Classification of Energy Management Schemes; Battery Management and Transmission Power Management Schemes; Network Layer and Data Link Layer Solutions; System power Management schemes.	12
IV	Mesh Networks: Necessity for Mesh Networks; MAC enhancements; IEEE 802.11s Architecture; Opportunistic Routing; Self Configuration and Auto Configuration; Capacity Models; Fairness; Heterogeneous Mesh Networks; Vehicular Mesh Networks Unit IV:	12
V	Sensor Networks: Introduction to Sensor Network architecture; Data Dissemination; Data Gathering; MAC Protocols for sensor Networks; Location discovery; Quality of Sensor Networks; Evolving Standards.	12
	Total	60

Text Books:

T1. Siva Ram Murthy and B.S.Manoj, Ad hoc Wireless Networks – Architectures and Protocols, C., Pearson Education, 2004.

Reference Books:

R1.Feng Zhao and Leonidas Guibas, Wireless Sensor Networks, Morgan Kaufman Publishers, 2004.

R2. C.K.Toh , Adhoc Mobile Wireless Networks, Pearson Education, 2002. 3. Thomas Krag and Sebastin Buettrich , Wireless Mesh Networking , O"Reilly Publishers, 2007

Course Outcome	Develop small projects on recent challenges in the field of sensor networks and wireless ad-hoc networks.

Mobile computing
(Elective-I)
CS-T302 (C)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(C)	Mobile Computing	4	40	60

Objectives	To study about the fundamental concepts, design issues, solutions to the issues, architectures and protocols and the state-of-the-art research developments in Mobile Networks and Sensors.
Pre-Requisites	Basic knowledge of Mobile Networks and sensors.
Teaching Scheme	Power point presentations, demonstrations using videos, animations as per the requirements.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Personal Communications Services (PCS): PCS Architecture, mobility management, Networks signaling, Global System for Mobile Communication (GSM) System overview: GSM Architecture, Mobility management, Network signaling.	12
II	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes, Mobile Data Communication; WLANs (Wireless LANs) IEEE 802.II standard, Mobile IP.	12
III	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML), Wireless Local Loop (WLL) : Introduction to WLL Architecture, wireless Local Loop Technologies.	12
IV	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) Vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000. Global Mobile Satellite Systems; case studies of the IRIDIUM, ICO and GLOBALSTAR systems.	12
V	Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols. Server-side programming in Java, Pervasive web application architecture, Device independent example application.	12
	Total	60

Text Books:

T1. Mobile Communication: J. Schiller, Pearson Education
T2. Mobile Computing: P.K. Patra, S.K. Dash, Scitech Publications.
T3. Mobile Computing: Talukder, TMH, 2nd Edition.

Reference Books:

R1. Pervasive Computing: Burkhardt, Pearson Education.
R2. Principles of Mobile Computing: Hansmann, Merk, Springer, 2nd Edition.
R3. Wireless Communication & Networking: Garg, Elsevier
R4. Third Generation Mobile Telecommunication Systems: P. Stavronlakis, Springer.
R5. The Wireless Application Protocol: Sandeep Singhal, Pearson Education.

Course Outcome	Develop small projects on recent challenges in the field of sensor networks and Mobile Networks.

Bioinformatics
(Elective-I)
CS-T302 (D)

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T304(D)	Bioinformatics	4	40	60

Objectives	The objective of this course is to introduce students the ideas and techniques of bioinformatics for solving some of the problems of biological sciences.
Pre-Requisites	Basic knowledge of biology is required.
Course Outcome	At the end of the course, the students will be able to: i) Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics ii) Existing software effectively to extract information from large databases and to use this information in computer modelling iii) Problem-solving skills, including the ability to develop new algorithms and analysis methods iv) an understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction, Algorithms and Complexity:Biological Algorithms versus Computer Algorithms, Notations, Algorithm Design Techniques, Tractable versus Intractable Problems. Molecular Biology Primer: Genes, Molecules, Structure of DNA, Proteins, Analysis. Exhaustive Search: Restriction Mapping, Impractical Restriction Mapping Algorithms, A Practical Restriction Mapping Algorithm, Regulatory Motifs in DNA Sequences, Profiles, The Motif Finding Problem, Search Trees, Finding Motifs, Finding a Median String.	10
II	Greedy Algorithms: Genome Rearrangements, sorting by Reversals,	12

	Approximation Algorithms, Breakpoints: A Different Face of Greed, A Greedy Approach to Motif Finding. Dynamic Programming Algorithms: The Power of DNA Sequence Comparison, the Change Problem Revisited, the Manhattan Tourist Problem, Edit Distance and Alignments, Longest Common Subsequences.	
III	Sequence Alignment:Global sequence alignment, the Needleman and Wunsch algorithm, Scoring Alignments, Local Sequence Alignment, the smith-waterman algorithm. Alignment with Gap Penalties, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction, Similarity-Based Approaches to Gene Prediction, Spliced Alignment. Divide and Conquer Approach to Sorting, Space Efficient Sequence Alignment, Block Alignment.	12
IV	Graph Algorithms:Graphs and Genetics, DNA Sequencing, Shortest Superstring, Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, Fragment Assembly in DNA Sequencing, Protein Sequencing and Identification, The Peptide Sequencing Problem, Spectrum Graphs, Protein Identification via Database Search, Spectral Convolution, Spectral Alignment.	14
V	Combinatorial Pattern Matching: Repeat Finding, Hash Tables, Exact Pattern Matching, Keyword Trees, Suffix Trees, Heuristic Similarity Search Algorithms, Approximate Pattern Matching, BLAST: Comparing a Sequence against a Database.	12
	Total	60

Text Books:

T1. Neil C. Jones and Pavel A. Pevzner, An Introduction to Bioinformatics Algorithms, MIT Press, 2004.

T2. Ion Mandoiu and Alexander Zelikovsky, Bioinformatics Algorithms, Techniques & Applications, Wiley Inter-Science, 2008

T3. Wing-Kin Sung, Algorithms in Bioinformatics: A Practical Introduction, CRC Press (Taylor & Francis Group), 2009.

Reference Books:

R1. T.K. Attwood and Phukan Smith, Introduction to Bioinformatics, Pearson Education.

R2. B. Bergeron, Bio-informatics Computing, Pearson Education.

R3.J.M Claverie and C.N. Notredame, Bioinformatics- A Beginners Guide, Wiley Pub.

Theory of Computation
(Elective-I)
CS-T302(E)

Subject Code	Subject Name	Credits	Mid-Semester Marks	Semester Exam Marks
CS-T302(E)	Theory of Computation	4	40	60

Objectives	To i. Understand regular, context-free, context-sensitive, and recursively enumerable languages. ii. Study deterministic and non-deterministic finite automata and their interconversions. iii. Learn about pushdown automata (PDA) and their equivalence to context-free grammars. iv. Explore practical applications of automata theory in various fields such as compiler design, text processing, and software verification. v. Explore the concept of Turing machines as a model of computation.
Pre-Requisites	Discrete mathematics, Design and analysis of algorithms.
Teaching Scheme	ICT enabled regular classroom lectures emphasizing on interactive learning and programming.

Detailed Syllabus

Unit	Topics	Hours
I	Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, minimization of FSM, Moore and Mealy machines. Finite automaton model, DFA and NFA, transition diagrams and Language recognizers, NFA to DFA conversion.	12
II	Regular Languages & Grammars: 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 (proofs not required). Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar	12

	and FA, inter conversion.	
III	Context Free Grammars: Context free grammar, derivation trees & derivation of strings. Ambiguity in CFGs. Minimization of CFG. Chomsky normal form, Pumping Lemma for CFLs. Enumeration properties of CFL (proofs omitted).	12
IV	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. (proofs omitted). Introduction to DCFL and DPDA.	12
V	Turing Machine: definition, model, Representation of TMs, Types of TMs (proofs omitted). Language acceptability by TMs, design of TM, Computable functions, recursively enumerable languages, Universal TMs, Halting problem, NP-Completeness.	12
	Total	60

Text Book:

1. Introduction to Automata Theory Languages and Computation. Hopcroft H.E. and Ullman J. D. Pearson Education

Ref. Books:

1. Theory of computer Science by K.L.P Mishra and N. Chandra Sekaran PHI (2001)
2. Elements of Theory of Computation, Lewis H.P. & Papadimitriou C.H. Pearson /PHI.

Course Outcome	Students will be able to i. design regular expressions for given patterns and convert them to finite automata. ii. solve real-world problems using automata. iii. apply finite automata to solve problems and recognize regular languages.

Embedded Systems
(Elective-I)
CS-T302(F)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(F)	Embedded Systems	4	40	60

Objectives	To introduce the technologies behind embedded computing systems. To introduce and discuss various software components involved in embedded system design and development. To expose students to the recent trends in embedded system design.
Pre-Requisites	Computer Organization, Microprocessors & Microcontrollers Basic electronics, digital electronics, knowledge of microcontrollers and C programming. Since you are from computer science background you would need a development board of any 8-bit microcontroller to get started.
Teaching Scheme	Theory - 4 Hours (Each week) Practical – 6 Hours (Each week) Total – 10 Hours (Each Week)

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Embedded Systems– Components of embedded system hardware–Software embedded into the system – Embedded Processors - CPU architecture of ARM processor (ARM9) – CPU Bus Organization and Protocol. Design and Development life cycle model - Embedded system design process – Challenges in Embedded system design.	12
II	Serial Communication Standards and Devices - UART, HDLC, SCI and SPI. Serial Bus Protocols - I2C Bus, CAN Bus and USB Bus. Parallel communication standards ISA, PCI and PCI-X Bus	12
III	Memory devices and systems - memory map – DMA - I/O Devices – Interrupts - ISR – Device drivers for handling ISR – Memory Device Drivers – Device Drivers for on-board bus. Programming concepts of Embedded programming – Features of Embedded C++ and Embedded Java (basics only). Software Implementation, Testing, Validation and debugging, system-on-chip. Design Examples: Mobile phones, ATM machine set-up-box.	12
IV	Inter Process Communication and Synchronization -Process, tasks and threads –Shared data– Inter process communication - Signals – Semaphore – Message Queues – Mailboxes – Pipes – Sockets – Remote Procedure Calls (RPCs).	12

V	Real time operating systems - Services- Goals – Structures - Kernel - Process Management – Memory Management – Device Management – File System Organization. Micro C/OS-II RTOS - System Level Functions – Task Service Functions – Memory Allocation Related Functions – Semaphore Related Functions. Study of other popular Real Time Operating Systems.	12
	Total	60

Text Books:

T1. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

T2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers - Elsevier 3ed, 2008

Reference Books:

R1. Frank Vahid and Tony Givargis, "Embedded Systems Design – A Unified Hardware / Software Introduction", John Wiley, 2002

R2. Iyer–"Embedded Real time System"s, 1e, McGraw Hill Education New Delhi, 2003

R3. K.V. Shibu, "Introduction to Embedded Systems", 2e, McGraw Hill Education India, 2016.

R4. Lyla B. Das, "Embedded Systems: An Integrated Approach", 1/e , Lyla B. Das, Embedded Systems, 2012

R5. Rajkamal, "Embedded Systems Architecture, Programming and Design", TMH, 2003

R6. Steve Heath,"Embedded Systems Design", Newnes – Elsevier 2ed, 2002.

Course Outcome	The Student will be able to: i) Demonstrate the role of individual components involved in a typical embedded system ii) Analyze the characteristics of different computing elements and select the most appropriate one for an embedded system iii) Model the operation of a given embedded system iv. substantiate the role of different software modules in the development of an embedded system iv) Develop simple tasks to run on an (Real Time Operating System) RTOS v) Examine the latest trends prevalent in embedded system design

Cyber security and digital forensics (Elective-II) CS-T302 (B)				
Subject Code	**Subject Name**	**Credits**	**Mid-Semester Marks**	**Semester Exam Marks**
CS-T302(G)	Cyber Security and Digital Forensics	4	40	60
Objectives	i. To understand the threats in networks and security concepts. Apply authentication applications in different networks. ii. To understand security services, adware and their applications. iii. To correctly define and cite appropriate instances for the application of computer forensics iv. To correctly collect and analyze computer forensic evidences. v. Identify the essential and up-to-date concepts, algorithms, protocols, tools, and methodology of Computer Forensics			
Pre-Requisites	Concepts of Computer Organization, Computer Networks and Operating systems.			
Teaching Scheme	ICT enabled regular classroom lectures with an emphasis on interactive learning and programming.			

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to computer security: threats, attacks, vulnerabilities, authentication, access control, cryptography. Browser attacks, web attacks targeting users, obtaining user or website data, email attacks, identity thefts. Cybercrimes: Definition, classifications and types of cybercrimes. Malware and its types.	12
II	Tools and methods used in cybercrime: Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus, Worms, Trojan Horses, Backdoors, Steganography, DoS, DDoS, MITM Attacks, IP spoofing, SQL Injection, Buffer Overflow, social engineering. Attacks on wireless networks. security challenges, policies and measures in the mobile and wireless computing.	12

III	The Legal Perspectives: Cybercrime and the legal landscape around the world, need of cyberlaws, the Indian IT Act, challenges to Indian law and cybercrime scenario in India, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Cyberlaw. Technology and students: Indian scenario.	12
IV	Steps to improve the computer security and security myths to stay away from, securing the popular Windows web browsers, steps to stay safe on public Wi-Fi networks and securing home wireless networks. E-mail, social networks security, detecting and securing the computers against malware infection.	12
V	Digital forensics: definition and uses, Locard's exchange principle, digital forensic process, life cycle, hardware and software, digital evidence and order of volatility, cloning, live vs dead system, hashing: types and uses. Windows system artifacts, forensics analysis of web browsers, e-mails, chats, social networking sites and mobile devices. Anti-forensic techniques.	12
	Total	60

Text books:

1. John Sammons, the basics of digital forensics– The primer for getting started in digital forensics, Elsevier Syngress Imprint.
2. Jeetendra Pande, Introduction to Cyber Security, Uttarakhand Open University, 2017.

Reference books:

1. Charles P. Pfleeger, Shari L. Pfleeger, J. Margulies, "Security in Computing", Prentice Hall, New Delhi, 2009.
2. C. Altheide & H. Carvey, Digital Forensics with Open-Source Tools, Syngress, 2011. ISBN: 9781597495868.
3. James Graham, Richard Howard, Ryan Olson, CYBER SECURITY ESSENTIALS, CRC press.

Course Outcome	Students will be able to i. Perform security analysis of their systems, networks and mobile devices. ii. Secure their systems against anti-forensic techniques. iii. Will learn safe browsing, chatting and social networking techniques.

Big Data ANALYSIS
(Elective – II)
CS-T306(A)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(H)	Big Data Analysis	4	40	60

Objectives	i) Understand the Big Data Platform and its Use cases ii) Provide an overview of Apache Hadoop iii) Provide HDFS Concepts and Interfacing with HDFS iv) Understand Map Reduce Jobs v) Provide hands on Hadoop Eco System vi) Apply analytics on Structured, Unstructured Data. vii) Exposure to Data Analytics with R
Pre-Requisites	Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.
Teaching Scheme	Theory -4 Hours (Each week) Practical – 6 Hours (Each week) Total – 10 Hours (Each Week)

Detailed Syllabus

Unit	Topics	Hours
I	Introduction To Big Data Introduction to Big Data, Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications	12
II	Hadoop and HDFS (Hadoop Distributed File System) Introduction to Hadoop(T1): Introduction, Hadoop and its Ecosystem tools, History of Hadoop, Apache Hadoop,Analysing Data with Hadoop, Hadoop Streaming. Hadoop Distributed File System Basics (T2): The Design of HDFS, HDFS Concepts, Design features, Components, Command Line Interface, Hadoop file system interfaces, HDFS User Commands, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.	12

III	Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features. Hadoop Eco System Pig:Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive:Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.	12
IV	Hbase:HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction, Machine Learning Algorithms for Big Data Analytics Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR. Estimating the relationships, Outliers	12
V	Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining. Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics	12
	Total	60

Text Books:

T1. Raj Kamal and PreetiSaxena, “Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning”, McGraw Hill Education, ISBN: 9789353164966, 9353164966, 2018

T2. Douglas Eadline, “Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem”, 1stEdition, Pearson Education, ISBN-13: 978-9332570351, 2016.

Reference Books:

R1. Seema Acharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015.

R2. Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.

R3. Anil Maheshwari, “Data Analytics”, 1 st Edition, McGraw Hill Education, ISBN-13: 978-9352604180, 2017.

R4. Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.

R5. Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications,

CRC press, 2013.
R6. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media, 2013.
R7. AnandRajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.

Course Outcome	The students will be able to: i) Identify Big Data and its Business Implications. ii) List the components of Hadoop and Hadoop Eco-System iii) Access and Process Data on Distributed File System iv) Manage Job Execution in Hadoop Environment v) Develop Big Data Solutions using Hadoop Eco System vi) Analyze Infosphere BigInsights Big Data Recommendations. vii) Apply Machine Learning Techniques using R.

Cryptography and Network Security
Elective- I
CS-T306(G)

Subject Code	Subject Name	Credits	Mid-Semester Marks	Semester Exam Marks
CS-T302	Cryptography & Network Security	4	40	60

Objectives	To understand i. Cryptographic theories, algorithms and systems. ii. Necessary approaches and techniques to build protection mechanisms in order to secure data and computer networks.
Pre-Requisites	Number theory, Computer Networks and Operating Systems
Teaching Scheme	ICT enabled regular classroom lectures with an emphasis on interactive learning and programming.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction: Need of Security, Security Policies, Model of network security, Security threats, vulnerabilities, attacks, services and mechanisms, OSI security architecture. Cryptography: Concepts and Techniques. Classical encryption techniques: Symmetric Cipher Model, substitution techniques, transposition techniques, Steganography.	12
II	Communications using Symmetric Cryptography. SYMMETRIC KEY CIPHERS: Block cipher design principles, Block cipher modes of operation: ECB, CBC, CFB, OFB, CTR, The Data Encryption Standard (DES), Strength of DES, Differential and Linear Cryptanalysis. International data encryption algorithm (IDEA). Advanced Encryption Standard: Origins, Structure, Round Functions, Key Expansion, AES Implementation.	12
III	Issues related to key exchange and private key management. Diffie-Hellman Key exchange algorithm. Communications using Public-key Cryptography. Principles of public key Cryptosystem. The RSA Algorithm and its security aspects. Cryptographic Hash Functions: Applications, Hash function based on cipher block chaining, Secure Hash algorithm.	12
IV	Message Authentication codes: Message authentication requirements, functions, MACs based on Hash Functions. Digital signatures: Properties, requirements, attacks and forgeries, NIST Digital Signature Algorithm. IP Security: Applications, Benefits, IPSec Services, Transport and Tunnel	12

	modes. Authentication, Encapsulating Security Payload.	
V	Web Security: requirements, secure sockets layer and Transport layer security, Secure Electronic Transaction, Electronic Mail Security. System security: Intrusion Detection, Password Management, Malicious Software: Types of Malicious Software, Viruses, Worms. Denial of Service Attacks, Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls.	12
	Total	60

Text Books:

T1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Education.

T2. Bruice Schneier, Applied Cryptography Protocols, Algorithms and Source Code in C, Wiley India.

Reference Books:

R1. Atul Kahate, Cryptography and Network Security, 2nd Edition, TMH

R2. Eric Maiwald, Fundamentals of Network Security, Dreamtech press.

R3. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security - Private Communication in a Public World, Pearson/PHI.

R4. Robert Bragg, Mark Rhodes, Network Security: The complete reference, TMH

Course Outcome	Students will be able to i. implement various substitution and transposition cipher algorithms ii. implement Symmetric key algorithms iii. implement Public-key algorithms iv. protect and secure data in store as well as in transmission.

Object Oriented analysis and Design using UML
(Elective – II)
CS-T306(C)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(J)	Object Oriented analysis and Design using UML	4	40	60

Objectives	In this subject student will learn about the following points: i) To develop background knowledge as well as core expertise in object-oriented system. ii) To analyze and design problems using UML. iii) To deliver the importance of software design process. iv) To be able to explain and justify designs based on design principles and patterns.
Pre-Requisites	Object Oriented Programming Algorithm Analysis and Design Principles of Programming Languages.
Teaching Scheme	Teaching By providing lectures. By discussion case studies. By providing references for related white papers and articles. By motivating to participate in the competitions like presenting papers. Daily class room interaction. Assessment By regular and surprise class tests. By mid-term and semester exams. By quiz and colloquial.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Object Technology: Complexity, The Object Model, Classes and Objects, Classification. OOAD Methods - Object Oriented Design by Booch, Rumbaugh's Object Modeling Technique.	12
II	Coad/ Yourdon's Object-Oriented Analysis, Shlaer/ Mellor's Object-Oriented Structured Analysis (OOSA) / Object Oriented Design Language (OODLE), Object Oriented Software Engineering (OOSE) by Jacobson. Importance of Modeling, Principles of modeling.	12
III	UML & Class: Overview of UML, Building blocks of UML. Analysis and design, Object oriented analysis and design, Classes, Relationships, class diagrams. Advanced classes,	12

	Advance Relationships, Interfaces, types and roles, Packages, Instances, Object diagrams.	
IV	Interactions, Use cases, Use case diagrams, Interaction diagrams, activity diagrams, Process and threads, Time and space, State chart diagram.	12
V	Components, Component diagrams, Deployment and Deployment diagram, Collaboration and Collaboration diagram. Case studies using UML diagram.	12
	Total	60

Text Books:

T1. Grady Booch, "Object-Oriented Analysis & Design with Applications", 3rd Edition, Pearson.

T2. J.Rumbaugh and Michael R. Blaha, "Object Oriented Modelling and Design", PHI

T3. E Gamma, R Helm, R Johnson and J Vlissides, — Design Patterns- Elements of Reusable Object-Oriented Software‖, Pearson.

Reference Books:

R1. Satzinger, Jackson, Burd, Object-Oriented Analysis & Design with the Unified Process‖, Course Technology Inc.

R2. CraigLarman, Applying UML and Patterns – An Introduction to Object-Oriented Analysis and Design and Iterative Development‖, 3rd Edition, Pearson Education.

R3. Jim Arlow, Ila Neustadt, UML 2 and the Unified Process – Practical Object-Oriented Analysis and Design‖, Pearson Education.

R4. Timothy C. Lethbridge, Robert Laganiere, Object Oriented Software Engineering‖, Tata McGrawHill.

Course Outcome	After completion of this course: i) Understand the different facets of object-oriented methodologies. ii) Gain an understanding of how design patterns facilitate software design. iii) Understand Object Oriented Software Development Process. iv) Apply object-oriented methods for analysis and design of real-world problems. v) Apply the concepts of UML to design real world problems.

Digital image Processing
(Elective – II)
CS-T306(D)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(K)	Digital Image Processing	4	40	60

Objectives	The course aims to cover techniques and tools for digital image processing, image transformation in spatial and frequency domains.
Pre-Requisites	Basic knowledge of Computer Graphics and Programming
Teaching Scheme	Blended teaching and learning with traditional and use of technology to emphasize on detailed implementation.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction: Digital image representation, Fundamental steps in image processing, Components of Digital Image processing systems, Elements of visual perception, Image Formation model, Image Sampling and quantization, Relationship between pixels – neighbourhood, adjacency connectivity, regions, boundaries and distance measures.	12
II	Image Enhancement: Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering- Smoothing Spatial filters, Sharpening Spatial filters, Frequency domain- Fourier Transform, Low-Pass, HighPass, Laplacian, Homomorphic filtering.	12
III	Image Segmentation: Detection of discontinuities - point, line and edge detection, Edge linking and boundary detection, Thresholding, Regionbased segmentation - region growing, region splitting and merging,	12
IV	Color Image Processing: Color Models, Pseudo color Image Processing, Color Transformations, Smoothing and sharpening, Image Segmentation based on color.	12
V	Image Compression: Coding redundancy, Interpixel redundancy, fidelity criteria, Image compression models,	12

	Error-free compression, Variable length coding, Bit-plane coding, Lossless predictive coding, Lossy compression, Image compression standards, Real-Time image transmission, JPEG and MPEG.	
	Total	60

Text Books:

T1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", Addison-Wesley,

T2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall

Reference Books:

R1. Digital Image Processing – Mehena, Adhikary and Routray; Alok Publications, Bhubaneswar.

Course Outcome	The course also aims to cover techniques and tools for digital image processing, and to provide hands-on experience in applying these tools to process images.

Cloud Computing
(Elective – II)
CS-T306(E)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(L)	Cloud Computing	4	40	60

Objectives	i) To impart the fundamentals of virtualization techniques. ii) To introduce concepts and security issues of cloud paradigm. iii) To introduce cloud computing-based programming techniques and cloud services.
Pre-Requisites	Having basic knowledge of operating systems like Windows OS, Linux etc. As Visualization play a major role in AWS you need to have the understanding of it. Networking is an essential skill as all operations on cloud platform involves it. Understanding the difference between the Public and Private cloud.
Teaching Scheme	Theory: 4 Hours each week Practical: 6 Hours each week Total: 10 Hours each week

Detailed Syllabus

Unit	Topics	Hours
I	INTRODUCTION TO VIRTUALIZATION Overview of Centralized, Distributed Computing -Cluster computing, Grid computing. Technologies for Network based systems - Virtual Machines and Virtualization Middleware – Data Center Virtualization for Cloud Computing – Implementation Levels of Virtualization – Virtualization Structures/Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices.	12
II	INTRODUCTION TO CLOUD COMPUTING System Models for Distributed and Cloud Computing – Software Environments for Distributed Systems and Clouds – Cloud Computing and Service Models – Public – Private – Hybrid Clouds – Infrastructure-as-a-Service (IaaS) – Platform-as-aService (PaaS) - Software-as-a-Service (SaaS)-Different Service Providers	12
III	CLOUD ARCHITECTURE AND RESOURCE MANAGEMENT Architectural Design of Compute and Storage Clouds – Public Cloud Platforms: – Amazon Web Services(AWS) –	12

	AzureEmerging Cloud Software Environments– Open Stack – Extended Cloud Computing Services – Resource Provisioning and Platform Deployment – Virtual Machine Creation and Management. CLOUD PROGRAMMING Parallel Computing and Programming Paradigms – Map Reduce – Twister – Iterative Map Reduce – Current technologies – Emerging Cloud software Environment.	
IV	SECURITY IN THE CLOUD Security Overview – Cloud Security Challenges – Security -as-a Service – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.	12
V	USING CLOUD SERVICES : Email Communications – Collaborating on To-Do Lists –Contact Lists – Cloud Computing for the Community- Collaborating on Calendars – Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management	12
	Total	60

Text Books:

T1. Kai Hwang , Geoffrey C Fox, Jack J Dongarra : "Distributed and Cloud Computing – From Parallel Processing to the Internet of Things" , Morgan Kaufmann Publishers – 2012

T2. RajkumarBuyya, Christian Vecchiola, and ThamaraiSelvi"Mastering Cloud Computing" McGraw Hill Education

Reference Books:

R1. Alex Amies, Harm Sluiman, QiangGuo Tong and Guo Ning Liu: "Developing and Hosting Applications on the cloud", IBM Press, 2012.

R2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (Theory in Practice)", O'Reilly Publications, 2009.

R3. Haley Beard, "Cloud Computing Best Practices for Managing and Measuring Processes for On-demand Computing – applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008

R4. James E. Smith and Ravi Nair: Virtual: Machines: Versatile Platforms for Systems and Processes, Morgan Kaufmann, ELSEVIER Publication, 2006.

R5. John W Rittinghouse and James F Ransome , "Cloud Computing: Implementation – Management – and Security", CRC Press, 2010.

R6. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", Pearson Education, 2009.

R7. Richard N. Katz, "The Tower and The Cloud", Higher Education in the Age of Cloud Computing, 2008.
R8. Toby Velte, Anthony Velte and Robert Elsenpeter: "Cloud Computing – A Practical Approach", TMH, 2009.

Course Outcome	The Student will be able to: i) Identify the significance of implementing virtualization techniques. ii) Interpret the various cloud computing models and services iii) Compare the various public cloud platforms and software environments. iv) Apply appropriate cloud programming methods to solve big data problems. v) Appreciate the need of security mechanisms in cloud vi) Illustrate the use of various cloud services available online.

Internet of Things
(Elective – II)
CS-T306(F)

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T302(M)	Internet of Things	4	40	60

Objectives	• Analyse the IoT architecture and design along with functional/compute stack and data management. • Apply IOT architecture for a given problem • Analyse the application protocol, transport layer methods for the given business case. • Analyse the application of data analytics for IOT for a given • Analyse the architecture and develop programming using modern tools for the given use case
Pre-Requisites	Basic knowledge of programming, data structure, Computer network and devices .
Teaching Scheme	Blended learning with traditional and use of technology to emphasize on detailed implementation.

Detailed Syllabus

Unit	Topics	Hours
I	What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack	12
II	Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.	12
III	IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	12
IV	Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network	12

	Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment	
V	IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, RaspberryPi with Python	12
	Total	60

Text Books:

T1. .David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases

T2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs.

T3. Srinivasa K G, “Internet of Things”,CENGAGE Leaning India, 2017

Reference Books:

R1. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press

R2. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi.

R3. Adrian McEwen, “Designing the Internet of Things”, Wiley.

R4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill.

R5. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media.

Course Outcome	The Student will be able to: i) Understand IoT and its hardware and software components ii) Interface I/O devices, sensors & communication modules iii) Remotely monitor data and control devices iv) Develop real life IoT based projects

FINANCIAL ENGINEERING
(Elective – II)
CS-T306(G)

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T302(N)	Financial Engineering	4	40	60

Objectives	The objective of this course is to learn the applications of derivatives in addressing financial problems.
Pre-Requisites	The prerequisites are knowledge of Financial Systems, Financial Markets, Fixed Income Securities and Financial Derivatives. Besides, basics of foreign exchange rates and statistical tools like mean, variance, probability etc should be known to the student. Knowledge of Financial Modeling is also must.
Course Outcome	At the end of the course, the students will be able to: i) Explain and critically discuss the concepts behind financial engineering ii) Understand how derivatives are used by financial practitioners to address problems in finance and investment iii) Formulate and explain the approaches used in current methodologies used to price derivatives, and be able to price a variety of options using both analytical and numerical methods iv) Have an understanding of the theory and practice of engineering of new financial products v) Explain and be able to apply option pricing to deal with the special nature of different types of underlier
Teaching Scheme	Learning will primarily be through reading, thinking, class discussions, attending lectures and tutorials, and solving exercises, and attempting problems.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Stochastic Calculus: Martingales, Brownian motions, Diffusions and stochastic differential equations, It's lemma, Girsanov's theorem. The Fundamental Theorem of Asset Pricing: Arbitrage, numeraires and martingale measures, The martingale property of	12

	asset prices, The martingale property of forward and futures prices, The risk-neutral martingale measure, and the forward martingale measure.	
II	Martingale Pricing and Monte Carlo Simulation: The martingale approach to derivative pricing. Examples: Black-Scholes and Black formulas. Monte Carlo simulation. Euler discretization. Choleski decomposition. Estimating the greeks through Monte Carlo simulation.	10
III	Introduction to Equity Derivatives: Key features of empirical volatility surfaces for equity derivatives. Implications for price distributions. Time-series evidence from the VIX. Volatility derivatives. Variance swaps: pricing and synthetic replication. The construction of the VIX. Quantos. Hedging with stochastic volatility and jumps.	12
IV	Introduction to Fixed Income Derivatives: Basic instruments (swaps, caps and oors, swaptions). The market pricing formulas and quoting conventions. Empirical volatility surfaces for xed income derivatives. Pricing caps, oors and swaptions as bond options.	14
V	Modeling Volatility: Local volatility models: the constant elasticity of variance (CEV) model and the implied volatility function (IVF) model. Stochastic volatility models: the Heston model. Calibration and Monte Carlo implementation of stochastic volatility models.	12
	Total	60

Text Books:

T1. John C. Hull, Options, Futures, and Other Derivatives, 6th edition, Prentice Hall, 2005.

T2. Paul Glasserman, Monte Carlo Methods in Financial Engineering, 1st edition, Springer,2004.

T3. Riccardo Rebonato, Volatility and Correlation, 2nd edition, Wiley, 2004.

Reference Books:

R1. Damiano Brigo and Fabio Mercurio, Interest Rate Models - Theory and Practice, 2nd edition, Springer, 2006.

R2. Riccardo Rebonato,Modern Pricing of Interest-Rate Derivatives: The LIBOR Market Model and Beyond, 1st edition, Princeton University Press, 2002.

R3. Philipp J. Schonbucher, Credit Derivatives Pricing Models, 1st edition, Wley, 2003.

Web technology
CS-T303

Subject Code	Subject Name	Credit	Int. Marks	Ext. Marks
CS-T303	Web Technology	4	40	60

Objectives	The subject covers the wide range of web technologies both client side and server side to provide the exposure to the students to develop Rich Internet Applications.
Pre-Requisites	Basic knowledge of programming and internet applications.
Teaching Scheme	Power-point slides, Demonstration which include videos, animations, pictures, graphics for better understanding theory and practical work.

Detailed Syllabus

Unit	Topics	Hours
I	**The Internet and WWW**: Understanding the WWW and the Internet, Emergence of Web, Web Servers, Web Browsers, Protocols, Building Web Sites ,HTML, Planning for designing Web pages, Model and structure for a Website, Developing Websites, Basic HTML, HTML tags, color background, using images links, Lists, Tables and Forms.	12
II	**Cascaded Style Sheet**: External Style Sheets, Internal Style Sheets, Inline Style, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists.	12
III	**JAVA Script Programming**: JAVA Script, Programming Fundamentals, Statements, Expressions, Operators, Popup Boxes, Control Statements, Try…. Catch Statement, Throw Statement, and Objects of JavaScript: Date object, array object, Boolean object, math object.	12
IV	**PHP** : Hypertext Preprocessor- Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection,	12

	string, Form processing (Get and Post Method), Form Validation, Files, PHP server Variables, Dates and Times, Advance Features: Cookies and Sessions, Filters, Exception Handling.	
V	**Data base connectivity using PHP** : 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, Setting query parameter, Executing query, Executing multiple queries, Deleting database, Deleting data and tables.	12
	Total	60

Text Books:

T1. Don Gosselin, et al., Web Warrior Guide to Web Design Technologies, Cengage

T2. Developing Web Applications in PHP and AJAX, Harwani, McGraw Hill

Reference Books:

R1. HTML 5, Black Book, dreamtech Press

R2. Developing Web Applications, Ralph Moseley and M. T. Savaliya, Wiley-India

R3. Web Technologies, Black Book, dreamtech Press.

Course Outcome	Develop the modern Web applications using the client and server side technologies and the web design fundamentals.

AI & Machine Learning
CS-T304

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T304	AI and Machine Learning	4	40	60

Objectives	• Understand basics of Artificial Intelligence concepts and applications. • Understand modern notions in Logic and uncertain knowledge concepts. • Understand and use of supervised and Unsupervised machine learning techniques. • Understand the types of regression and applications of neural network concepts. • Understand and implement the practical concepts of Machine learning concepts
Pre-Requisites	Knowledge of basic probability, data structure, engineering optimization, and matrix theory.
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Introduction to Artificial Intelligence: Introduction, AI Techniques, Problem-Solving Process, Problem Types and Characteristics, Real-World Problems. Search Methods: General Search Algorithm, Types of Search Methods – BFS, DFS, Informed Search – Best First Search, Hill Climbing, A* Search, Iterative Deepening, Min Max Search, Alpha-Beta Pruning, Constraint Satisfaction Search.	14
II	Logic: Propositional Logic, Predicate Logic, Unification, Inference in FOL, Representing Knowledge Using Rules, Resolution.	8

	Uncertain Knowledge and Reasoning: Uncertainty and Methods, Bayesian Probability and Belief Network, Probabilistic Reasoning, Forward and Backward Reasoning, Perception	
III	Introduction: Machine Learning, Supervised Learning, Unsupervised Learning, Ensemble Learning, Reinforcement Learning, Transfer Learning Supervised Learning: Decision Tree Induction, Naïve Bayes Classification, Rule based Classification, K-Nearest Neighbor, Performance evaluation metrics of Classifiers Unsupervised Learning: Clustering, Partitioned Clustering (K-Means), Hierarchical Clustering, BIRCH, Density based Clustering (DBSCAN). Performance evaluation metrics of Clustering and Cluster Indices	12
IV	Regression: Linear Regression, Multivariate Regression, Logistic Regression, Polynomial Regression Artificial Neural Networks: Multi-Layer Feed Forward Networks, Delta Learning Rule for Multi-Perceptron Layer, Error Back-Propagation Training Networks, Introduction to Deep Neural Network, Convolutional Neural Network, Recurrent Neural Network	14
V	Practical Applications of ML using Python : Data pre-processing: Importing libraries, importing dataset, taking care of missing data, encoding categorical data, split data into train and test set, features scaling Lab: Data Manipulation using Numpy and Pandas, Data Visualization in different Graphs and basic python based on arrays, list, data management, functions. Implementation of Decision tree, Naïve-Bayes, MLP algorithms	12
	Total	60

Text Books:

T1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson Education India, 2015.

T2. T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction, 2nd Edition, Springer Verlag, 2009.

T3. K. P. Murphy, Machine Learning: A Probabilistic Perspective, 4th Edition, MIT Press, 2012

Reference Books:

R1. N. J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 2003.

R2. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

R3. T. Mitchel, Machine Learning, McGraw-Hill Science, 1997.

R4. G. James, D. Witten, T. Hastie, and R. Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2013.

R5. L. Wasserman, All of Statistics, 1st Edition, Springer, 2004

Course Outcome	At the end of the course, the students will be able to: • Student will be familiar with the basics of Artificial Intelligence concepts. • Students will be able to analyze and implement Machine Learning techniques in real life problem. • Student will be able to analyze and implement Supervised and Unsupervised machine learning techniques to solve various problem. • Students will be able to apply advanced machine learning concepts. • Students will be familiar with the Artificial Neural network computing and their application in data science in software industry.

Data Mining and Soft Computing
CS-T305

Sub. Code	Subject Name	Credit	Int. Mark	Ext. Mark
CS-T305	Data Mining and Soft Computing	4	40	60

Objectives	The basic objective of this course is to introduce students the ideas and techniques of soft computing for solving the tasks of different data mining to uncover hidden knowledge from vast amount of data.
Pre-Requisites	Knowledge of data analysis, optimization, and matrix theory.
Teaching Scheme	Regular classroom lectures with use of ICT tools as and when required, sessions are planned to be interactive with focus on problem solving activities.

Detailed Syllabus

Unit	Topics	Hours
I	Knowledge discovery in Databases, Data Mining Processes, Data mining Tasks-Association Rule Mining, Classification, Clustering, Regression, Change Detection. Data Mining Software-WEKA, KEEL, Classical Algorithms of Data Mining different tasks.	14
II	Fuzzy Set Theory: fuzzy sets, basic definition and terminology, Set-Theoretic operations, Membership Function Formulation and Parameterization, T-norm, T-conorm; Fuzzy Rules and Fuzzy Reasoning: Extension Principle and Fuzzy Relations, Fuzzy if-then rules, Fuzzy reasoning; Fuzzy Inference Systems: Mamdani Fuzzy models, Sugeno Fuzzy models, Tsukamoto Fuzzy models.	10
III	Neural Networks: Model of a neuron, LMS, Perceptron, MLP and Back propagation algorithm, Radial Basis Function Networks, Functional Link Artificial Neural Networks, Self- Organizing Maps.	12
IV	Nature Inspired Computing: Simulated Annealing, Genetic Algorithm, Differential Evolution, Ant & Bee Algorithm, Particle	12

	Swarm Optimization.	
V	Multi-Objective Optimization: Pareto Optimality, Weighted Sum Method, Metaheuristic Approaches, VEGA, NSGA-II.	12
	Total	60

Text Books:

T1. J. Han, M. Kamber, and J. Pei, Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann Series.

T2. J. S. R. Jang, C.-T, Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, 1st Edition, Pearson Education, 2015.

T3. S. Haykin, Neural Networks: A Comprehensive Foundation, 2nd Edition, Pearson Education.

T4. X. -S. Yang, Nature-Inspired Optimization Algorithms, 1st Edition, Elsevier Publication, 2014.

T5. K. Deb, Multi-objective Optimization Using Evolutionary Algorithms, John Wiley & Sons Ltd., 2002.

Reference Books:

R1. M. Panda, S. Dehuri, and M. R. Patra, Modern Approaches of Data Mining-thoeyr and Practice, Narosa, 2016.

R2. Simon Haykin, Neural Networks A Comprehensive Foundation, Pearson Education.

R3. H. J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Kluwer Academic Publishers.

R5. A. P. Engelbrecht, Computational Intelligence An Introduction, John Wiley & Sons Ltd.

Course Outcome	At the end of the course, the students will be able to: i) Explore different tasks of data mining. ii) Explore the different techniques of soft computing. iii) Differentiate between supervised and unsupervised learning.

Subject Code	Subject Name	Credit
CS-L307	Web Technology Laboratory	4

Detailed Syllabus

HTML & XML

- Write HTML code to use the tags like caption, title, body etc.
- Write an HTML code to illustrate the usage of a. Ordered List b. Unordered List
- Write an HTML code to illustrate Nested and Definition tag.
- Write an HTML code to illustrate Hyper Link tag (Anchor tag).
- Write an HTML code to create a link At the bottom to take user to the top of the page
- Write HTML code to Design a mark sheet and display all your marks with subjects in a tabular format.
- Write an HTML code to display your education details in a tabular format.
- Write an HTML code to show books in inventory in different tables by using rowspan and colspan.
- Write an HTML code to display your CV on a web page.
- Write HTML code for form and place some text boxes, command box, selection box etc on the form.
- Write a small program using XML.
- Write an XML program to display products
- Develop an attractive Web site for an event to be organized in your institute.

CSS

- Write an HTML code to demonstrate the usage of CSS.
- Write an HTML code to demonstrate the usage of inline CSS.
- Write an HTML code to demonstrate the usage of internal CSS.
- Write an HTML code to demonstrate the usage of external CSS.
- Write an HTML code to create a web page that displays college information using various Style sheets.

JavaScript

- Write a Java script to prompt for users name and display it on the screen.
- Write a Java Script for displaying message, time and date etc using document write method.
- Write a Java Script Script to extract month, year, day from current date.
- Write a Java Script Script to extract hour, minute and seconds from current time.
- Write a Java Script to calculate simple interest and compound interest using arithmetic operators.
- Write programs to work with radio buttons and checkbox.

- A web application that takes name and age from an HTML page. If the age is less than 18, it should send a page with “Hello , you are not authorized to visit this site” message, where should be replaced with the entered name. Otherwise it should send “Welcome to this site” message.
- A simple calculator application that takes two numbers and an operator (+,-,*,/,%) from an HTML page and returns the result page with the operation performed on the operands.
- After applying all (CSS, Java Script and HTML form submitting tags on the pages, design a 6 pages website.
  Login page
  Home page
  About Us page
  Contact us page
  News Page
  Site view
- Design an XML document to store information about a student in an degree college affiliated to FMU. The information must include Regd. No, Name, and Name of the College, Stream, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.

PHP

- Write a program using PHP and HTML to create a form and display the details entered by the user.
- Write PHP code to display date and time.
- Write a PHP program named states.php that declares a variable states with value "Mississippi Alabama Texas Massachusetts Kansas". Write a PHP program that does the following:
- Search for a word in variable states that ends in xas. Store this word in element 0 of a list named statesList.
- Search for a word in states that begins with k and ends in s. Perform a case in sensitive comparison. [Note: Passing re. Ias a second parameter to method compile performs a case-insensitive comparison.] Store this word in element1 of statesList.
- Search for a word in states that begins with M and ends in s. Store this word in element 2 of the list.
- Search for a word in states that ends in a. Store this word in element 3 of the list

PHP with MySQL

- Write an HTML program to design an entry form of student details and send it to store at database server
- Write a program to establish the connection with the database and populating values in the combo box.

- Write a program to display all the records in the table.
- Write a program to insert the record into the table.
- Write a program to display a registration form.
- Write a program to store the data in the table.
- Write PHP code to create a form through which data can be uploaded into automated system.
- Write PHP code to create a cookie.
- Write PHP code to create a table and insert records into it.
- Write a PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.
- A user validation web application, where the user submits the login name and password to the server. The name and password are checked against the data already available in Database and if the data matches, a successful login page is returned. Otherwise a failure message is shown to the user.
- A web application takes a name as input and on submit it shows a hellopage where is taken from the request. It shows the start time at the right top corner of the page and provides the logout button. On clicking this button, it should show a logout page with Thank You message with the duration of usage (Use session to store name and time).

DATA MINING AND SOFT COMPUTING Laboratory
CS-l308

Subject Code	Subject Name	Credit
CS-L308	Data Mining and Soft ComputingLaboratory	4

Detailed Syllabus

Learning of WEKA and KEEL Tool.

Development of Program for different classification techniques:

a) Minimum Distance Classifier.
b) K-nn.
c) Bayesian Classifier.
d) Decision Tree (IDB)

Development of Program for Association Rule mining Technique like

a) Apriori.
b) Genetic Based Apriori.

Development of Maximal for clustering Technique.

a) K-means
b) K-modes
c) K-medicos
d) Fuzzy K-Means

Fourth Semester				
Code	**Subject**	**Lectures**	**Practical**	**Credits**
CS-PL401	Technical Seminar	4	0	4
CS-PL402	Major Project (Report + Viva) *	0	0	12
Total Credits				16

* Major Project Report 80% of total mark of CS-PL402.

* Major Project Viva 20% of total mark of CS-PL402.