DEPARTMENT
OF
INFORMATION TECHNOLOGY, SMIT, MAJITAR

COURSE CURRICULUM FOR B.TECH (IT)
ACCORDING TO

NATIONAL EDUCATION POLICY-2020

APPLICABLE FOR

1ST YEAR FROM 2024-25 BATCH AND SUBSEQUENT BATCHES

ALSO, FOR 2023 BATCH (2ND YEAR ONWARDS)

Total Credits:

$$21+21+27 + 26 + 28 + 26 + 18 +13 = 180$$

1st Year

FIRST YEAR B. TECH CURRICULUM 2024 (Common to all branches)

Semester	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
	GROUP A (FIRST SEMESTER) **PHYSICS GROUP**						**GROUP B (FIRST SEMESTER** **CHEMISTRY GROUP**					
I		Engineering Mathematics–I	3	1	0	4		Engineering Mathematics–I	3	1	0	4
		Elements of Civil Engineering	2	1	0	3		Element of Mechanical Engineering	2	1	0	3
		Engineering Physics	3	1	0	4		Engineering Chemistry	3	1	0	4
		Basic Electronics	2	1	0	3		Element of Electrical engineering	2	1	0	3
		Communication Skills	2	0	0	2	**CS101A1**	Computer Programming in C	3	1	0	4
		Engineering Graphics	1	0	2	2		Environmental Science	2	0	0	1
		Constitution of India	2	0	0	1						
		Workshop Practice	0	0	2	1	**CS101A4**	Computer Programming Lab	0	0	2	1
		Engineering Physics Lab	0	0	2	1		Engineering Chemistry Lab	0	0	2	1
			15	4	6	21			15	5	4	21
	Total Contact Hours (L + T + P)		25				Total Contact Hours (L + T + P)		24			
	*Mandatory audit course						***Mandatory audit course**					
II	**GROUP A (SECOND SEMESTER)**						**GROUP B (SECOND SEMESTER)**					
		Engineering Mathematics–II	3	1	0	4		Engineering Mathematics–II	3	1	0	4
		Element of Mechanical Engineering	2	1	0	3		Elements of Civil Engineering	2	1	0	3
		Engineering Chemistry	3	1	0	4		Engineering Physics	3	1	0	4
		Element of Electricalengineering	2	1	0	3		Basic Electronics	2	1	0	3
	CS101A1	Computer Programming in C	3	1	0	4		Communication Skills	2	0	0	2
		Environmental Science	2	0	0	1		Engineering Graphics	1	0	2	2
								Constitution of India	2	0	0	1
	CS101A4	Computer Programming Lab	0	0	2	1		Workshop Practice	0	0	2	1
		Engineering Chemistry Lab	0	0	2	1		Engineering Physics Lab	0	0	2	1
			15	5	4	21			15	4	6	21
	Total Contact Hours (L + T + P)		24				Total Contact Hours (L + T + P)		25			

Note: UHV–I has been introduced under Mandatory Induction Program.

B.TECH. COURSE STRUCTURE – SEMESTER WISE

Year	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	Credits
		THIRD SEMESTER					
2nd	MA205A1	Discrete Mathematics	3	1	0	4	4
	IT211A1	Digital Design and Computer Organization	3	1	0	4	4
	IT212A1	Data Structures	3	1	0	4	4
	IT213A1	Object Oriented Programming using C++	3	1	0	4	4
	IT2**A3	Program Elective-I	3	1	0	4	4
	IT2**A2/ IT2**A8	Open Elective-I/Minor/NCC	3	1	0	4	4
	IT214A4	Data Structures Laboratory	0	0	2	2	1
	IT215A4	Object Oriented Programming using C++ Laboratory	0	0	2	2	1
	IT216A5	Project Based Learning- I	0	0	2	2	1
TOTAL			18	6	6	30	27

Year	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	Credits
		FOURTH SEMESTER					
2nd	MA206A1	Probability, Statistics, and Stochastic Processes	3	1	0	4	4
	IT221A1	JAVA Programming	3	1	0	4	4
	IT222A1	Database Management Systems	3	1	0	4	4
	IT2**A3	Program Elective-II	3	1	0	4	4
	IT2**A2/ IT2**A8	Open Elective-II/Minor/NCC	3	1	0	4	4
	GN201A1	Universal Human Values- II Understanding harmony and Ethical Human Conduct	3	0	0	3	3
	IT223A4	JAVA Programming Laboratory	0	0	2	2	1
	IT224A4	Database Management Systems Laboratory	0	0	2	2	1
	IT225A5	Project Based Learning- II	0	0	2	2	1
TOTAL			18	5	6	29	26

		FIFTH SEMESTER					
Year	**Course Code**	**Course Title**	**Total Number of Contact Hours**				**Credits**
			Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Total Hours**	
3rd	IT311A1	Artificial Intelligence	3	1	0	4	4
	IT312A1	Formal Languages and Automata Theory	3	1	0	4	4
	IT313A1	Computer Networks	3	1	0	4	4
	IT314A1	Software Engineering	3	1	0	4	4
	IT3**A3	**Program Elective-III**	3	0	0	3	3
	IT3**A2/ IT3**A8	Open Elective-III/Minor/NCC	3	1	0	4	4
	IT315A4	Artificial Intelligence Laboratory	0	0	2	2	1
	IT316A4	Computer Network Laboratory	0	0	2	2	1
	GN301A1	Quantitative Aptitude and Logical Reasoning -I	1	0	0	1	1
	IT317A5	Project Based Learning- III	0	0	2	2	1
	IT318A9	Industrial Training-I	0	0	2	2	1
TOTAL			18	6	8	32	28

		SIXTH SEMESTER					
Year	**Course Code**	**Course Title**	**Total Number of Contact Hours**				**Credits**
			Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Total Hours**	
3rd	BA346A1	Industrial Management	2	0	0	2	2
	IT321A1	Operating System	3	1	0	4	4
	IT322A1	Web Technology and Web Services	3	1	0	4	4
	IT3**A3	**Program Elective-IV**	3	1	0	4	4
	IT3**A3	**Program Elective-V**	3	1	0	4	4
	IT3**A2/ IT3**A8	Open Elective-IV /Minor	3	1	0	4	4
	IT323A4	Operating System Laboratory	0	0	2	2	1
	IT324A4	Web Technology and Web Services Laboratory	0	0	2	2	1
	GN302A1	Quantitative Aptitude and Logical Reasoning -II	1	0	0	1	1
	IT325A5	Mini Project	0	0	2	1	1
TOTAL			16	5	08	31	26

SEVENTH SEMESTER								
Year	Course Code	Course Title	Total Number of Contact Hours					Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours		
4th	IT4**A2/ IT4**A8	Open Elective-V/Minor	3	1	0	4		4
	IT4**A2	Choice-Based Elective	3	0	0	3		3
	IT411A6	Major Project -Phase-I	0	0	20	20		10
	IT412A9	Industrial Training-II	0	0	2	2		1
TOTAL			6	1	22	29		18

EIGHTH SEMESTER								
Year	Course Code	Course Title	Total Number of Contact Hours					Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours		
4th	IT4**A2/ IT4**A8	Open Elective-VI /Minor	3	1	0	4		4
	IT421A6	Major Project -Phase-II	0	0	18	18		9
TOTAL			3	1	18	22		13

LIST OF ELECTIVES FOR 3rd SEMESTER			
IPROGRAM ELECTIVE-I			
Year	COURSE CODE	COURSE TITLE	CREDIT
2nd	IT211A3	Python Programming	4
	IT212A3	System Simulation and Modelling	4
	IT213A3	Information Systems and Security	4
	IT214A3	Microprocessors & Peripheral Devices	4
	IT215A3	E-Commerce	4
	IT216A3	Soft Skills and Interpersonal Communication	4

LIST OF ELECTIVES FOR 4TH SEMESTER			
PROGRAM ELECTIVE-II			
Year	COURSE CODE	COURSE TITLE	CREDIT
2nd	IT221A3	Design and Analysis of Algorithms	4
	IT222A3	Microcontrollers	4
	IT223A3	Computer Graphics	4

LIST OF ELECTIVES FOR 5TH SEMESTER			
PROGRAM ELECTIVE-III			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	IT311A3	User Interaction(UI)- User Experience(UX)	3
	IT312A3	Digital Image Processing	3
	IT313A3	Information Retrieval	3
	IT314A3	Design Thinking	3
	IT315A3	Data Warehousing & Data Mining	3
	IT316A3	Big Data Analytics	3
	IT317A3	Optimization Techniques	3
	IT318A3	Internet of Things (IOT)	3

LIST OF ELECTIVES FOR 6TH SEMESTER			
PROGRAM ELECTIVE-IV			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	IT321A3	Machine Learning	4
	IT322A3	Natural language Processing	4
	IT323A3	Latest Trends in Information Technology	4
	IT324A3	System Programming	4
	IT325A3	Bio Inspired Computing	4
	IT326A3	Autonomous Mobile Robotics and Computational Intelligence	4
	IT327A3	Real Time Systems	4
	IT328A3	Cloud Computing	4
	IT337A3	Ad-hoc Wireless Networks	4
	IT338A3	High Performance Computing	4
PROGRAM ELECTIVE-V			
	IT329A3	Deep Learning	4
	IT330A3	Pattern Recognition	4
	IT331A3	Web Content Management and Web 3.0	4
	IT332A3	Soft Computing	4
	IT333A3	Cyber Physical Systems	4
	IT334A3	Social Network Analysis	4
	IT335A3	Remote Sensing And Geographic Information System	4
	IT336A3	Wireless Sensor Networks	4
	IT339A3	Augmented Reality	4

LIST OF ELECTIVES FOR 7TH SEMESTER			
CHOICE BASED ELECTIVE			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
4th	IT481A2	Science, Technology and Society	3
	IT482A2	Essence of Indian Traditional Knowledge	3

OPEN ELECTIVE/ MINOR - **Cyber Security**			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	IT210A2/ IT210A8	Introduction to Cryptography	4
4th	IT220A2/ IT220A8	Introduction to Cyber Security	4
5th	IT310A2/ IT310A8	Cyber Security Solutions	4
6th	IT320A2/ IT320A8	Cyber Digital Forensics	4
7th	IT410A2/ IT410A8	Block Chain Technology	4
8th	IT420A2/ IT420A8	Ethical Hacking and Data Privacy	4

OPEN ELECTIVE/MINOR - **Multimedia Computing and Communications**			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	IT219A2/ IT219A8	Multimedia fundamentals	4
4th	IT229A2/ IT229A8	Mobile Computing and Communication	4
5th	IT319A2/ IT319A8	Digital Signal Processing	4
6th	IT329A2/ IT329A8	Multimedia Animation and Modeling	4
7th	IT419A2/ IT419A8	Speech Processing	4
8th	IT429A2/ IT429A8	Information Theory and Error Correcting Codes	4

Sub Code: CS101A1   **Credit:4 (L-3, T-1, P-0)**

Sub Name: Computer Programming Using C

Questions to be set: 05 (All Compulsory)

Course Objectives: The main aim of the course is to teach basic computer programming concepts and apply them to computer based problem solving methods, to teach the students problem solving using C and to introduce them to different data structures like stacks, lists, etc.

Pre-requisites: There are no specific prerequisite for this course.

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Describe the working of hardware and software components necessary for functioning of a computer.
2. Describe the fundamentals of programming syntax and its definition by example of C language.
3. Explain the concepts of branching, loop construct, functions, pointers and structures of C language.
4. Write moderately difficult program for a specific goal.
5. Infer the syntax errors prompted by the C compiler and visualize the output of given code.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs.	CO	PO	PSO
Module 1: <Module Name>	in class	Introduction, Basic anatomy of the computer, ALU, Memory Devices and Memory Types, I/O Devices, Number Systems & Logic Gates. Levels of Programming Language, Application Programs, System Programs, Operating Systems, Translator, Linker, Loader, Structured and Object-Oriented Programming, Algorithms and Flowcharts. History of C, Basic structure of a C program, Sample programs, Programming style, Executing a C program. Character set, C tokens, Keywords and identifiers, Constants, variables, Data types, Declaration of variables, Defining symbolic constants, Declaring a variable as constant, Declaring a variable as volatile, Overflow and underflow of data.	9	1,2	1	
	**Assignment Topics	Declaration of storage class, Assigning of storage class				
Module 2: <Module Name>	in class	Different categories of operators in C language, Arithmetic expressions, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expression, Operator precedence and associativity, Mathematical functions. Reading a character, Writing a character, Formatted input, Formatted output.	9	2,3	1,2	2

		Decision making with IF statement, Simple IF statement, IF---ELSE statement, Nesting of IF---ELSE statement, ELSE IF ladder, Switch statement, The ? : operator, The GOTO statement. WHILE statement, DO statement, FOR statement, Jumps in loops, Concise test expressions.				
	Assignment Topics					
Module 3: <Module Name>	in class	One-dimensional arrays: Declaration, initialization of 1D array, Two dimensional arrays: Declaration, initialization of 2D array, Declaring and initializing string variables, Reading strings from terminal, Writing strings to screen, Arithmetic operations on strings, Putting strings together, Comparison of two strings, String handling functions	8	2,3	1,2	2
	Assignment Topics	Multidimensional arrays and Dynamic arrays				
Module 4: <Module Name>	in class	Introduction to Pointers, Accessing a variable through its pointer, Chain of pointers, Pointer expressions, Pointers and arrays, Pointers and character strings, Array of pointers. Elements of user defined functions, Definitions of functions, Return values and their types, Function calls, Function declaration, Category of functions, No arguments and no return values, Arguments but no return values, Arguments with return values, No Arguments but returns a value, Function that return multiple values, Nesting of functions, Recursion, Passing arrays to functions, Passing string to functions, Scope, Visibility and lifetime of variables, Pointers and function arguments, Functions returning pointers, Pointers to functions Preprocessor Directive – macro substitution.	8	3,4	1,2,3	2
	Assignment Topics	Dynamic Memory allocation- malloc, calloc, free, realloc, linked list and its applications.				
Module 5: <Module Name>	in class	Defining a structure, Declaration of structure variables, Accessing structure members, Structure initialization, Copying and comparing structure variables, Operations on individual members, Arrays of structures. Defining and opening a file, Closing a file, Input/output operations on a file, Error handling during I/O operations, Random access to files, Command line arguments.	6	4,5	1,2,3	2

	Assignment Topics	Arrays within structures, Structures within structures, Structures and functions, Union, Size of structures, Bit fields, Pointers and structures, Troubles with pointers.				

Text Books:
1. Programming in ANSI C by E. Balaguruswamy

Reference Books:
1. Mastering in C by K. Venugopal.
2. Fundamentals of C by Gottfried.
3. The C Programming by Kerningham and Ritchie.
4. Let Us C by Y. Kanetkar.

COMPUTER PROGRAMMING LAB

Course Objectives: In Computational practice lab, each student is required to develop programs

based upon each UNIT of Theory paper-Computer Programming using C

- To teach basic computer programming concepts and apply them to computer based problem solving methods.
- To teach the student problem solving using C.
- To introduce the students to the field of programming using C language.
- To introduce the student to data structures such as arrays, lists, stacks etc.

Prerequisites: There are no specific prerequisites for this lab.

Course Outcomes: After the completion of the complete syllabus, the student will be capable of the followings:

1. Examine basic Linux commands
2. Devise a solution for a given problem using an algorithm/flowchart
3. Write C programs to solve a given problem using decision statements, loop constructs, functions, pointers, structure and files
4. Infer the syntax errors prompted by the C compiler and visualize the output of given code.
5. Practice good programming skills like indentation, in-line comments, and documentation.

LIST OF EXPERIMENTS

A.   Introduction to Basic Linux Commands

B.   Write a C Program to:
1.   Print a message
2.   Compute Arithmetic Operations(+, -,*,/,%)
3.   Compute Simple and Compound Interest
4.   Swap two variables with / without using third variable
5.   Find the greatest among three numbers using
      i)   If statement
      ii)   Ternary operator
6.   Find the roots of a quadratic equation
7.   Design a basic calculator using
      i)   If-Else
      ii)   Switch case
8.   Print the following pattern
```
    *
   **
   ***
   ****
   *****
```
9.   Find the sum of the following series:
      i)   1+2+3+…….+N
      ii) $1^2+2^2+3^2$ $+N^2$
10.   Find the sum of digits in a number/
11.   Find the reverse of a number
12.   Check whether a number is palindrome or not
13.   Find the sum of numbers in an array
14.   Find the smallest and largest number in an array
15.   Reverse an array
16.   Perform linear search of an element in an array
17.   Perform binary search of an element in an array

18. Sort an array using bubble sort algorithm
19. Perform addition, subtraction and multiplication of two 2D arrays

20. Perform basic operations on a string with / without using built-in functions
21. Check whether a string is palindrome or not
22. Add two numbers using a user-defined function
23. Display the Fibonacci upto n-term using user-defined function
24. Find factorial of a number using recursion
25. Find sum of array elements using user-defined function
26. Swap two numbers using call by reference
27. Sort an array using pointers taking the help of any suitable sorting algorithm
28. Create a structure to hold student data and display it
29. Implement linked list using self-referential structures.
30. Perform basic operations in a file

C. Introduction to the concept of Tower of Hanoi

Text Books:
 1. Programming in ANSI C by E. Balaguruswamy

Reference Books:
 1. Mastering in C by K. Venugopal.
 2. Fundamentals of C by Gottfried.
 3. The C Programming by Kerningham and Ritchie.
 4. Let Us C by Y. Kanetkar.

Sub Code: MA205A1   **Credit: 4 (L-3, T-1, P-0)**

DISCRETE MATHEMATICS

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to familiarize on numerous counting techniques and abstract structures which appear frequently in many areas such as Algorithm analysis, data structures, database management system. Discrete mathematics plays a crucial role in enabling students of computer science to tackle these problems. Graph theory has tremendous application in Computer Networks, Switching. Group theory has enormous applications coding theory

Pre-requisites: Set theory, Permutations and Combinations, Relations, Functions, Differential&Integral calculus.

Course Outcomes (CO'S): On successful completion of this course, students will be able to:

1. Solve problems using Counting Principles, Relations, Functions and Understand lattices as algebraic structures.
2. Apply concepts of Group theory to model the real-world problems.
3. Analyze the use of graphs in engineering applications.
4. Solve problems using Permutation and Combination, Ordering, Recursion and generating functions.
5. Evaluate problems related to mathematical logic. Extend the concepts of Predicate Calculus in computer science.

**not more than 20% of total topics to be allotted for assignment.

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: \<Lattices\>	in class	Set theory: Principle of inclusion and exclusion, Relations, and functions, Techniques of Proofs, Pigeonhole	10	1		
		Principle; Partial ordering, lattice and algebraic systems,				
		principle of duality, basic properties of algebraic systems				
		defined by lattices, distributive and complemented				
Module 3: \<Graph Theory\>	in class	Graphs, Digraphs, Walk, Path, Cycles, Connectedness, Tree, Computer representation of relation, relation digraph, and graphs, transitive closer and Warshall's Algorithm.	8	3		
	**Assignment Topics	Transitive closer and Warshall's Algorithm.		3		
Module 4: \<Ordering\>	in class	Elementary configurations: - Permutations and Combinations, Generating functions, Partitions and Compositions, Lexicographical and Fike's orderings of permutations. Algorithms for Lexicographical, Reverse Lexicographical and Fike's ordering of permutation.	7	4		

	**Assignment Topics	Reverse Lexicographical and Fike's ordering of permutation.		4		
Module 5: <Predicate Calculus> Module 3: <Graph Theory>	in class	Predicate calculus: Connectives, Well-formed formula (WFF), Quantification, examples and properties of WFF into Causal form. Resolution and refutation, answer extraction and simple examples.	10	5		
	**Assignment Topics	Resolution and refutation, answer extraction and simple examples.		5		
	in class	Graphs, Digraphs, Walk, Path, Cycles, Connectedness, Tree, Computer representation of relation, relation digraph, and graphs, transitive closer and Warshall's Algorithm.	8	3		

Text Books:

1. Jean-Paul Tremblay and Manohar, R: Discrete Mathematical Structures with application to Computer Science, McGraw Hill.

2. C.L. Liu: Elements of discrete mathematics, McGraw Hill.

3. Narasingh Deo: Graph theory with applications to Computer Science, PHI.

   Reference Books:

1. B. Kolman, R.C. Busby & S. Ross.: Discrete Mathematical Structures, Pearson.

2. Principles of Artificial Intelligence; N. J. Nielson.

3. E. S. Page & L.B. Wilson: An introduction to Computational Combinatorics,

   Cambridge University.

Sub Code: IT211A1   **Credit: 4 (L-3, T-1, P-0)**

DIGITAL DESIGN AND COMPUTER ORGANIZATION

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide basic knowledge in digital electronics and internal architecture of a computer.
Pre-requisites: Knowledge of Number system and logic gates

Course Outcomes (CO): **On successful completion of the course, students should be ble to:**
1. Identify various combinational logic circuits and their applications.
2. Identify various sequential logic circuits and their applications.
3. Design basic digital circuits using HDL.
4. Analyze the competence of a computer system architecture.
5. Design alternative computer systems for improved performance.

**not more than 20% of total topics to be allotted for assignment.

Module	Topics	Hrs	CO	PO	PSO
Module 1: Basic Logic Gates and Combinational Circuits	Boolean Algebra: De-Morgan's Theorem, Simplification of Logic Circuits, Combinational Circuits: Introduction to K-map, Half and Full Adder Circuit, Parallel Adder, Multiplexer, De multiplexer, Decoder, Encoders, Comparators, 7-Segment Decoder, and current trends in digital electronics (Reversible logic)	9	1		
Module 2: Sequential Circuits	Latches and Flip-Flops, State Diagram and State Tables, Analysis of Asynchronous Sequential Circuits, Analysis of Synchronous Sequential Circuits, Design of Sequential Logic Circuit, Asynchronous and Synchronous Counter and Shift Register.	8	2		
Module 3: Hardware Descriptive Language (HDL)	Motivation and Introduction to HDL (VHDL/Verilog), Modules, Language origins, simulation and synthesis, Behavioral modeling, Structural modeling	8	3		
Module 4: Computer Architecture, Memory and I/O	Computer Architecture: von Neuman Architecture, Fetch Decode Execution Cycle, Machine instructions and addressing modes, ALU, data-path and control unit Memory System: Caches, Virtual memory, I/O Introduction, DMA, Interrupts PC I/O systems	10	4		
Module 5: Microarchitecture and Pipelining	Microarchitecture: Flynn's Classification**,** Introduction, Single and multicycle processor, pipelined processor, Performance Analysis,	8	5		

Text Books:

1. David Money Harris & Sarah L. Harris (2012). *Digital Design and Computer Architecture*, Morgan Kaufmann; 2nd edition
2. Douglas L. Perry (2017). *VHDL: Programming by Example*, McGraw Hill Education; 4th edition
3. Douglas Comer. (2019), *Essentials of Computer Architecture*, (2nd ed.), CRC Press
4. M. Morris Mano, (2017), *Computer System Architecture*, (3rd ed), Pearson.
5. William J. Fletcher, (1997), *An Engineering approach to Digital Design*, (1st ed), PHI.

Reference Books:

1. Joseph D. Dumas II,(2016), "Computer Architecture: Fundamentals and Principles of Computer Design", (2nd ed), CRC Publication.
2. C. H. Roth, (1998), "Digital System Design using VHDL", (4th ed), PWS publication.

DATA STRUCTURES

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on the organization of information, the implementation of linear data structures such as linked lists, stacks, queues, and non-linear data structures such as trees, and graphs. This course also explores recursion principles, the close relationship between data structures and algorithms and the analysis of algorithm complexity.

Pre-requisites: Programming concepts and 'C' language.

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Describe the working of data structures like array, stack, queue, linked list, tree and graph

2. Explain common applications for array, stack, queue, linked list, tree and graph

3. Solve a given problem using appropriate data structures and algorithm

4. Discuss about the working of the principal algorithms for sorting, searching, and hashing

5. Correlate the performance of a program with respect to the choice of data structure & algorithm

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction>	in class	Definition, Algorithmic analysis: 'Oh' notation, Contiguous data structures: Representation of multidimensional arrays, highly structured sparse matrices using dimensioned arrays,	8	1		
	**Assignment Topics	String representation and manipulation.				
Module 2: <Stacks & Queues>	in class	Definition, Operations on stacks, Implementation using array. Application of Stacks: Evaluation of arithmetic expressions. Recursion: Use of recursive techniques in enumeration problems and back tracking algorithms, Recursion removal using stacks. Definition, Operations on queue, Implementation of queues, Circular queues. Applications	8	1, 2		
	**Assignment Topics					
Module 3: <Non-contiguous Data Structures>	in class	Linear linked list: Insertion, Traversal and deletion operations on singly linked list.Varioustypes of linked list: Doubly linked list, Circular lists, Use of header node in circular lists, Generalized (recursive) list, Application of linear list.	7	2,3		
	**Assignment Topics	Representation and manipulation of sets, Strings and graphs.				
Module 4:	in class	Definition of a tree and various terminologies used in tree, Binary tree, Recursive and non-recursive	10	2,3		

<Trees & Graphs>		tree traversal algorithms, Representation of n-ary trees using binary trees, Application of trees, Expression trees. Search trees: Definition, Insertion, Deletion and reversal, Height balanced search trees (using AVL trees illustrative example) and weight balanced search trees. Terminology and representations: Introduction, Definition and terminology, Graph representations, Traversals, connected components and spanning trees, Shortest path problem, Dijkstra's algorithm.				
	**Assignment Topics					
Module 5: <Sorting and searching >	in class	Sorting: Insertion, 2-way merge, Heap sort and quick sort, Comparison of different sorts. Hashing technique: Hash tables, Different hashing functions, Overflow handling, Methods for collision handling, Theoretical evaluation.	7	4,5		
	**Assignment Topics	Radix sort. Searching: Linear, Binary search, Comparison of different methods. H				

Text Books:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia.
2. Samanta, D., "Classic Data Structures", PHI.

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson
2. E.M. Reingold and W.J. Hansen, "Data Structures", CBS.
3. A. S. Tanenbaum, Y. Langsam, M.J. Augenstein, "Data Structures using C", Pearson.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson

Sub Code: IT213A1   **Credit: 4 (L-3, T-1, P-0)**

OBJECT ORIENTED PROGRAMMING USING C++

Questions to be set: 05 (All Compulsory)

Course Objectives: This course introduces C++ as an Object-Oriented Programming Language, building on existing knowledge of C and Java. The unit covers the C++language with a focus on its object-oriented features, and how these can be implemented as part of program designs and implementation. The students will also study and gain practical experience with the implementation issues related to object-oriented techniques, be able to build good quality software using object-oriented techniques and understand the role of patterns in object-oriented design.

Pre-requisites: Computer Programming concepts

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Identify importance of object-oriented programming and difference between structured oriented and object-oriented programming features.
2. Able to make use of objects and classes for developing programs.
3. Able to use various object-oriented concepts like operator overloading to solve different problems.
4. Apply virtual and pure virtual function & complex programming situations
5. Illustrate the process of data file manipulations using C++.

** Not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Basic concepts of OOP >	In Class	The Data types: Literal constant, Variables, Pointer types, String types, Constant qualifier, Reference types, The Boolean type, Enumeration types, Array types, Typedef names, Volatile qualifier, Class types, Expressions: Definition, Operators: Arithmetic, Increment and decrement, Conditional, Size of operator, New and delete, Comma	8	1		
	**Assignment Topics	The bitwise operator, Precedence, Type conversions, Statements: Selection, Iteration, Jump.				
Module 2: < Procedural-based programming & Object–based programming >	In Class	Inline functions, Linkage directives: Extern "C", Scope: Global objects and functions, Local objects, Dynamically allocated objects. Classes: Definition , Class object, Class member functions, Constructors and destructors, Friend function and classes, Static class members, Structures and unions, Bit field: A space saving member, Classscope, Nested classes, Structured programming and Object oriented programming paradigm.	10	2		
	**Assignment Topics	Functions: Overview, Function prototype, Argument passing, Returning a value, Recursion				
Module 3:	In	Overloaded declarations, the three steps of				

< Overloaded functions/ operators (polymorphism)&	Class	overload resolution, Argument type conversions, Overloading operators: Operators like =, (), ->, <>, + and -- (Using both friend as well as member functions, Importance of this pointer).	8	3		

Generic programming using template function & template classes>		Definition of generic programming, Function template, Template arguments and overloading function template				
	**Assignment Topics	Overloading function template				
Module 4: <Inheritance and io-stream library >	in class	Inheritance: Base class member access, Inheritance types, Protected mechanism, Virtual base classes. Virtual functions (Run-time polymorphism concept): Virtual functions, Pure virtual functions, Early vs. late binding. The io-stream library: Streams, Stream classes, Managing unformatted and formatted I/O operations, Manipulators.	10	4		
	**Assignment Topics	The io-stream library: Streams, Stream classes, Managing unformatted and formatted I/O operations, Manipulators.				
Module 5: <Files/ exception handling >	in class	Classes for file stream operations, Accessing files, Sequential I/O operations, Random access	4	5		
	**Assignment Topics	Command- line arguments, Exception handling (throw, try, and catch)				

Textbooks:

1. Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill.

2. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill.

Reference Books:

1. Bjarne Stroustrup, "C++ Programming Language", Pearson.

2. Stanley B Lippman and Lajoie, "C++ Primer", Pearson.

3. Saurav Sahay, "OOP with C++", Oxford University Press.

4. B.L. Juneja and Anita Sethi, "Programming with C++", New Age International Publication

Sub Code: IT214A4   **Credit: 1 (L-0, T-0, P-2)**

DATA STRUCTURES LABORATORY

Course Objectives: The objective of this course is to get insight into the practical applications of various algorithms.

Pre-requisites: Theory paper CS 1302 Data Structures and associated prerequisites

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Write program related to application of data structures using programming constructs of a language like C programming language
2. Identify the suitable input and output for a specified problem statement
3. Conclude the working of various algorithms in terms of time and space complexity
4. Examine the errors encountered in the program using appropriate tools and fix them
5. Write well-indented and well-documented code

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	in class	Tips on C programming, Searching an array- Linear, Binary Search	7.2	1		
	**Assignment Topics	Insertion and Deletion on specific array positions				
Module 2: Matrix, Stack and Queue	in class	Matrix: Sparse and Compact Matrix Stack and Queue data structure	7.2	2		
	**Assignment Topics	Implementation of stack as a queue and vice versa				
Module 3: Linked List	in class	Linked List: Singly, Doubly, Singly-Circular	7.2	3		
	**Assignment Topics	Doubly-Circular				
Module 4: Tree	in class	Tree Data Structure Tree Traversal Algorithms: InOrder, PreOrder, PostOrder	7.2	4		
	**Assignment Topics	Given InOrder and PreOrder, find out PostOrder traversal				
Module 5: Graph	in class	Graph algorithms: Breadth First Search	7.2	5		
	**Assignment Topics	Depth First Search				

Text Books:
1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia.
2. Samanta, D., "Classic Data Structures", PHI.

Reference Books:
1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson
2. E.M. Reingold and W.J. Hansen, "Data Structures", CBS.
3. A. S. Tanenbaum, Y. Langsam, M.J. Augenstein, "Data Structures using C", Pearson.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson.

OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY

Course Objectives: The student should be able to explain the fundamental properties of the C++ Language and to combine the elements of C++ language in developing structured programs.

Pre-requisites: C Programming and corresponding theory paper CS 1308 Object Oriented Concepts &Programming using C++.

Course Outcomes(CO): On successful completion of this course, students should be able to:

1. To demonstrate the skills necessary to correctly compile, debug and test programs in C++
2. Apply class and object to program design and implementation
3. Understand the concept of constructor and destructor and apply the same in developing programs.
4. Apply C++ features like operator overloading to program design
5. Use of inheritance and polymorphism in developing structured program

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO

Module 1: **Structure concepts Implementing classes and objects**	in class	1.1 Write a program to create a structure named "cricket" with following details:-
		a. Player nameb. Team name c.Batting average Using structure cricket declare an array with 50 elements & read information about all the players and display team- wise list containing names of players with their batting average score.
		
		1.2. Define a structure named "census" with following three members:
		  i. A character array "city" to store the names.
		  ii. A long integer to store population of the city.
		  iii. A float number to store literacy level. Implement the following:
		  i. Read the details for five cities randomly using an array variable.
		  ii. Sort the city list alphabetically and display all the details.
		1.3. Define a structure named "Date" with three integer members "day", "month" and "year". Develop an interactive modular program to perform the following tasks:
		i. To read the data into structure members using a function.
		ii. Create a function named validate() to validate the date Display the date in the format "April 29 2022" using a function.
		
		2.1 Create a class named circle with data member Radius, pi (constant member) and area. Create following member functions:
		  i. to accept the radius from the user
		  ii. to calculate the area of the circle
				1, 2		

		iii. to display the details
		
		2.2 Given that an EMPLOYEE class contains following data members: Employee_Number, Employee_Name, Basic, DA, IT, Net_Sal. Member Functions: to read the data, to calculate Net_Sal and to print data members. Write a C++ program to read the data of an employee and compute Net_Sal of the employee (DA= 52% of Basic and Income Tax(IT)=30% of the gross salary).While writing consider following:
		    i. Initialize members using method.
		    ii. Create more than two objects.				

	**Assignment Topics	2.3 Write an OOP in C++ to prepare a student Record using class and object with the following data members and member functions: Data Members: Name, Regn Number, and Marks in three subjects Member functions: Read, display and average marks				
Module 2: **Array of objects Function overloading, passing objects as arguments and returning objects**	in class	3.1 Define a STUDENT class with USN, Name and marks in 3 tests of a subject, declare an array of 10 student objects find the average of two better marks for each student. Print USN, Name and average marks of all the students. 3.2 Write an OOP in C++ to create a class Employee with data members as Name, Employee code and Gross salary. Include member functions to read input and display output of individual objects. Create an array of 10 employees. Display the details of the employees with highest and lowest gross salary. 3.3 Write an OOP in C++ to create a class called BOOK with the following data members and member function: Data Members: Title, Author, Price,ISBN No. Member functions: Read, Display, Search_book(using ISBN No). 4.1 Create an array of 5 BOOK type objects and demonstrate all member functions. Create a class named C_POWER with a function power() to raise a number m to the power n. The function takes a double value for m and int value for n, returns the result correctly. Use a default value of 2 for n to make the function to calculate squares when this argument is omitted. Write another function that takes an int value of m. Both functions should have same name. Write a main function that gets values of m and n from user. 4.2 Write a C++ program to create a class called COMPLEX and implement the following by overloading functions ADD() that return a COMPLEX number.	2			

		ADD(a, s2)- where a is an integer (real part) and s2 is a complex number. ADD(s1, s2)- where s1 and s2 are complex numbers.				
	**Assignment Topics	4.3 Write a program in C++ to create a class named TIME that stores two time values in hours (float) and minutes (integer). Perform the following operations by using a function add():- Add T1+T2 where , T1 and T2 are time objects. Add T1+x where T1 is a TIME object and x is any integer. Return time objects from the member function tomain() and display.				
Module 3: **Programs on constructors and destructors Static data and static member function**	in class	5.1 Write a C++ program to create a class called STRING and implement the following operations. STRING s1="SMIT" STRING s2="MAJITAR" STRING s3=s1+s2 (Use copy constructor). 5.2 Write a program in C++ to create a class named student, create a constructor and destructor for the class and demonstrate sequence of execution of constructors and destructors. 6.1 Write a program in C++ to define a class named Bank. Include the following data members:- a. Name of account holder b. Account number c. type of account d. balance amount in account e. number of transactions in the bank(static data member) Create the following member functions:- i. To read inputs ii. To deposit an amount To withdraw amount after checking current balance Display number of transactions (use static function). 6.2 Write an OOP in C++ to demonstrate static members of a class. Include static data members to count the number of objects created for the class	3			
	**Assignment Topics	6.3 Write an OOP in C++ to demonstrate static members function of a class to pre-initialize private static data members. Also show restrictions that apply on static member functions.				
Module 4: **Friend function Implementing linked list in C++ Operator overloading**	in class	7.1 Create two classes DM and DB which stores the value in distances. DM stores distance in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display. Use the concept of friend function.	4			

7.2 Write an OOP in C++ to create a Class Twovalues with two integer type data members and member function to read values in those data members. Create another Class Min_Max and declare it as friend of Class Twovalues. Min_Max should have member functions to find the minimum and maximum of two values.

7.3 Write an OOP in C++ to demonstrate the advantage of overloading '+' operator using friend function.

8.1 Write a C++ program to create a class called LIST (linked list) with member functions to :-
Insert an element at any position and to display the list.
8.2 Write a C++ program to create a class called LIST (linked list) with member functions to :-
Delete an element from any position and to display the list.

8.3 Write an OOP in C++ to create a class called STACK with an array of integer type data member and member functions to PUSH/POP elements from the stack and display the elements on the stack.

9.1 Write a program in C++ to overload unary minus operator to change the sign of a number. Perform the addition on the entered values from text boxes.

9.2 Write a C++ program to create a class called COMPLEX and implement the following by overloading + operator:-
  i.   a+ s2; where a is an integer (real part) and s2 is a complex number.
  ii. s1+ s2 ; where s1 and s2 are complex numbers.
Return object and display the result.

9.3 Write a C++ program to create a class called STACK using array of integers. Implement the following operations by overloading the operators + and --.
  i.   s1=s1+element; where s1 is a object of the class STACK and element is an integer to be pushed on top of the stack.
  ii. s1=s1--;where s1 is a object of the class STACK, -- operator pops the element.
Note: Handle the STACK empty and STACK full conditions.

9.4 Write a C++ program to create a class called MATRIX using a two- dimensional array of integers. Implement the following operations by overloading the operator== which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading the operators + and – respectively :-

				5		

		if(m1==m2)
		{
		m3=m1-m2; m4=m1+m2;
		}
		else display error				

	Assignment Topics	9.5 Write a C++ program to create a class called DATE. Accept two valid dates in the form dd/mm/yy. Implement the following operations by overloading the operators + and - .
		   i. no_of_days=d1-d2; where d1 and d2 are DATE objects. d1>=d2 and no_of_days is an integer.
		   ii. d2=d1-no_of_days; where d1 is a DATE object and no_of_days is an integer.				

Module 5: **Template class and template functions** **Inheritance** **Run-Time Polymorphism** **Files in C++**	in class	10.1 Write a program in C++ to create a template function and perform bubble sort. 10.2 Write a program, in C++ to create a template class STACK and perform push and pop operations. 10.3 Write an OOP in C++ to create a template class ARRAY and implement run time boundary checking by overloading [] operator. 11.1 Write a C++ program to create a class called STUDENT with data members USN, Name and Age. Using inheritance, create the classes UGSTUDENT and PGSTUDENT having fields as Semester, Fees and Stipend. Enter the data for at least 5 students. Find the semester wise average age for all UG and PG students separately. 11.2 Write an OOP in C++ to demonstrate accessing derived class objects' member using base class pointers. Also show the sequence of execution of constructors and destructors wheninheritance is involved. 12.1 WAP in C++ to create a class called Figure. Use this class to store two double type values that could be used to compute the area of various shapes (i.e., length, breadth for rectangle and base, height for triangle). Derive two specific classes called Triangle and Rectangle inherited from super class Figure. Create a virtual function called area( ) to compute and display the area of the basic shapes. Redefine this function in derived classes to suit its requirements. 12.2 Write a C++ to implement the following using the concept of inheritance.-		5		
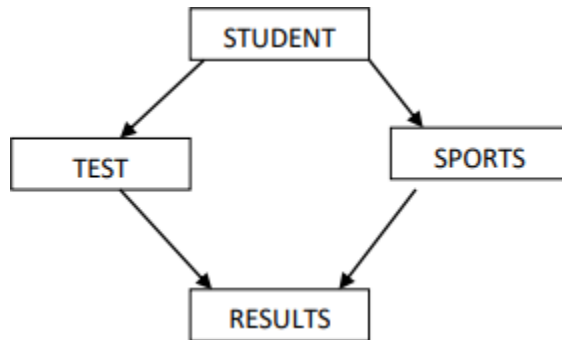
i. Create data member roll_no,reg_no and member function get_number() to take input and put_number() to display in the base class STUDENT.
ii. The class Test contains a data member part1 and part2.Redefine the above two functions.
iii. The class SCORE contains a member score. Redefine get_number and put_number ().
iv. Redefine display function in RESULT class as well to calculate total, where TOTAL=part1+part2+score.

Note: Implement the concept of run-time polymorphism, and include constructors in all the classes.

12.3 Write an OOP in C++ to create a base class convert with two data members val1 and val2 and two member functions getinit() and getconvert() which return the initial values and converted values. It includes a pure virtual function compute() which must be defined by by two derived classes lit_to_gal and far_to_cel. Each of these classes have their own definition of compoute().

	**Assignment Topics	13.1 Write a program in C++ to create a file named "costs" and implement the following by creating menu driven program:-				
		i. The file should contain two columns "item_name" and "cost".				
		ii. Insert data under these two columns assuming the file is empty initially.				
		iii. Allow user to add more data as and when he wants.				
		iv. Retrieve the item details if item name is given as an input.				
		Display the entire content of the file.				
		13.2 Write a program in C++ to copy the contents of one file into another in reverse order.				
		13.3 Write a program in C++ to change a particular character in a file using command line.				

Text Books:

1. Herbert Schildt, "The Complete Reference C++", Tata McGraw Hill.

2. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill.

Reference Books:

1. Bjarne Stroustrup, "C++ Programming Language", Pearson.

2. Stanley B Lippman and Lajoie, "C++ Primer", Pearson.

3. Saurav Sahay, "OOP with C++", Oxford University Press.

4. B.L. Juneja and Anita Sethi, "Programming with C++", New Age International Publication.

Sub Code:MA206A1   **Credit: 4 (L-3, T-1, P-0)**

PROBABILITY, STATISTICS AND STOCHASTIC PROCESSES.

Questions to be set: 05

Questions to be answered: ALL

Course Objectives: The objective of this course is to enhance the capability of students to analyze the problems related to random phenomena. Concepts on probability theory will be of immense help to the students in analyze random experiments. Statistical Analysis plays a big role in areas like data mining and information retrieval. Stochastic models have tremendous applications in queuing theory, finance, Insurance . Students will find adequate tools in these modules which will be effective enough to solve related problems.

Pre-requisites: Differential and Integral Calculus, Matrix Algebra, Permutation and Combination.

Course Outcomes (CO): After completing the course, the students will be able to

CO1: demonstrate basic principles of probability and understand a random variable that describe randomness or an uncertainty in certain realistic situation.

CO2: comprehend concepts of discrete, continuous probability distributions and able to solve problems of probability using various distributions.

CO3: analyse the statistical data for inference and apply various tests for testing the Hypothesis,

CO4: understand the various classifications of Random Processes that arise frequently and model them.

CO5: apply different Queuing models that appear in Computer Science

Module I: Probability Theory, Random Variables, and distribution: Introduction, Classical definition of probability, Axiomatic definition of probability, Conditional probability, Baye's theorem. Random variables, Mean, Variance, Chebyshev's inequality, Central limit theorem.   [10 HR]

Module II: Conditional Probability and known distribution: Correlation coefficient, conditional distributions, conditional expectations, and regression curves, Standard probability distributions (Binomial, Poisson, Uniform, Normal, exponential, chi-square.), Reliability and MTTF.   [10 HR]

Module III: Introduction to Statistics: Random sample, Sampling distribution, Statistic, Least square curve fitting Parameter estimation: Unbiased estimate, Consistent estimate, Maximum likelihood estimate, interval estimate. Testing of Hypothesis for mean with known variance for normal population.   [6 HR]

Module IV: Stochastic Processes: Introduction to Stochastic Process, Poisson Process, Discrete parameter Markov Chains,.   [8 HR]

Module V: Queuing Models: Concept of a queues: Basic idea of continuous parameter Markov chain, Birth and death processes, $M/M/1/\infty$, $M/M/1/N$, queuing systems.   [6 HR]

Textbook:

K.S Trivedi, Probability & Statistics with Reliability, Queuing and Computer Science Applications, 2008, Wiley.

P.L. Meyer : Introductory Probability theory and statistical Applications, Second Ed. Oxford & IBM Publishers.

Miller & Freund: Probability & Statistics for Engineers, Eight Ed. Pearson Ltd.

Reference Books:

1. Introduction to Probability Theory and its Applications, William Feller, 2008, Wiley.
2. Introduction to Probability with Statistical Applications, Geza Schay, 2007, Birkhaus.

Sub Code: IT221A1   **Credit:4 (L-3, T-1, P-0)**

JAVA PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: The Java Programming Language course provides students with a solid foundation for programming with JAVA. It also highlights the creation of graphical user interfaces (GUIs), exceptions, file input/output (I/O), and threads; and network programming.

Pre-requisites: Object Oriented Programming.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Demonstrate an ability describe and recall the various object-oriented concept

2. Formulate and interpret an object-oriented model and design solution using object oriented concepts.

3. Illustrate a diverse set of design solutions using techniques of Interface, Packages, File Handling, Multi-threading, etc.

4. Select and design methodology using bottom up approach and solve open ended problems using Java.

5. Define and create modern engineering tools, techniques and resources to build software using Java programming language.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction to Java & Classes>	In Class	Evolution and features of java, Overview of java, Data types, Variables and arrays, Type conversion and casting, Type promotion in expression, arrays. Class fundamentals, Declaring objects, Assigning object reference Variables, Introducing methods, Constructors, 'this' keyword, The finalize() method.	8	1,2		
	**Assignment Topics	Two control statements, Lexical issues, Literals, Variables, Operators, Bitwise operators, Relational operators, Boolean and logical operators, Assignment Operators, The '?' operator, Operator precedence, JAVA statements. Garbage collection and stack class.				
Module 2: <Methods and classes & Strings handling>	In Class	Overloading methods and constructors, using object as parameters, Argument passing, Returning objects, Access control, Static methods, Nested and inner classes, Command line argument. String constructors, String length, Special string operators, Character extraction, String comparison, String searching, String modification, Changing case of characters within a string, Compression and String buffer, String builder.	8	2,3		
	**Assignment Topics	Recursion				
Module 3: < Inheritance, Interfaces and Packages,	In Class	Basics of inheritance, Types of inheritance, Using super keyword, method overriding, Dynamic method dispatch, Abstract class, Using final with inheritance, The object class, Defining and implementing	8	2,3		

Exception Handling >		interface, Extending interfaces, Nested interfaces, Applying interfaces, Defining and creating packages, Access protection, Importing packages. Fundamentals, Exception types, Uncaught exceptions, Using try and catch, Multiple catch clauses, Nested try statements, Finally, Java's built in exceptions, Creating own exception classes				
	**Assignment Topics	Throws				
Module 4: <Input/Output and file handling & Multithreaded programming>	in class	Java I/O classes and interfaces, The stream classes, Byte streams, The character streams, The console class, File class, Byte-stream class, Random access files. Thread basics, Java's thread model, Thread priorities, Messaging, Thread class and runnable interface. The main thread, Creating a thread, Creating multiple threads, Interthread communication, Suspending/resuming and stopping threads.	8	4,5		
	**Assignment Topics	Synchronization.				
Module 5: < Network programming & Event Based Programming>	in class	Networking basics, The networking classes and interfaces, The InetAddress class, Inet4Address, TCP socket. The applet class, Repaint(), The HTML applet tag, Passing Parameter to applet, Event handling,	8	5		
	**Assignment Topics	URL, URLConnection, HTTP/URL Connection, TCP/IP server sockets, Datagram socket and Datagram Packet. Using delegation event model, Abstract Window program, Displaying information within a window, AWT controls.				

Text Books:

1. Programming With JAVA, 2nd Edition, E. Balaguruswami and TMH Publication.
2. Java: The Complete Reference, 7th Edition, Herbert Scheldt, TMH Publication

Reference Books:

1. The Java Programming Language: K.Arnold and J. Gosling.
2. Professional java Server Programming: Allamaraju.
3. JAVA2: The Complete Reference, 3rd Edition, Patrick Naughton and HarbertSchildt, TMHPublication.
4. Internet & Java Program: R.Krishnamoorthy& S. Prabhu, New Age Internet Publisher

Sub Code: IT222A1   **Credit:4 (L-3,T-1, P-0)**

DATABASE MANAGEMENT SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides the basic information about relational Database Management System and their development. The major objectives of the course is to provide an introduction of DBMS and their use, be familiar with the basic DBMS architecture, components, and interfaces, have experience using at least one modern Database Management System, understand and use database models in database and application design

Pre-requisites: Programming Concepts

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Describe fundamental elements of a relational database management system.
2. Design entity-relationship diagrams to represent simple database application scenarios.
3. Explain the basic concepts of relational data model, Entity-relationship model, Relational database design, relational algebra and database language SQL.
4. Apply and relate the concept of transaction, concurrency control and recovery in database
5. Analyze various Normalization techniques and improve the database design by normalization

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PS
Module 1: <Introduction & Data modelling >	In Class	DBMS: Characteristics, Advantages, Architecture. Database concept and architecture, Data models, Instances and schema, Database languages, Database manager, Database administrator, Database users, Concept of centralized database management system and distributed database system. Entity sets, attributes types and keys, Entity Relationship (ER) diagram, Type role and structural constraints, Enhanced entity- relationship (EER), Object modelling, Specialization and generalization, Modelling of union types, Relational-algebra operations.	8	1,2		
	**Assign ment Topics	Data models: Definition, Purpose and Types, Hierarchical models, Network model, Relational model.				
Module 2:	In	Database design process, Relational database design,	8	3		

<Database design >	Class	Relation schema, Functional dependencies, Membership and minimal covers, Normal forms, Multivalued dependencies, Join dependencies, Converting EER diagrams to relations.				
	**Assignment Topics	Effect of de-normalization on database performance.				
Module 3: < Data Storage and	In Class	File organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+	9	3,4		
Indexes & Database query languages >		trees. Query-by-example (QBE), Introduction to SQL, Use of some special data types, Overview of SQL 92, Basic queries in SQL, Advanced queries in SQL, Functions in SQL, Basic data retrieval, Aggregation, Categorization, Updates in SQL, Embedded SQL and 4GLs, Procedural extension to SQL: PL/SQL.				
	**Assignment Topics					
Module 4: < Transaction processing, Concurrency control and backup & recovery mechanisms >	in class	Desirable properties of transactions, Implementation of atomicity and durability, Reconsistent model, Read only and write only model, Concurrent executions, Schedules and recoverability, Serializability of schedules, Concurrency control, Precedence graph. Overview of concurrency control, Locking techniques, Lock based protocols, Time stamp based protocols, Commit protocols, Optimistic technique, Granularity of data items, Time stamp ordering multi version concurrency control, Deadlock handling, Recovery mechanisms, Database recovery techniques based on immediate and deferred update.	9	4		
	**Assignment	Concepts of database security mechanisms, Case study				

	Topics	of Distributed Database Systems				
Module 5: <Graph Database & NoSQL >	in class	Overview of graph database, Structure and advantages of graph database. An overview of NoSQL, Characteristics of NoSQL, Advantages and challenges of NoSQL, NoSQL storage types, Case study of MongoDB.	6	5		
	**Assign ment Topics	high level view of graph space, Property graph model.				

Text Books:

1. Elmasri and Navathe: "Fundamentals of Database Systems", Addison Wesley.
2. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw-Hill

Reference Books:

1. Thomas Connolly, Carolyn Begg, "Database Systems – A Practical Approach to Design, Implementationand Management", Pearson Education.
2. Jefrey D. Ullman, Jenifer Widom, "A First Course in Database Systems", Pearson Education.
3. Bipin C Desai, "An Introduction to Database Systems", Galgotia.
4. Atul Kahate, "Introduction to Database Management Systems", Pearson.
5. Ian Robinson, Jim Webber, Emil Eifrem,"Graph Databases",O'Reilly Media.
6. Gaurav Vaish, "Getting started with NoSQL", Packt.

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY and ETHICAL HUMAN CONDUCT

Course Objectives:

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

Pre-requisites: None. However, it is desired that students may have gone through UHV-I: Universal Human Values-Introduction

Course Outcome (CO):

1. Students are expected to understand self-exploration and Basic Human Aspirations.
2. To understand harmony in themselves (Human being).
3. To become more aware of their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
4. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

Therefore, the course and further follow up is expected to positively impact common graduate attributes like:
   1) Holistic vision of life
   2) Socially responsible behaviour
   3) Environmentally responsible work
   4) Ethical human conduct
   5) Having Competence and Capabilities for Maintaining Health and Hygiene
   6) Appreciation and aspiration for excellence (merit) and gratitude for all

Module 1 –Introduction to Value Education   (9 Hrs)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session *PS1 Sharing about Oneself*
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS*2 Exploring Human Consciousness*
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfil the Basic Human Aspirations
Tutorial 3: Practice Session PS*3 Exploring Natural*

Acceptance

Module 2 – Harmony in the Human Being (9 Hrs)

Lecture 7: Understanding Human being as the Co-existence of the Self and the
Body Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS*4 Exploring the difference of Needs of Self and Body*
Lecture 9: The Body as an Instrument of the Self
Lecture 10: Understanding Harmony in the Self
Tutorial 5: Practice Session PS*5 Exploring Sources of Imagination in the Self*
Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS*6 Exploring Harmony of Self with the Body*

Module 3 – Harmony in the Family and Society (9 Hrs) Lecture 13:

Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS*7 Exploring the Feeling of Trust*
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS*8 Exploring the Feeling of Respect*
Lecture 16: Other Feelings, Justice in Human-to-Human
Relationship Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS*9 Exploring Systems to fulfil Human Goal*

Module 4 – Harmony in the Nature/Existence (6

Hrs) Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation, and Mutual Fulfilment among the Four Orders of
Nature Tutorial 10: Practice Session PS*10 Exploring the Four Orders of Nature*
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS*11 Exploring Co-existence in Existence*

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics
(9 Hrs)

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS*12 Exploring Ethical Human Conduct*
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS*13 Exploring Humanistic Models in Education*
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS*14 Exploring Steps of Transition towards Universal Human Order*

Content for Practice Sessions (Tutorials)

In order to connect the content of the proposals with practice (living), 14 practice sessions have been designed. The full set of practice sessions is available in the Teacher's Manual as well as the website.

Practice Sessions for Module 1 – Introduction to Value Education
PS1   Sharing about Oneself
PS2   Exploring Human
Consciousness PS3   Exploring
Natural Acceptance

Practice Sessions for Module 2 – Harmony in the Human Being
PS4 Exploring the difference of Needs of Self and Body

PS5 Exploring Sources of Imagination in the
Self PS6   Exploring Harmony of Self with the
Body

Practice Sessions for Module 3 – Harmony in the Family and Society
PS7   Exploring the Feeling of Trust PS8   Exploring the Feeling of
Respect PS9   Exploring Systems to fulfil
Human Goal

Practice Sessions for Module 4 – Harmony in the Nature (Existence)
PS10   Exploring the Four Orders of
Nature PS11   Exploring Co-existence
in Existence

Practice Sessions for Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12   Exploring Ethical Human Conduct
PS13   Exploring Humanistic Models in Education
PS14   Exploring Steps of Transition towards Universal Human Order

Text Book
A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1

The Teacher's Manual
Teachers' Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53- 2

Reference Books
1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Sub Code: IT223A4   **Credit: 1 (0L+0T+2P)**

JAVA PROGRAMMING LABORATORY

Objectives: To impart the programming knowledge and skill of Java. The major objective of this course is to make the students aware of various features of Java programming language through practical experiments.

Pre-requisites: OOPS with C++ Lab.

Course Outcomes (CO): On successful completion of this course, students will be able to

1. Create Java programs using the basic concepts of class, datatypes, variables, and arrays, operators etc.
2. Use the concepts of control statements, methods, inheritance etc. in Java programs.
3. Build packages and interfaces and develop multi-threaded Java models for synchronizing as well as Inter thread communications & work with enumeration and metadata annotations.
4. Develop I/O applets.
5. Understand and apply Java networking and GUI concepts to develop client-server applications and interactive interfaces.

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Java & Classes	in class	Familiarization with the Java development environment (IDE) . Practice compiling and running Java programs using the command line or IDE. Experiment with basic Java syntax including variables, data types, and control structures..	7.2	1		
	**Assignment Topics					
Module 2: Methods and Classes, Strings Handling	in class	Explore the concept of methods in Java and understand method overloading and overriding. Practice creating and using classes to model real-world entities. Experiment with string manipulation operations such as concatenation, substring, and searching.	7.2	2		
	**Assignment Topics					
Module 3: Inheritance, Interfaces and Packages, Exception Handling		Understand the concept of inheritance and explore the use of interfaces to define contracts. Learn about packages and how they organize classes into namespaces. Practice handling exceptions in Java to write robust and fault-tolerant code.	7.2	3		
	**Assignment Topics					

Module 4: Input/Output and File Handling	in class	Explore different ways of reading input from the user and writing output to the console. Understand file handling concepts in Java including reading from and writing to files. Practice using Java's built-in classes for file input/output operations.	7.2	4		
	Assignment Topics					
Module 5: Network Programming & Event-Based Programming	in class	Learn about networking concepts in Java including sockets and URLs. Understand event-driven programming using Java's Swing or JavaFX libraries. Practice creating GUI applications with event handling capabilities	7.2	5		
	Assignment Topics					

DATABASE MANAGEMENT SYSTEMS LABORATORY

Questions to be set: 05 (All Compulsory)

Course Objectives: At least 10 experiments covering the entire syllabus of the corresponding theory paperto be carried out using the theory studied /programming skill of the subject concerned to get insight into thepractical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer**.**

Pre-requisites: Corresponding theory paper Database Management Systems and associated prerequisites.

Course Outcomes (CO): On successful completion of this course, the student should be able to:
1. Select appropriate SQL/MongoDB commands and functions for a given query on the database.
2. Infer constraints and relationships between tables from conceptual/logical level schema and convert them into relationship and integrity constraints at the physical level schema.
3. Write Oracle PL/SQL Programs for data processing.
4. Design nested queries for efficient data processing on the database.
5. Test an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Implementation of DDL and DML commands, functions and operators of SQL**	In Class	Implementation of DDL and DML commands of SQL with suitable examples	0.5	1		
	**Assignment Topics	**Write SQL queries for following question**: **Customer** (Cust id : integer, cust_name: string) **Item** (item_id: integer, item_name: string, price: integer) **For the above schema, perform the following—** a) Create the tables and insert five records in each table b) Display the schema of each table c) Change the data type of price from integer to number. d) Change the name of column/field item name to I_name. e) Delete the record of customer having cust_id _6' f) Add a column age in table Customer g) Rename the attribute price in table Item to Costprice h) Add an attribute in table Item i) Update the price of Item id '4' from 1000 to 2000 j) Update the name of Customer having id _001' k) Delete the contents of the table Customer l) Display table Item in the following way:	2.5	1		

		i) Selected rows all columns ii) All rows selected columns iii) All rows selected columns iv) Selected rows selected columns m) Drop table Customer				
	in class	Implementation of different types of functions with suitable examples.	0.5	1		
	**Assignment Topics	**Create a table EMPLOYEE with following schema:** **(Emp_no, E_name, E_address, E_ph_no, Dept_no, Dept_name,Job_id, Designation , Salary,** **DOJ)** **Write SQL statements for the following query.** 1. List the E_no, E_name, and Salary of all employees working as MANAGER. 2. Display all the details of the employee whose salary is more than the Salary of any manager 3. List the employees in the ascending order of Designations of those joined after 1981. 4. Display the sum and average of salary of all employees 5. List the employees who are either _CLERK' or _ANALYST'. 6. List the employees who joined on 1-MAY-81, 3-DEC-81, 17-DEC-81,19-JAN-80 . 7. List the employees who are working for the Dept no 10 or20. 8. List the Employee names those starting with 'S'. 9. Display the name as well as the first five characters of name(s) starting with 'H' 10. List the Employee names ending with 'a'. 11. Display the maximum and minimum salary of employees 12. Display the count of employees in each designation	2.5	1		
	in class	Implementation of different types of operators in SQL	0.5	1		
	**Assignment Topics	**Create a table Salesmen with following schema:** **(salesman_id, name , city , age, commission)** **Write SQL statements for the following query.** 1. Filter those salesmen with all information who comes from any of the cities Paris and Rome 2. Make a list of salesman_id, name, city and commission of each salesman who live in cities other than Paris and Rome 3. Write a SQL statement to find those salesmen with all information who gets the commission within a range of 100 and 500 4. Write a query to sort out those salesmen with all information whose ID value is within any of 3007, 3008 and 3009.	2.5	1		

		5. Write a SQL statement to find those salesmen with all other information and name started with any letter within 'A' and 'K' 6. Write a SQL statement to find that salesman with all information whose name begins with the letter 'B'. 7. Write a SQL statement to find all those salesmen with all information whose names are ending with the letter 'n' 8. Write a SQL statement to find those salesmen with all information whose name containing the 1st character is 'N' and the 4th character is 'l' and rests may be any character 9. Display the salesman details in ascending order of his age 10. Display names of salesman containing two a's in his name 11. Display the count of salesman within the age group 25 to 35 12. Display the total number of salesman staying in each city				
Module 2: **Java Connectivity**	in class	Implementation of JAVA Database connectivity.	0.5	5		
	**Assignment Topics	1. Write a program to do the following: i) Develop the following JSP page: **Employee Information** **Emp ID** **Emp Name** **Basic salary:** **DA:** **HRA:** **TAX:** **Submit** ii) After giving the details of an employee, the information should be stored in the database. The message should be displayed as "Employee information are stored successfully". Create a table named as "Login" having two columns User Id and Password. Write a program to create a login page. Once the user performs the login, the authentication should be checked from the login table and "Valid Login" or "Invalid Login" should be displayed.	2.5	5		
Module 3: **SQL Joins, Subqueries and Constraints**	in class	Implementation of different types of Joins	0.5	2		
	**Assignment Topics	**Consider the following schema:** **Sailors (sid, sname, rating, age)** **Boats (bid, bname, color)** **Reserves (sid, bid, day(date))**	2.5	2		

		1. Find all information of sailors who have reserved boat number 101. 2. Find the name of boat reserved by Bob. 3. Find the names of sailors who have reserved a red boat, and list in the order of age. 4. Find the names of sailors who have reserved at least one boat. 5. Find the ids and names of sailors who have reserved two different boats on the same day. 6. Find the ids of sailors who have reserved a red boat or a green boat. 7. Find the name and the age of the youngest sailor. 8. Count the number of different sailor names. 9. Find the average age of sailors for each rating level. 10. Find the average age of sailors for each rating level that has at least two sailors.				
	in class	Implementation of Subqueries and Views	0.5	4		
	Assignment Topics	**Consider the following schema:** **Sailors (sid, sname, rating, age)** **Boats (bid, bname, color)** **Reserves (sid, bid, day(date))** Write subquery statement for the following queries. 1. Find all information of sailors who have reserved boat number 101. 2. Find the name of boat reserved by Bob. 3. Find the names of sailors who have reserved a red boat, and list in the order of age. 4. Find the names of sailors who have reserved at least one boat. 5. Find the ids and names of sailors who have reserved two different boats on the same day. Database Management System Lab(CS 1462) Computer Science and Engineering Page 39 6. Find the ids of sailors who have reserved a red boat or a green boat. 7. Find the name and the age of the youngest sailor. 8. Count the number of different sailor names. 9. Find the average age of sailors for each rating level. 10. Find the average age of sailors for each rating level that has at least two sailors.	2.5	4		
	in class	Implementation of different types of constraints	0.5	2		
	Assignment Topics	Create a table called EMP with the following structure. **Name Type** **---------- ----------------------** **EMPNO NUMBER (6)** **ENAME VARCHAR2 (20)** **JOB VARCHAR2 (10)** **DEPTNO NUMBER (3)** **SAL NUMBER (7,2)**	2.5	2		

		1. Allow NULL for all columns except ename and job. 2. Add constraints to check, while entering the empno value (i.e) empno > 100. 3. Define the field DEPTNO as unique. 4. Create a primary key constraint for the table (EMPNO). 5. Create another table and add foreign key in table emp				
	in class	Implementation of Database Backup & Recovery Commands, Rollback, Commit, save point.	0.5	2		
	Assignment Topics	1. Write a query to implement the save point. 2. Write a query to implement the rollback. 3. Write a query to implement the commit.	2.5	2		
Module 4: **PL/SQL**	in class	Basics of PL/SQL	0.5	3		
	Assignment Topics	1. Write a PL/SQL block to find the largest of two numbers. 2. Write a PL/SQL block to calculate the area of a circle. 3. Write a PL/SQL block to calculate simple interest and compound interest. 4. Write a PL/SQL block to find the sum of first 100 odd nos. and even nos. 5. Write a PL/SQL block to find the sum of first 100 natural nos.	2.5	3		
	in class	PL/SQL Continued	0.5	3		
	Assignment Topics	1. Write a PL/SQL block to find the sum of digits of a number. 2. Write a PL/SQL block to reverse the digits of a number. **3.** Write a PL/SQL block to raise the salary by 20% of given employee on following table. **Emp_Salary (eno, ename, city, salary)** 4. Write a PL/SQL block to check whether a string is a palindrome or not. 5. Write a PL/SQL block to check whether a given number is a Armstrong number. 6. Write a PL/SQL block to find factorial of a number. 7. Write a PL/SQL block to check whether a number is prime or not. 8. Write a program to generate all prime numbers below 100.	2.5	3		
Module 5: **MongoDB**	in class	Basics of MongoDB	0.5	1		
	Assignment Topics	Write a MongoDB query for the following: The collection in the database should have the name 'Departments'. It should have the following fields: Departments (Dept_id, Dept_name, Manager_id, Location) Insert at-least SIX records. a) Find the names of all departments which are located at Kolkata.	2.5	1		

		b) Sort the departments according to increasing order of their 'Dept_id'. c) Find the names of all departments which are located either in _Delhi' or 'Bombay'. d) Rename the department name where Manager_id is 100.				
	in class	MongoDB continued	0.5	1		
	Assignment Topics	Write a MongoDB query for the following: The collection in the database should have the name 'Project'. It should have the following fields: Project(Project_id, P_name, Department, no_of_member, P_cost) Insert at-least SIX records. a) Find the Project_id and P_name of all projects belongs to 'CSE' department. b) Sort the projects alphabetically with respect to project name. c) Find the names of all projects belong to both 'ECE' and 'EE' department. d) Change the P_cost for project_id=5 to 1,00,000.	2.5	1		

Text Books:

1. Elmasri and Navathe: "Fundamentals of Database Systems", Addison Wesley.
2. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw-Hill

Reference Books:

1. Thomas Connolly, Carolyn Begg, "Database Systems – A Practical Approach to Design, Implementationand Management", Pearson Education.
2. Jefrey D. Ullman, Jenifer Widom, "A First Course in Database Systems", Pearson Education.
3. Bipin C Desai, "An Introduction to Database Systems", Galgotia.
4. Atul Kahate, "Introduction to Database Management Systems", Pearson.
5. Ian Robinson, Jim Webber, Emil Eifrem,"Graph Databases",O'Reilly Media.
6. Gaurav Vaish, "Getting started with NoSQL", Packt.

Sub Code: IT311A1   **Credit: 4(L-3, T-1, P-0)**

ARTIFICIAL INTELLIGENCE

Questions to be set: 05 (All Compulsory)

Course Objectives: The aim of this course is to provide an introduction to some fundamental issues and algorithms in artificial intelligence (AI). The course approaches AI from an algorithmic, computer science- centric perspective. The course aims to provide some fundamental tools and algorithms required to produce AI systems able to exhibit limited human-like abilities, particularly in the form of problem solving by search, representing and reasoning with knowledge, planning, natural language understanding, computer vision, automatic programming and machine learning.

Pre-requisites: Algorithms will be an essential component, in addition the course requires some mathematics specially Calculus, Probability and statistics. Natural Sciences Mathematics or equivalent, and Discrete Mathematics, are likely to be helpful although not essential. Mathematical Methods for Computer Science, Probability, Logic and Proof, Prolog and Complexity Theory are likely to be useful.

Course Outcomes (CO): On successful completion of this course, the student should be able to:

1. Distinguish between the popular view of the field and the actual research results.
2. Appreciate the fact that the computational complexity of most AI problems requires us regularly to deal with approximate techniques.
3. Describe different perspectives on what the problems of artificial intelligence are and how different approaches are justified.
4. Design basic problem solving methods based on AI-based search, knowledge representation, reasoning, planning, and machine learning algorithms.
5. Identify problems requiring AI based solutions.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction to Artificial Intelligence & Machine Learning>	In Class	Introduction: Definition of AI, Overview of Artificial Intelligence- Problems of AI, AI techniques, Turing test, Typical AI problems: Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem. Machine Learning: Learning- Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Learning by gradient descent. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.	10	1,2		

	Assignment Topics	Intelligent and Rational agents , Practical impact of AI				
Module 2: < Problem solving by Search & Informed Search Techniques>	In Class	Problem solving by Search : Tic -Tac- Toe problem, 8-puzzle problem, 8-Quenes problem. State space search, Uninformed search strategies: BFS, DFS, Depth Limited search, Iterative Deepening DFS, Bi-directional depth first search. Informed Search Techniques : Informed (Heuristic) Search Strategies, Best First Search (BFS), Greedy BFS, A* Search, Heuristic Functions, Iterative-Deepening A*, Hill Climbing Search, Genetic Algorithms.	11	2,3		
	Assignment Topics	Problems, Problem Space & search, Formulating problems: Pegs and Disks problem, Missionary Cannibals problem ,Simulated Annealing Search, Local Beam Search.				
Module 3: < Adversarial Search & Bayesian Networks>	In Class	Adversarial Search : Game Trees, Optimal Decision in Games: Minimax Algorithm, Alpha Beta Pruning, TD learning, Game theory. Bayesian Networks : Bayesian inference, Marginal independence, Hidden Markov models, Learning Bayesian networks, Laplace smoothing, Expectation Maximization, Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	7	4,5		
	Assignment Topics					
Module 4: < Constraint Satisfaction Problems >	in class	Constraint Satisfaction Problems: N-Queen problem, Crossword puzzle, Map coloring problem, Boolean satisfiability problem (SAT). The backtracking algorithm for CSPs. Heuristics for improving the search for a solution. Forward checking.	7	3,4,5		
	Assignment Topics	Constraint propagation and arc consistency. Backtracking, Back jumping using Gaschnig's algorithm, Graph-based back jumping.				
Module 5: < Knowledge representation and Reasoning >	in class	Logic programming, forward verses backward reasoning, matching, control knowledge.	8			
	Assignment Topics	Knowledge representation issues, representation & mapping, approaches to knowledge representation, representing		4,5		

		simple fact in logic, Syntax versus semantics, Propositional logic, Predicate logic, Horn clauses, First-order logic Resolution, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Procedural verses declarative knowledge				

Text Books:

1. Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall (3rd ed.).
2. Elaine Rich, Kevin Knight & Shivashankar B. Nair (2008). Artificial Intelligence (Third Edition) TMH.
3. Bishop, C. M. (2006) Machine Learning and Pattern Recognition. Berlin: Springer.

Reference Book:

1. Poole, D. L. & Mackworth, A. K. (2010). Artificial intelligence: foundations of computational agents. Cambridge University Press.
2. Nilsson, N. J. (1998) Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufmann

FORMAL LANGUAGES AND AUTOMATA THEORY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course builds upon preliminary knowledge delivered in discrete structure for computer science and computer programming concepts. The main objectives of the course are to provide learners with a detailed understanding of the mathematical models of the machines and their evolution through requirement generation and advancement in languages. Thorough the concepts and operations in Formal Language and Automata Theory, their use in Compiler Design and their application in Natural Language Processing.

Pre-requisites: Knowledge in discrete mathematics and in programming.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Explain different concepts in automata theory and formal languages.
2. Produce various grammars and their acceptors.
3. Analyze the various language acceptors.
4. Acquire a fundamental understanding of computational models related to decidability and recursive enumerability.
5. Illustrate various proofs using mathematical principles

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: \<Introduction & Finite Automata\>	In Class	Definitions: Language, Grammar, Automata, Relation between language, Grammar and automata, Importance of automata theory. Informal introduction: Drawing examples from everyday life to bring out the essence of finite automata, Finiteness and its importance in automata theory. Deterministic finite automata: Definition, Processing strings, Transition functions, Language of a DFA; Nondeterministic finite automata: Non-determinism, Definition, Extended transition functions, Language of a NFA, Equivalence of DFA and NFA, Kleene's theorem, Epsilon transitions, Applications of Finite automata in text search.	9	1,2		
	**Assignment Topics	Mathematical preliminaries: Sets, Logic, Functions, Relations, Languages.				
Module 2: \<Regular Expressions and Regular Languages\>	In Class	Memory required to recognize a language, Regular expressions, Regular expression to finite automata, Finite automata to regular expression, Algebraic laws for regular expressions, applications of regular expressions, Criterion for regularity, Regular languages. Pigeonhole principle, Pumping lemma for regular languages, Closure properties.	8	3,5		

	Assignment Topics	Testing membership of regular languages, Equivalence of automata.				
Module 3: <Context Free Grammars and Languages>	in class	Definition, Leftmost and rightmost grammars, Parse trees, Ambiguity: Ambiguous grammar, removing ambiguity. Normal forms, Applications of context free grammars: Parsers.	6	2		
	Assignment Topics					
Module 4: <Pushdown Automata, Context Free Languages & Turing Machines>	in class	Definition of pushdown automata, Representing pushdown automata, Acceptance by pushdown automata: By final state, By empty stack, Deterministic pushdown automata, Equivalence of pushdown automata and context free grammars, Testing membership of context free, Decision problems for context free languages. Definition, Language of a Turing Machine, Programming Turing Machines, The Church-Turing Thesis, A simple programming language, Extensions of the Basic Turing Machine.	10	2,3		
	Assignment Topics	Pumping lemma for context free languages, Closure properties of context free languages,				
Module 5: <Recursively Enumerable Languages, Undecidability & Language Learning>	in class	Definition, Enumeration, Chomsky hierarchy. The halting problem, the post correspondence problem. Learning framework, Inductive inference.	7	2,4		
	Assignment Topics	Time and space complexity of Turing machines, Complexity classes. Grammar induction				

Text Books:

1. John. E. Hopcroft, Rajeev Motwani, Jeffry.Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Education.
2. Peter Linz, An Introduction to Formal Languages and Automata, Narosa

Reference Books:

1. James. L. Hein, Discrete Structures, Logic and Computability, Narosa
2. Partha Niyogi, The Computational Nature of Language Learning and Evolution, PHI.
3. C.K. Nagpal, Formal Languages and Automata Theory, Oxford University Press, 2011.
4. John Martin , Introduction to Languages and the Theory of Computation, Tata McGraw Hill.

COMPUTER NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on several computer network concepts, applications and protocols in OSI as well as TCP/IP layered architecture. It also covers the various protocols of various layers, their operations and applications. Further it discusses the concept of network security, challenges and their counter measures.

Pre-requisites: Communication Techniques.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Understand and identify the engineering fundamentals concerning Data Communication and Computer Network.
2. Identify the complex engineering problem involved in Data communication and its architecture for a successful network based communication.
3. Ability to Practice and formulate a solution for an engineering problem concerning any layers in Data Communication model
4. Demonstrate an ability to formulate and interpret a model based on the fundamentals of Computer Networks
5. Compare and understand the IOS reference model and TCP-IP reference model for data communication

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Overview & Data Link Layer >	in class	Introduction to data communications, Types of Network, Store and forward, Packet Switching, Circuit Switching, Layered architecture: OSI and TCP/IP, Performance Metric: Delay, Throughput, Jitter Data link layer design issue, Error detection and correction: Parity bit, Polynomial: CRC. Elementary data link protocol: Random Access: ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Controlled Access: Reservation, Polling. Ethernet Frame Structure, L2 Addressing, ARP.	9	1,5		
	**Assignment Topics					
Module 2: < Network Layer & Routing>	in class	Network Topology and performance evaluation, Internet Protocol: IPv4 and IP addressing and sub-netting. Internet Control Message Protocol (ICMP), Mapping Physical to Logical Address: Reverse Address Resolution Protocol (RARP), Dynamic Host Configuration Protocol (DHCP). Structure of IP datagram, Network Address Translation (NAT). Distance Vector routing (DVR), Link state routing, and Interior gateway protocol: Routing Information Prortocol (RIP) and Open Shortest Path First (OSPF), Exterior gateway protocol: Border Gateway Protocol (BGP).	9	1,2		
	**Assignment					

	Topics					
Module 3: < Transport Layer>	in class	Functions of transport layer protocols: Reliable and unreliable service, Introduction to Transmission Control Protocol (TCP) and User Datagram Protocol (UDP), Header description of TCP and User Datagram Protocol (UDP), Congestion control mechanism of TCP.	9	1,3		
	**Assignment Topics					
Module 4: < Application Layer>	in class	Brief overview of protocols in Application Layer: Domain Name Systems, Hyper Text Transmission Protocol,), Multimedia Application: Audio and video streaming using UDP, VoIP.	9	1,4		
	**Assignment Topics					
Module 5: < Network Security & Other Network Technologies >	in class	Confidentiality, Authenticity, Integrity and Non-repudiation, Attacks, Introduction to Symmetric and asymmetric Cryptography. Wireless LAN: IEEE 802.11 specification, CSMA/CA. Introduction to Cellular Network, Ad Hoc Network and Software Defined Network	4	1,2		
	**Assignment Topics					

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw Hill.

2. William Stallings, "Data and Computer Communications", PHI.

Reference Books:

1. Andrew S. Tanenbaum, "Computer Networks", PHI.

2. A S Godbole, "Data Communication and Networking", Tata McGraw Hill.

3. William C Y Lee, "Mobile Communication Engineering", Tata McGraw Hill.

4. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Wiley

Sub Code: IT314A1   **Credit:4 (L-3, T-1, P-0)**

SOFTWARE ENGINEERING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course presents a comprehensive study of software quality assurance, including software quality control management, processes, systems, methods, standards, certification, and reliability measurement**.**

Pre-requisites: Procedure oriented and object-oriented programming paradigm.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Demonstrate competence in using engineering fundamentals to visualize solutions using knowledge of software engineering skills.
2. Extend an ability to formulate a solution plan and methodology for an engineering problem using software engineering.
3. Apply an ability to formulate and interpret a model for project management.
4. Explain an ability to define complex problem, find and analyze requirements
5. Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction & Software Life Cycle>	In class	The software engineering discipline-evaluation and impact, Programs vs. software products, Emergence of software engineering, Notable changes in software development practice, System engineering, handling complexity through Abstraction and Decomposition. Life Cycle Models: Classical waterfall model, Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, Introduction to Agile software development, Extreme Programming and Scrum, DevOps, Domain Analysis.	8	1		
	**Assignment Topics	Comparison of different life cycle models.				
Module 2: <Software Project Management & Requirements Analysis and Specification>	In class	Responsibilities of project manager, Project planning, Metrics for project size estimation techniques, Empirical estimation techniques, COCOMO, Halstead's software science, Staffing level estimation, Scheduling, Staffing, Risk management, Software configuration management. Requirements gathering and analysis, Software requirement specification (SRS), Traceability, Overview of formal system development techniques.	8	3		
	**Assignment Topics	Organization and team structure.				

		Characteristics of a Good SRS Document, IEEE 830 guidelines.				
Module 3: <Software Design (Function-Oriented and Object-Oriented Software Design)>	In class	Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs function oriented design. Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD technique to real life systems, structured design, detailed design, Design review. Unified Modeling Language (UML), UML Diagrams: Static and Dynamic.	8	2		
	**Assignment Topics					
Module 4: <User interface design, Coding and Testing>	in class	Mode-based Vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology, Task and object modeling, Selecting a metaphor, Interaction design and rough layout. Coding, Code review, Testing-Basic Concept of testing, Testing Strategies, Testing in the large vs. testing in the small, Unit testing, Black-box testing, Integration testing, System testing, Some general issues associated with testing, Test driven development, testing tools, Special Value Testing, Combinatorial Testing, Decision Table Testing, Cause effect graphing, Pairwise Testing, White box Testing, Condition Testing, MC/DC Coverage, MC/DC Testing, Path Testing, Dataflow and Mutation Testing, Debugging, Program analysis tools.	8	4		
	**Assignment Topics	Characteristics of a Good User Interface, User Guidance and Online Help. User interface inspection				
Module 5: <Software Reliability And Quality Management, Computer Aided Software Engineering & Software Maintenance and Reuse>	in class	Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model, Personal software process (PSP), Six sigma, Software quality metrics. Case and its scope, Case environment, Case support in software life cycle. Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basics issues in any reuse program.	8	5		
	**Assignment Topics					
		Other characteristics of case tools, Towards second generation case tool, Architecture of a case environment. Reuse approach, Reuse at organization level.				

Text Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI.
2. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill.

Reference Books:

1. Jalote Pankaj, "An integrated approach to Software Engineering", Narosa.
2. Pressman R, "Software Engineering- Practioner Approach", McGraw Hill.
3. Somerville, "Software Engineering", Pearson
4. Budgen, "Software Design", Pearson

Sub Code: IT315A4   **Credit:1(L-0, T-0, P-2)**

ARTIFICIAL INTELLIGENCE LABORATORY

Course Objectives: This course is designed to offer a comprehensive introduction to the fundamental concepts and algorithms in artificial intelligence (AI), with a focus on algorithmic and computer Science-centric perspectives.

Pre-requisites: Proficiency in programming languages such as Python, Java, or C++, including knowledge of data structures and algorithms. Familiarity with basic concepts in mathematics, including calculus, linear algebra, and probability theory.

Course Outcomes (CO): On successful completion of this course, students should be able to:
1. Write program related to AI, Problem Solving and Machine Learning Fundamentals.
2. Problem solving by Search & Informed Search Techniques.
3. Comprehensive understanding of intelligent decision-making processes in complex and uncertain environments.
4. Solving Constraint Satisfaction Problems for Model real-world problems.
5. Design, apply and Implementation of Knowledge Representation Structures

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction to AI, Problem Solving and Machine Learning Fundamentals>	in class	Students will gain hands-on experience in implementing a simple AI algorithm for a classic game, Students will understand the principles of supervised learning, gradient descent optimization, and how to implement a simple classification model in Python, Students will gain hands-on experience in building and training an RNN model for sentiment analysis, along with an understanding of basic NLP concepts and deep learning architectures.	4	1		
	**Assignment Topics					
Module 2: <Problem solving by Search & Informed Search Techniques>	in class	Implement different uninformed search strategies to find the optimal move for a Tic-Tac-Toe game, Implement different informed search strategies to solve the 8-Puzzle problem using heuristic functions, Solve the 8-Queens problem using various search techniques.	4	2		
	**Assignment Topics					
Module 3: <Adversarial Search & Bayesian Networks>	in class	Implementation of Minimax algorithm for playing Tic-Tac-Toe against an AI opponent, Construction of a Python-based chess engine that utilizes the Alpha-Beta Pruning algorithm for efficient move selection, performing medical diagnosis using Bayesian inference.	4	3		
	**Assignment Topics					

Module 4: <Constraint Satisfaction Problems>	in class	Implementation of the N-Queen problem using the backtracking algorithm and Map Coloring problem using forward checking heuristic. These exercises should provide a hands-on experience with implementing CSPs, backtracking, and forward checking in Python.	7.2	4		
	**Assignment Topics					
Module 5: <Knowledge Representation and Reasoning >	in class	Implementation of the concepts of propositional logic, syntax, and semantics by performing various operations like Syntax Checker, Truth Table Generator, Semantic Analyzer. Exploration of predicate logic and its applications in knowledge representation by performing the exercises of Predicate Logic Parser, Knowledge Base Constructor, Inference Engine.	7.2	5		
	**Assignment Topics					

** Assignment Topics: Exercises to be formulated by the course instructor to cover a range of AI and ML topics and provide students with practical experience in implementing algorithms and models using Python.

Text Books:
1. Russell, S. & Norvig, P. (2010). Artificial intelligence: a modern approach. Prentice Hall (3rd ed.).
2. Elaine Rich, Kevin Knight & Shivashankar B. Nair (2008). Artificial Intelligence (Third Edition) TMH.
3. Bishop, C. M. (2006) Machine Learning and Pattern Recognition. Berlin: Springer.

Reference Book:
1. Poole, D. L. & Mackworth, A. K. (2010). Artificial intelligence: foundations of computational agents. Cambridge University Press.
2. Nilsson, N. J. (1998) Artificial Intelligence - A Modern Synthesis. Palo Alto: Morgan Kaufman.

COMPUTER NETWORKS LABORATORY

Course Objectives: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into thepractical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Communication Technique and Data Communication

Course Outcomes (CO): On successful completion of this course, the student should be able to:

1. Identify and understand various functions used in socket programs
2. Develop and test of socket program for client server interaction for various purpose.
3. Implementing and Validate Sub network with static and various dynamic routing protocols.
4. Analyze the packet structure of various protocols used for communication
5. Understand the fundamentals of SDN

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: TCP Socket Programs	in class	Introduction to client-server architecture, Introduction to working of TCP, functions related to TCP Socket Programming.	4	1,2		
	**Assignment Topics	Program to write a simple Message passing TCP socket program, TCP Socket program with specific aim, TCP socket program involving multiple clients.	3	1,2		
Module 2: UDP Socket Programs	in class	Introduction to client-server architecture, Introduction to working of UDP, functions related to UDP Socket Programming.	4	1,2		
	**Assignment Topics	Program to write a simple Message passing UDP socket program, UDP Socket program with specific aim.	3	1,2		
Module 3: Creating/Designing Sub-network with Static routing	In Class	Introduction to classless IP, Introduction to CIDR and VLSM, Introduction to Network Devices and Sub-netting, Basic Router configuration followed by Static route configuration	3	3		
	**Assignment Topics	To configure the sub-network with given requirements and configure the static route in the topology for routing.	3	3		
Module 4: Creating/Designing Sub-network with Dynamic routing	in class	Revision to CIDR and VLSM, revision to Basic Router configuration followed by Dynamic route configuration	3	3		
	**Assignment Topics	To configure the sub-network with given requirements and configure the Dynamic route in the topology for routing.	3	3		
Module 5: Introduction to SDN and traffic Monitoring	in class	Introduction to Software Defined Network, Introduction to Installation of Mininet, Overview of Mininet environment, Introduction to tools like ipref and wire shark.	3	4,5		

	Assignment Topics	To establish and configure the simple SDN network topology and use tools like ipref and wire shark for necessary analysis.	3	4,5		

Text Books:
1. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill
2. Andrew S. Tanenbaum, "Computer Networks", PHI.

Reference Books:
1. William Stallings, "Data and Computer Communications", PHI.
2. Alberto Leon-Garcia, Indra Widjaja, "Communication Networks – Fundamental Concepts and Key Architectures", Tata McGraw-Hill

Sub-Code:GN301A1   **Credit: 1 (L-1, T-0, P-0)**

QUANTITATIVE APTITUDE AND LOGICAL REASONING – I

Questions to be set: 05 (All Compulsory)

Course Objective: The main aim of introducing "Quantitative Aptitude & Logical Reasoning" to university students is to develop numerical skills among students and to prepare them for various examinations to enhance better job prospects. This initiative is being taken to include essential mathematical principles to build students' confidence. It is expected to expand students' knowledge and foster their logical reasoning and analytical thinking abilities.

Pre-requisites: NIL

Course Outcomes (CO): On successful completion of this course, the student should be able to:

1. Solve variety of simple problems in the space of quantitative domain.
2. Use data to determine or to deduce other facts from a set of given data of less complexity.
3. Use shortcuts, tricks and techniques to solve the problems with moderate   accuracy.
4. Demonstrate essential skills pertaining to public speaking, resume writing and telephone etiquette.
5. Demonstrate basic skills during the placement interviews

Module	Topics to be covered	Topics	Hrs.	CO	PO	PSO
Module 1: **Quantitative Aptitude**	In class	Problems on Trains, Time and Distance, Height and Distance, Time and Work, Simple Interest, Compound Interest, Profit and Loss, Partnership, Percentage, Problems on Ages, Calendar, Clocks, Average, Area, Volume and Surface Area	6	1		
Module 2: **Puzzles, Problem Solving and Analysis**	In class	Sudoku, Number Puzzles, Missing Letter Puzzles, Playing Card Puzzles, Clock Puzzles.	3	2		
Module 3: **Logical Reasoning**	In class	Number Series, Letter and Symbol series, Verbal Classification Essential Part, odd man out and visual reasoning, Analogies, Artificial Language, Matching Definitions, Making Judgements.	5	3		
Module 4: **Professional Builder**	In class	Resume Writing, Public Speaking, Extempore, Telephone etiquette.	4	4		
Module 5: **Use Cases**	In Class	Mock Interview – Hard and Soft Skills Sector: FMCG, IT, Production, Manufacturing etc.	2	5		

Text books:
1. Aggarwal, R. S. (2008). *Quantitative Aptitude*. S. Chand., ISBN: 9788121924986, 8121924987
2. Devi, S. (2005). *Puzzles to puzzle you*. Orient Paperbacks., ISBN: 8122200141, 9788122200140

INDUSTRIAL TRAINING-I

Course Objectives: The students are required either to undergo after 4th semester in the summer break/Vacation Straining in industries or to attend summer training course on courses beyond the scope of normal curriculum organized by the Department by calling experts from outside or to visit in industry for gaining valuable knowledge

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Select and provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
2. Adapt and enhance knowledge in one particular technology
3. Express and demonstrate self-confidence and helps in finding their own proficiency.
4. Develop leadership ability and responsibility to perform or execute the given task
5. Illustrate and practice within a real job situation.

Sub Code: BA346A1   **Credit: 2 (L-2, T-0, P-0)**

INDUSTRIAL MANAGEMENT

Questions to be set: 05 (All compulsory)

Course Objective: To provide basic knowledge of functions of management along with their practical implications

Pre-requisites: No pre-requisites

Course Outcomes (CO): On successful completion of this course, the student should be able to:

1. Provide basic knowledge and application of functions of management
2. Understand and apply principles of management evolved by pioneers of management.
3. Apply basic quantitative techniques for making decisions related to operations management
4. Apply various techniques for optimal production management
5. Apply concepts of materials management for maintaining optimal inventory

** Not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Introduction	In Class	Philosophy and Development of Management thought. Concept and definition of management, Functions and Roles of Management, Social Responsibilities of Management.	3	1		
	** Assignment Topics			1		
Pioneers in Management	In Class	Taylor's Scientific Management, Contribution of Henry Fayol, Maslow, McGregor, Gilbreth and Mayo.	3	2		
	** Assignment Topics			2		
Quantitative Techniques in Managerial Decisions	In Class	Concept of budget and budgetary control. Time-event network analysis; ABC Analysis, Break-even Analysis; Decision Tables; Concept of productivity, measuring productivity, Use information technology	5	3		
	** Assignment Topics			3		
Production Management	In Class	Types of production; Types of Planning, Manufacturing Planning; Production planning, Scheduling; Work study & Method Study; Systems of wage payments, bonus, Automation. Organization of production, planning and control department.	5	4		
	** Assignment Topics			4		
Materials Management	In Class	Practice of purchasing and materials management, quality, Inventory Management, EOQ model; Value Analysis and Value Engineering.	4	5		

	** Assignment Topics		5		

Text Books:

1. H. Koontz and H. Weihrich, "Management", McGraw Hill
2 Dobler W.D. "Purchasing & Materials Management", TMHC, New Delhi

Sub Code: IT321A1   **Credit: 4 (L-3, T-1, P-0)**

OPERATING SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: The principles and concepts that govern the design of modern computer operating systems are studied. Managing computing resources such as the memory, the processor and the Input/output devices are covered. Algorithms for CPU scheduling, memory and general resource allocation; process coordination and management; deadlocks and memory management techniques; case studies of Linux operating systems are also covered.

Pre-requisites: Computer Organization and Programming Language concepts.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Describe the different operating system architectures and structures.
2. Select the appropriate scheduling algorithms or techniques for efficient utilization of computer resource like CPU, Memory, etc.
3. Interpret theory of data inconsistency problem and provide a procedure for synchronization problem.
4. Manage various technical issues related to operating systems' services using principles of computer science and engineering.
5. Compose methods for analyzing the performance of various identified algorithms or techniques in operating systems

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: \<Introduction>	in class	Basics of Computer Organization, Interrupt, Bus, ISA, CPU Operation. What operating systems do? Operating system structure, Operating system operations, Special-purpose systems, Operating system services, User-operating system interface, System calls, Types of system calls.	7	1		
	**Assignment Topics	Operating system design and implementation. Case study: Linux Design Principles				
Module 2: \<Process management >	in class	Process: Concept, Multithreaded programming, Multithreaded models, Thread libraries, Threading issues, Process scheduling criteria and algorithms, Thread scheduling, Operating-system examples.	9	2,5		
	**Assignment Topics	Case study: Linux Process and I/O Scheduler.				
Module 3: \<Process synchronization>	in class	Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems.	8	3		
	**Assignment Topics	Monitors, Examples.				

Module 4: < Deadlock & Memory management >	in class	System model, Characterization, Methods of handling deadlocks, Prevention, Avoidance, Detection and recovery. Fixed and variable partition, Swapping, Paging and segmentation, Structure of page table, Combined systems, Virtual memory: Overlays, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing, Allocating kernel memory. Case study: Linux Memory Management	9	2,4		
	**Assignment Topics					
Module 5: < File systems & I/O systems>	in class	File system concept, Access methods, Directory structure, File- system mounting, File sharing, Protection. Overview, Kernel I/O subsystem, Kernel Data Structure, Transforming I/O requests to Hardware Operations,	7	2		
	**Assignment Topics	Allocation methods. Case Study: Linux I/O Systems.				

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts",
   Wiley & Sons.Inc..
2. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw-Hill.

Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating systems", PHI.
2. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw-Hill.
3. P. Balakrishna Prasad, "Operating Systems", Scitech Publication.
4. William Stallings, "Operating Systems-Internals and Design Principles", Pearson Education

WEB TECHNOLOGY AND WEB SERVICES

Questions to be set: 05 (All Compulsory)

Course Objectives:
1. To equip learners with adequate skills to conceptualize, design and develop well-engineered websystems.
2. To enable learners to apply free and open source web technologies for developing powerful and scalable web applications.

Pre-requisites: Programming language concepts, Computer Networks, Database Systems.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Identify the various terms and components of HTML, CSS, JavaScript, PHP and Drupal

2. Illustrate various components of web development languages

3. Connect different modules of open source technologies for website development

4. Select appropriate web technology for implementing solution to a given problem

5. Construct a web domain using appropriate tools and techniques

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction & HTML AND XHTML>	in class	History of internet and world wide web, World Wide Web consortium, Web architecture, Web 2.0, HTTP protocol, Personal, distributed and client-server computing. Introduction, editing XHTML, w3c XHTML validation service, headers, linking, images, special characters, unsorted lists, nested and ordered lists, XHTML tables, XHTML forms, internal linking.	8	1,2		
	**Assignment Topics	Web browser basics, Browser portability, meta elements.				
Module 2: < HTML5>	in class	HTML5 Basics, HTML5 Syntax, New HTML5 Elements, Times and Dates, Browser Support, Semantic Formatting, New Input Types and Attributes, New Form Elements and Attributes, Playing Audio, Playing Video.	7	2		
	**Assignment Topics	The Canvas, Other HTML5 Technologies.				
Module 3: <Style Sheets, JQuery and Ajax>	in class	Inline styles, embedded style sheets, conflicting styles, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu. JQuery: Introduction, What JQuery does, Functions, Selecting elements, Useful predefined Jquery functions, Add page elements, Adding events, Ajax: Introduction to Ajax: Overview of Ajax; The basics of Ajax.	9	1,3		

	Assignment Topics	User style sheets. Formatting elements			
Module 4: <Server Side Programming & Database Access through the Web >	in class	LAMP Technology, PHP: Origins and uses of PHP, Overview of PHP, General syntactic characteristic, Primitives, operations and expressions, Control statements, Looping, Arrays, Functions, Form handling, Files. Relational Databases, An introduction to SQL, The MySQL Database system, Database access with PHP and MySQL.		3,5	
	Assignment Topics	Cookies, Session tracking. Architectures for Database access			
Module 5: <Case studies: Drupal as a Content Management System >	in class	Basics of CMS, Workflow management using CMS, Free and open source content management frameworks in PHP: Drupal. Drupal: Drupaltechnology Stack in LAMP Platform, Drupal modules: Core, contributed and custom modules, Drupal Theme Configuration, Site Building: Content Type, Entity, Nodes, Views, Blocks, Taxonmoy, User management.		4,5	
	Assignment Topics	Wordpress, Joomlaand, permission and roles.			

Text Books:

1. M. Deitel, P.J. Deitel, A. B. Goldberg, "Internet & World Wide Web How to program", 3rd Edition, Pearson Education, 4 th edition, PHI, 2011.
2. Robert W. Sebesta, "Programming the World Wide Web", 4th Edition, Pearson Education.

Reference Books:

1. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India. Joyce Farrell, XueBai, Michael Ekedahl, "The Web Warrior Guide to Web Programming", Thomson

OPERATING SYSTEMS LABORATORY

Questions to be set: 05 (All Compulsory)

Course Objectives: At least 10 experiments covering the entire syllabus of the corresponding theory paper to be carried out using the theory studied /programming skill of the subject concerned to get insight into the practical applications of the theoretical studies. The outcome of the lab classes must lead to a skilled and self-sustained program developer.

Pre-requisites: Corresponding theory paper Operating Systems and the associated prerequisites

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Analyze and debug various technical issues related to operating systems services and use different types of Modern OS
2. Illustrate the concept of process and thread creation for executing user's task.
3. Apply the theory for implementing various process scheduling algorithms.
4. Produce optimal solution for data inconsistency problem by synchronizing processes and threads and deadlock handling.
5. Examine the various memory management strategies for efficient resource utilization and implement it.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Implementation Shell command of System Call	in class	Introduction to Process Creation, Termination, and use of various system call.	1.5	1		
	Unix Process Control Shell Programming Implementation of System Calls Interprocess Communication using PIPE. Interprocess Communication using SIGNALS	Implementation of different Linux tools and the *proc* file system. Write a shell program to calculate the factorial of a given number. Implement the fork() system call that generates the factorial and gives a sequence of series like 1, 2, 6, 24, 120… in the child process. The number of the sequence is provided in the command line. Implement the C program in which main program accepts an integer array. Main program uses the fork system call to create a new process called a child process. Parent process sorts an integer array and passes the sorted array to child process through the command line arguments of execve system call. The child process uses execve system call to load new program that uses this sorted array for performing the binary search to search the particular item in the array.	7.5	1		

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Module						
		Implementation of full duplex communication between parent and child processes using Pipe.				
Module 2: Scheduling Algorithms	in class	Introduction to Process, Process Life Cycle, Scheduling Criteria, and Various algorithms.	2	2		
	Implementation of CPU Scheduling Algorithms	WAP to implement various preemptive and non-preemptive scheduling algorithms, including Multi-level Scheduling algorithm.	10	2		
Module 3: Interprocess Communication	in class	Introduction to Process Synchronization and solution to Critical Section Problem. Discuss various classical synchronization problem.	1	3		
	Interprocess Communication using shared memory Producer Consumer problem using semaphore	Write a program that creates a shared memory segment and waits until two other separate processes writes something into that shared memory segment after which it prints what is written in shared memory. Write a C program to implement the givengame to illustrate Interprocess Communicationusing shared memory Implement producer consumer problem (bounded buffer) using multithreading and semaphore. Implement Reader Writers problem using multithreading and semaphore.	5	3		
Module 4: Deadlock	in class	Introduction to Deadlock, Conditions for deadlock to occur and solution for deadlock handling	0.5	4		
	Algorithm for Deadlock Avoidance	Implement Banker's algorithm for deadlock avoidance.	2.5	4		
Module 5: VM Management	in class	Introduction to Memory management for optimization.	1	5		
	Implement of Page Replacement Algorithm	Implement FIFO page replacement algorithm Implement LRU page replacement algorithm	5	5		

Text Books:
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Wiley & Sons.Inc..
2. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw-Hill.

Reference Books:
3. Andrew S. Tanenbaum, "Modern Operating systems", PHI.
4. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw-Hill.
5. P. Balakrishna Prasad, "Operating Systems", Scitech Publication.
6. William Stallings, "Operating Systems-Internals and Design Principles", Pearson Education

Sub Code: IT324A4   **Credit: 1 (L-0, T-0, P-2)**

WEB TECHNOLOGY & WEB SERVICES LABORATORY

Objectives: The objective of this laboratory is to develop an ability to design and implement static and dynamic website and also further develop web application.

Pre-requisites: Java Programming Lab.

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

1. To be able to design web pages.
2. To be able to create dynamic web pages.
3. To be able to illustrate the web data representation and services.
4. To be able to apply the concept of web programming by implementing the server side and client side programming.
5. To develop web applications using PHP, manage databases with MySQL, and understand the fundamentals of LAMP technology.

List of Programs:

1. Writing a validate function in java script to check the information submitted in the form is correct.

2. Write a function in java script to move a text in a page.

3. Write a function in java script to capture the Mouse Position.

4. Write a function in java script to opens printer dialogue to print current page.

5. Write a function in java script to show the date and time dynamically in the browser title bar.

6. Write a function in java script to disable both left and right button of a mouse and display an alert message.

7. Write a function in java script that asks the visitor for his or her name when entering your page, then prints a "Hello" welcome message anywhere you wish in the body of the page. If the visitor does not type in a message, a default message shows, instead.

8. Write a function in java script to presents text surrounded by three changing 'glow' colors, while also shifting the vertical and horizontal layout for a striking animation effect strongly resembling neon light displays. Colors, dimensions, and rate are all settable.

9. Write a function in java script to create links with over- and under-lines that move from side to side on mouseOver.

10. Write a function in java script to launch a popup window without the Windows frame or titlebar.

11. Write a JavaScript program for simple Calculator.

12. Various programs related to XML.

<u>**QUANTITATIVE APTITUDE AND LOGICAL REASONING - II**</u>

Questions to be set: 05 (All Compulsory)

Course Objective:
The key objective of this course is to strengthen the numerical skills and logical abilities & skills of university students and prepare them for various competitive exams, thereby improving their employment opportunities. This initiative aims to incorporate fundamental mathematical principles to build students' confidence. Additionally, it seeks to broaden their knowledge and foster their logical reasoning and analytical thinking skills.

Pre-requisites: NIL

Course Outcomes (CO): On successful completion of the course, the students will be able to:

1. Student will be able to solve variety of problems simple to complex in the space of quantitative domain.
2. Students will be able to use data to determine or to deduce other facts from a set of given data which are simple to complex.
3. Students will be able to use shortcuts, tricks and techniques to solve the problems with high accuracy.
4. Students will be able to demonstrate essential skills pertaining to business communications.
5. Students will be able to demonstrate advanced skills required at the time of placement interviews.

Module	Topics to be covered	Topics	Hrs.	CO	PO	PSO
Module 1: **Quantitative Aptitude**	In class	Problems on Permutations and Combinations, Probability, Numbers, Problems on Numbers, Problems on HCF and LCM, Decimal Fraction, Simplification, Square Root and Cube Root, Surds and Indices, Ratio and Proportion, Chain Rule, Pipes and Cistern, Boats and Streams, Allegation and Mixtures, Logarithm, Races and Games, Stocks and Shares, Probability, True Discount, Odd man out and Series.	8	1		
Module 2: **Puzzles, Problem Solving and Analysis**	In class	Logical Connectives and Syllogisms, Data Interpretation, Cases, Venn Diagrams.	3	2		
Module 3: **Logical Reasoning**	In class	Verbal Reasoning, Logical Problems, Logical Games, Data Arrangement and Blood Relations, Analyzing Arguments, Statement and Assumption, Course of action, Statement and Conclusion, Theme Detection, Cause and Effect, Statement and Argument, Logical Deduction.	4	3		
Module 4: **Professional Builder**	In class	CV Writing, Verbal & Non Verbal Communication, Group Discussion, Netiquettes,	2	4		
Module 5: **Use Cases**	In Class	Mock Interview on Hard and Soft Skills Sector - IT, FMCG, Product, Financials, Manufacturing, Production, Construction etc.	3	5		

Text books:

1. Aggarwal, R. S. (2008). *Quantitative Aptitude*. S. Chand., ISBN: 9788121924986, 8121924987
2. Devi, S. (2005). *Puzzles to puzzle you*. Orient Paperbacks., ISBN: 8122200141, 9788122200140

Sub Code: IT325A5   **Credit:1 (L-0, T-0, P-2)**

MINOR PROJECT

Course Objective: The students are required to undertake innovative and research-oriented project under the direct supervision of a faculty member of the department. The mini project should not only to reflect their knowledge gained in the previous semesters but also to acquire additional knowledge and skill of their own effort.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Describe the basic concepts of computer science related to the problem under consideration
2. Identify an appropriate engineering problem to be solved
3. Construct an appropriate design methodology for software development and demonstrate effective communication and writing skills
4. Experiment on a designed model and develop an ability to work in a team.
5. Evaluate the project based on application of knowledge and practical understanding of the model.

MAJOR PROJECT-PHASE I

Course Objective: The students are required to undertake innovative and research-oriented project, not only to reflect their knowledge gained in the previous semesters but also to acquire additional knowledge and skill of their own effort.

During this phase, the students are required to submit progress of their work in phases to make the department aware of his/her project. At the end, students have to report to the internal guides/faculty members for final refinement and documentation. It is mandatory to follow the engineering methodologies in carrying out the project work. The project is evaluated through internal presentation before the panel of faculty members followed by the evaluation by external examiner appointed by the university.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Analyse, design and implement a computational system to meet desired needs within realistic constraints.
2. Apply modern programming languages and technologies to develop a sustainable and robust software / hardware application or perform qualitative analysis on computational systems using appropriate tools.
3. Propose set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
4. Express ethics, values and respects legal as well as social issues for the computing profession or computational application.
5. Justify the technical design incorporated in the computational system with the help of in-depth analysis, presentation as well as document pertaining to the project work.

Sub-Code: IT412A9   **Credit:1 (L-0, T-0, P-2)**

INDUSTRIAL TRAINING-II

Course Objectives: The students are required either to undergo after 6th semester in the summer break/Vacation Straining in industries or to attend summer training course on courses beyond the scope of normal curriculum organized by the Department by calling experts from outside or to visit in industry for gaining valuable knowledge.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Select and provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
2. Adapt and enhance knowledge in one particular technology
3. Express and demonstrate self-confidence and helps in finding their own proficiency.
4. Develop leadership ability and responsibility to perform or execute the given task
5. Illustrate and practice within a real job situation.

Sub Code: IT421A6   **Credit:9 (L-0, T-0, P-18)**

MAJOR PROJECT-PHASE II

Course Objective: The students are required to undertake innovative and research-oriented project, not only to reflect their knowledge gained in the previous semesters but also to acquire additional knowledge and skill of their own effort.

During this phase, the students are required to submit progress of their work in phases to make the department aware of his/her project. At the end, students have to report to the internal guides/faculty members for final refinement and documentation. It is mandatory to follow the engineering methodologies in carrying out the project work. The project is evaluated through internal presentation before the panel of faculty members followed by the evaluation by external examiner appointed by the university.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Analyse, design and implement a computational system to meet desired needs within realistic constraints.
2. Apply modern programming languages and technologies to develop a sustainable and robust software / hardware application or perform qualitative analysis on computational systems using appropriate tools.
3. Propose set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
4. Express ethics, values and respects legal as well as social issues for the computing profession or computational application.
5. Justify the technical design incorporated in the computational system with the help of in-depth analysis, presentation as well as document pertaining to the project work.

Sub Code: IT211A3   **Credit:4 (L-3, T-1, P-0)**

PYTHON PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course introduces Python as imperative, functional, procedural and object oriented programming language. Python also serves as a scripting language for web applications. The units cover the Python language with a focus on its object-oriented features, web applicability and how these can be implemented as part of program designs and implementation. The students shall also gain knowledge on practical applications of python in scientific computing using libraries such as NumPy, Matplotlib etc.

Pre-requisites: Computer Programming concepts of C, C++ etc.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Define the basic structure of python programming.

2. Differentiate imperative, functional and procedural programming features in Python

3. Practice features for designing and implementing python program.

4. Compose applications using various libraries and concepts of Python.

5. Select methods to build and package Python modules for reusability

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: \<Introduction & Python Program Flow Control\>	in class	History, need of python programming, data types, variables, expressions, operators, sequence, list, tuple, set, dictionary, print statement, etc. Conditional blocks using if, else and elseif, Simple for loops in python, For loop using ranges, string, Use of while loops in python, Loop manipulation using pass, continue, break and else,	8	1,2		
	**Assignment Topics	Programming using Python conditional and loops block, Functions.				
Module 2: \< Python Object–based programming \>	in class	Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class, Inheritance, overlapping and overloading operators,	8	2,3		
	**Assignment Topics	Adding and retrieving dynamic attributes of classes.				
Module 3: \< Error and Exceptions & Python Regular Expression	in class	Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions. Powerful pattern matching and searching, Real time parsing of networking or system data,	8	3		

and GUI design >		Widgets and basic components, Layout options, Event handling.				
	Assignment Topics	Real time parsing of networking or system data, Widgets and basic components				
Module 4: <Python Database Interaction and File Operation>	in class	SQL Database connection using python, Creating and searching tables, Reading and storing config information on database, Programming using database connections, Reading config files in python, Writing log files in python, Understanding read functions: read(), readline() and readlines().	8	4		
	Assignment Topics					
Module 5: < Python Standard Library & Applications>	in class	Study of modules for creating graphical user interfaces, connecting to relational databases, generating pseudorandom numbers, arithmetic with arbitrary precision decimals, manipulating regular expressions, unit testing, Python Package Index (PyPI). APIs for scripting: Web Server Gateway Interface, Web frameworks like Django, Libraries for scientific computing such as NumPy, SciPy and Matplotlib.	8	4,5		
	Assignment Topics	Pylons, Pyramid, TurboGears,web2py, Tornado, Flask, Bottle, Zope etc.				

Text Books:

1. Mark Lutz, "Programming Python", O'Reilly.
2. W.Chun, "Core Python Programming", Pearson.

Reference Books:

1. Allen Downey, "Think Python", Green Tea Press
2. Mark Lutz, "Learning Python", 3rd Edition, O'Reilly
3. Guido van Rossum and Jr. Fred L. Drake , "An Introduction to Python", Network Theory Ltd.

SYSTEM SIMULATION AND MODELING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course envisages the fundamentals of discrete event simulation (DES), which includesdiscrete event simulation methodology, development of simulation models, verification and validation, and the design of simulation experiments.

Pre-requisites: Probability & Statistics and System Analysis concepts.

Course Outcomes: On successful completion of this course, students will be able to:

1. Explain the understanding of mathematical modeling through use in computer system modellingand simulations
2. Describe the system behavior in investigating discrete event simulation, modeling and system dynamics
3. Develop simulation models
4. Test validity of model through analysis of output data
5. Simulate the models for the purpose of optimum control by using different software.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Simulation & Examples	in class	Components of a system, Model of a system, Types of models, Discrete and continuous systems, Components and organization of a discrete event simulation model, Continuous simulation, Monte Carlo simulation, Steps in simulation study, Advantages Disadvantages. Simulation of Queuing systems, Simulation of inventory systems, Simulation of Reliability Systems.	8	1		
	**Assignment Topics	Combined discrete continuous simulation, pitfalls of simulation				
Module 2: General Principles and Modeling Complex Systems. Statistical Models in Simulation	in class	The event scheduling approach, The process interaction approach, The activity scanning approach, List processing in simulation: Approaches to storing lists in a computer, Time-shared computer model. Review of terminology and concepts, Useful statistical models, discrete distributions, Continuous distributions.	8	1,2		
	**Assignment Topics	**Multi-teller Bank with Jockeying, Job-Shop Model, Efficient event-list manipulation.**				
Module 3: Queueing Theory &	in class	Characteristics of queuing systems, Queueing Notations, Transient and Steady-State behaviour of Queues, Long –Run measures of performance of Queueing	9	2,3		

Random Number Generation		Systems, Steady state behavior of Infinite population Morkovian models [M/G/1 only]. Properties of random numbers, Generation of pseudo random numbers, Random-Number Generators : Linear Congruential Generators, Combined Linear Congruential Generators. Building Valid, Credible, and Appropriately Detailed.				
	**Assignment Topics	**Networks of Queues. Feedback Shift Register Generators, Tests for Random Number Generators**				
Module 4: Simulation Models and Selecting Input Probability Distributions	in class	Guidelines for determining the level of Model Details, Verification of Simulation Computer Programs, Techniques for increasing Model Validity and Credibility. Identifying the distribution with data, Estimation of Parameters, Determining how representative the fitted distributions are, Selecting input Models in the absence of data, Models of arrival Processes(Poisson process, Non stationary Poisson process, batch arrivals).	9	3		
	**Assignment Topics	**Statistical Procedures for Comparing Real- World Observations and Simulation Output Data.**				
Module 5: Output Data Analysis for a Single System and Experimental Design	in class	Transient and Steady State behavior of a stochastic process, Types of simulations with respect to output analysis. Common mistakes in experimentation, Types of Experimental Designs, 2k factorial Designs.	9	4,5		
	**Assignment Topics	**2kr factorial Designs.**				

Text Books:
1. Averill M Law, "Simulation Modeling and Analysis", Tata McGraw Hill.
2. Banks, Carson, Nelson, Nicol, "Discrete-Event System Simulation", Pearson Education.

Reference Books:
1. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design,Measurement, Simulation, and Modeling", John Wiley & Sons.
2. Gordon, "System Simulation", Prentice Hall.
3. Singh V.P, "System Modeling and Simulation", New Age International.
4. Frank L. Severence, "System ModelingAnd Simulation: An Introduction", Wiley

Sub Code: IT213A3   **Credit: 4(L-3, T-1, P-0)**

INFORMATION SYSTEMS AND SECURITY

Questions to be set: 05 (All Compulsory)

Course Objectives: **To enable students to comprehend the development, design, and implementation of Management Information Systems (MIS), and to understand the fundamentals of information security assessment and security auditing.**

Pre-requisites: Nil

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Understand the basic principles of Management Information System and distinguish planning and control of management system.
2. Identify the benefits and challenges of enterprise systems.
3. Examine the security risk assessment, control and measure the various security management processes.
4. Demonstrate the security audit tasks and the key aspects of legal and ethical issues.
5. Develop skills in security auditing, logging, and audit trail analysis and understand the dynamics of intellectual property, privacy, and ethical issues.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs
Module 1: Understanding MIS	in class	Introduction to Management Information Systems, History of MIS, Impact of MIS, Role and Importance, MIS Categories, Managers and Activities in IS, Types of Computers Used by Organizations in Setting up MIS.	6
	**Assignment Topics	Hardware support for MIS.	
Module 2: Conceptual Foundations and Kinds of Information Systems	in class	Introduction, The Decision Making Process, System Approach to Problem Solving, The Structure of Management Information System. Introduction, Types of Management Systems Concepts of Management Organization, Planning and Control: Introduction, Differences between planning and control information, Systems Analysis, Systems Design.	6

		**Assignment Topics	MIS Planning and Development: Introduction, Planning, development.	
Module 3: MIS and BPR	in class		Introduction, Business Process Re – Engineering, Improving a process in BPR, Object Oriented methodology, BPR – Current Focus, MIS Organization Structure: Introduction, MIS at Management levels, Strategic Level Planning, Operational Level Planning, Economic and Behaviour Theories. Enterprise Resource Planning: Introduction, Basics of ERP, Evolution of ERP.	6
	**Assignment Topics		Enterprise Systems in Large Organizations, Benefits and Challenges of Enterprise Systems.	
Module 4: IT Security Management and Risk Assessment	in class		IT Security Management, Organizational Context and Security Policy, Security Risk Assessment, Detailed Security Risk Analysis. Security Controls, Plans, and Procedures: IT Security Management Implementation, Security Controls or Safeguards, IT Security Plan.	6
	**Assignment Topics		Implementation of Controls, Implementation Follow-up.	
Module 5: Physical, Infrastructure and Human Resources Security	in class		Overview, Physical Security Threats, Physical Security Prevention and Mitigation Measures, Recovery from Physical Security Breaches, Integration of Physical and Logical Security. Security Awareness, Training, and Education, Employment Practices and Policies.	6
	**Assignment Topics		E-Mail and Internet Use Policies, Computer Security Incident Response Teams.	

| Module 6: Security Auditing, Legal and Ethical Aspects | in class | Security Auditing Architecture, Security Audit Trail, Implementing the Logging Function, Audit Trail Analysis. Cybercrime and Computer Crime. | 6 |
| | **Assignment Topics | Intellectual Property, Privacy, Ethical Issues. | |

Text Books:

1. W. Stallings, Computer Security: Principles and Practice, 2nd Edition, Prentice Hall, ISBN: 0132775069, 2011.
2. M. Stamp, Information Security: Principles and Practice, 2nd Edition, Wiley, ISBN: 0470626399, 2011.
3. James A O'Brien, Management Information Systems, Tata McGraw Hill.

Reference Books:

1. M. E. Whitman and H. J. Mattord, Principles of Information Security, 4th Edition, Course Technology, ISBN: 1111138214, 2011.
2. M. Bishop, Computer Security: Art and Science, Addison Wesley, ISBN: 0-201-44099-7, 2002.
3. G. McGraw, Software Security: Building Security In, Addison Wesley, ISBN: 0321356705, 2006.

MICROPROCESSORS AND PERIPHERAL DEVICES

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is intended to give students good understanding of internal architectural details and functioning of 8085 and 8086 microprocessors. The students will have thorough and in-depth knowledge of microprocessors, its architecture, working principles including timing diagrams and assembly language programming using hand assembly as well as assembler. This course also highlights 8051Microcontroller.

Pre-requisites: Digital Circuits & Logic Design and Computer Organization & Architecture.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Identify and describe the structure and functions of basic elements of 8085, 8086 Microprocessors andvarious peripheral devices.
2. Sketch block diagrams of Microprocessors and peripheral devices. Illustrate the execution of instructionsby the MP using timing diagrams. Explain interfacing of MP with peripheral devices
3. Design circuit diagrams for interfacing the MP with peripheral devices as per the problem statement forcreating an application
4. Write programs for microprocessors and MP based applications using assembly language
5. Describe the MP-specific assembly language constructs and syntaxes.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction to microprocessor & 8085>	in class	Microprocessors Evolution and Types, Overview of microprocessor-based systems. Pin description &Internal Architecture of 8085, Multiplexed data/address bus, Addressing modes of 8085, 8085 instructions, Instruction cycle, Machine cycle, Bus timing of 8085, and 8085 interrupts. Programming using 8085 instructions using hand assembly. Counters and time delays.	9	1,2		
	**Assignment Topics	8085 Stacks and subroutines.				
Module 2: < Introduction to 8086>	in class	Pin descriptions of 8086, internal architecture of 8086, 8086 instructions, interrupts of 8086& interrupt vector table.	9	1,3		
	**Assignment Topics	Addressing modes supported by 8086				
Module 3: <Assembly language programming	in class	An introduction to assembly language programming in 8086, macros, procedures. 8086 address and data buses, RAM/ROM interfacing to 8086, 8086 port addressing space.	8	4,5		

using 8086 & Memory System Design and I/O System Design>	**Assignment Topics	Assembler directives. DOS interrupt 21H functions, I/O mapped I/O and memory mapped I/O, designing a port address decoder.				
Module 4: <Introduction to Peripheral Devices >	in class	Introduction to 8259 PIC, 8254 PIT, 8251 USART.	7	3		
	**Assignment Topics	8255 PPI				
Module 5: <Introduction to 80286, 80386 and 8051 microcontroller >	in class	Internal architectures of 80286 and 80386, special registers of 80286 and 80386.	7	3		
	**Assignment Topics	Memory management in 80286 and 80386, Architecture 16 bit & 32 bit processors.				

Text Books:

1. Microprocessor Architecture, Programming and Applications with 8085, by Ramesh Gaonkar, PenramInternational Publishing (India) Pvt. Ltd., Fifth Edition.
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications,by Walter A. Triebel and Avtar Singh, Pearson Education, Fourth Edition.
3. Microprocessors and Microcomputer based system design, by MahamedRafiquzzaman, UBS, 1994(Only for MOTORALA 68000 Microprocessor)

Reference Books:

1. Microprocessor X86 Programming - K R Venugopal and Raj Kumar, BPB Publications, 1995.
2. IBM PC Assembly Language Programming, by Peter Abel, Pearson Education Asia, Fifth edition.
3. Advanced Microprocessors & Peripherals Architecture, Programming &Interfacing , by A K Ray, K MBhurchandi, Tata Mcgraw Hill Publishing Company Limited, 2000.

Sub Code: IT215A3   **Credit: 4 (L-3, T-1, P-0)**

E-COMMERCE

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide advanced concepts and technologies in depth for e-commerce, provide with the necessary quantitative reasoning and analysis to deal with critical questions for modern e-business development, introduce models for satisfying performance from a complex e-commerce application and introduce related topics such as security and legal, ethical, and social issues.

Pre-requisites: Nil

Course Outcomes (CO): At the end of the course, the student will be able to:
1. Understand E-commerce activities and apply E-commerce business models in various applications.
2. Identify various E-commerce marketing concepts.
3. Identify various security threats in E-commerce environment.
4. Apply basic cryptography techniques to enable secure E-commerce.
5. Illustrate E-commerce payment systems and explain intellectual property rights.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to E-Commerce and E-Commerce Business Models	in class	Introduction to E-commerce: – What is E-Commerce – E-commerce and E-business – Features of e-commerce technology – Types of E-commerce E-Commerce Business Models: – Introduction – Key elements – B2C Business model – B2B Business model – C2C Business model – P2P Business model	7	1		
	**Assignment Topics	Survey of various existing E-Commerce business models		1		
Module 2: E-Commerce Infrastructure and E-Commerce Marketing concepts	in class	E-commerce Infrastructure: – The Internet – WWW – Building an E-commerce website E-Commerce Marketing Concepts: – Basic marketing concepts – Consumer Behavior – Internet marketing – Online marketing communications	7	2		
	**Assignment Topics	Brief history of the Internet and brief history of the world wide web(WWW).		2		

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 3: E-Commerce Security	in class	Security Threats in E-Commerce Environment: – Malicious code, Unwanted programs, Phishing and identity theft, Hacking and cybervandalism, Credit card fraud, Spoofing and spam web sites, Denial of Service(DoS) attacks. Basic Cryptography for protecting communications in the Internet: – Security concerns – Security requirements – Encryption-Private key encryption – The key distribution problem– Diffie-Hellman key exchange protocol–Public key encryption–RSA encryption algorithm-Message digest–MD5 message digest algorithm– Other message digest algorithms – Digital signature – Digital certificate – Certificate revocation. Securing Channels of Communication: – Secure Sockets Layer(SSL) – Secure HyperText Transfer Protocol (S-HTTP) – Virtual Private Networks (VPN) Protecting Networks: – Firewalls–- Packet Filtering Routers – Application Gateways	8	3		
	**Assignment Topics	Examples of firewall systems.		3		
Module 4: E-Commerce Payment Systems	in class	E-Commerce Payment Systems: – Introduction – Types of Payment system – Credit card E-Commerce transactions – Digital wallets – Digital Cash – Electronic Billing Presentation and payment	7	4		
	**Assignment Topics	Survey payment system of any popular E-Commerce web site.		4		
Module 5: Ethical, Social and Political Issues in E-commerce	in class	Ethical, Social and Political Issues in E-commerce – Understanding ethical, social and political issues – Privacy and Information Rights – Intellectual Property Rights – Governance – Public safety and Welfare	7	5		
	**Assignment Topics	IT Act 2000 of India.		5		

Text Books:

1. E-Commerce: Business, Technology, Society, Kenneth C.Laudon & Carol G.Traver, 2008, Pearson Education.

Reference Books:

1. Digital Money: The New Era of Internet Commerce, Daniel Lynch and Lundquist,1996, John Wiley
2. Web Commerce Technology Handbook, Daniel Minoli & Emma Minoli, 1998,McGraw Hill
3. Frontiers of Electronics Commerce, Kalakota Whinston Stone, 1996, Addison Wesley

4. Developing E-Commerce Sites: An Integrated Approach, Vivek Sharma & Rajiv Sharma, 2000, Pearson Education
5. E-Business and E-commerce Management, Dave Chaffey, 2009, Pearson Education

SOFT SKILLS AND INTERPERSONAL COMMUNICATION

Questions to be set: 05 (All Compulsory)

Course Objectives: This course aims at holistic development of students and improves their employability skills.

Pre-requisites: Prior knowledge of any particular subject is not a mandatory requirement. Ability to read, write and understand English language is expected from students. After completion of the course a student is expected to show improved communication skills

Course Outcomes(CO): On completion of the course, the students will be able to:
1. Apply knowledge of human communication and language processes as they occur across various contexts.
2. Evaluate key theoretical approaches used in inter disciplinary field of communication.
3. Choose and apply at least one of the appropriate approaches to the analysis and evaluation of human communication.
4. Assess and evaluate primary academic writing associated with the communication discipline.
5. Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Basics of Communication Comprehension and analysis	in class	Importance of Communication, stages of communication, modes of communication, barriers to communication, strategies for effective communication, listening: Importance, types, barriers, Developing effective listening skills Comprehension of technical and non-technical material, Reading for Facts, Guessing Meanings from Context, Skimming, Scanning, Inferring Meaning.	8	1		
	**Assignment Topics					
Module 2: Writing	in class	Effective sentences, cohesive writing, clarity and conciseness in writing, Better paragraphs Writing Skills – Structure and Presentation of Different Types of Writing – Letter writing/Resume Writing/ e-correspondence/ Technical Report Writing.	3	2		
	**Assignment Topics	Technical Report Writing				
Module 3: Professional Personality Attributes & Self Grooming	in class	Story Telling for impactful communication, Group Discussions, Dialogue writing, Extempore, Debates, Role Plays, Conversation Practice, Code and Content, Stimulus & Response, PronunciationEtiquette, Tone: Rising tone; Falling Tone, Flow inSpeaking, Speaking with a purpose, personality, Empathy,	6	3,5		

		Branding yourself, Influencing others				
	**Assignment Topics	Case Studies: Speech / TedTalks				
Module 4: Business Writing / Correspondence Presentation Skills	in class	Internal Business Communication: Writing Memos, Circulars, Notices, Report writing, Instruction, Business Letters, Resumes, Job applications, communication through email Oral Presentations (individual or group), Seminars, PPTs Written Presentations through Posters, Projects, Reports, emails, Assignments, Class room presentation; style, method, Individual conferencing; essentials, Public Speaking; method; Techniques; Clarity of substance; Emotion; Humor, Overcoming Stage Fear; Audience Analysis & retention of audience interest; Audience Participation	12	3,4		
	**Assignment Topics					
Module 5: Technical Communication Interpersonal Communication	in class	Distinction between General and Technical Communication, Technical Report: Definition & importance, Thesis/Project writing: structure & importance, synopsis writing: Methods, Technical research Paper writing: Methods & style, Seminar & Conference paper writing, Critical thinking, Discourse competence, combination of expression & conclusion, Socio-linguistic competence, Cross-cultural communication,	8	5		
	**Assignment Topics					

Text Books
1. Technical Communication – Principles and Practices by Meenakshi Raman& Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
2. Personality Development and Soft Skills by Barun K. Mitra, OUP, 2012, New Delhi.

Reference Books
1. Spoken English- A Manual of Speech and Phonetics by R.K.Bansal &J.B.Harrison, Orient Blackswan, 2013, New Delhi.
2. Business Correspondence and Report Writing by Prof. R.C. Sharma &Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Practical Communication: Process and Practice by L.U.B. Pandey;
4. A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2014, Delhi.
5. Skills for Effective Business Communication by Michael Murphy,Harward University, U.S.
6. Business Communication for Managers by Payal Mehra, Pearson Publication, Delhi
7. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005

Sub Code: IT221A3   **Credit: 4 (L-3, T-1, P-0)**

DESIGN AND ANALYSIS OF ALGORITHMS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course builds upon preliminary knowledge delivered in Data Structures. The main objectives of the course are to provide thorough knowledge and understanding of different algorithm analysis techniques, design strategies and their applications. Special purpose machines, some critical problems and innovative techniques are used in solving them.

Pre-requisites: Data Structures and Programming concepts.

Course Outcomes (CO): On successful completion of this course, students should be able to:
1. Define asymptotic notations and solve problems related to it
2. Calculate time and space complexities for recursive/non-recursive algorithm based on following algorithmdesign techniques - divide and conquer, greedy, dynamic programming and branch and bound.
3. Select appropriate algorithm design technique to solve a given problem.
4. Explain the working of existing algorithm / algorithm design techniques
5. Discuss and describe the classes P, NP, and NP-Complete

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Algorithms & Mathematical preliminaries >	In Class	Definition, aim of the subject, designing algorithms and Analyzing algorithms: An introduction, Performance of a program: Space and Time complexity. Asymptotic notations and common Functions	9	1		
	**Assignment Topics	Example Asymptotic notation: Insertion sort				
Module 2: < Recurrences and divide and conquer >	In Class	The basics of divide & conquer method, Merge sort , Quick sort, Solving recurrences: Substitution method, Recursion tree method, Finding maximum and minimum, Strassen's matrix multiplication, Binary search.	7	2		
	**Assignment Topics	Master method: Proof of master method				
Module 3: < Greedy method >	in class	Basics of greedy method, Applications- 0/1 Knapsack Problem – Topological sorting-Heapsort, Huffman codes, Activity selection, Minimum spanning tree-Kruskal's algorithm, Prim's algorithm, Single source shortest path: Dijkstra's algorithm	7	3		
	**Assignment Topics	Topological sorting – Bipartite Cover				
Module 4: < Dynamic programming	in class	Basics of dynamic programming, Applications- Matrix chain multiplication, longest common subsequence, Traveling salesperson problem, all pair shortest Path-Floyd and Wars hall's algorithm.	9	4		

& Back Tracking >		Backtracking Method, Applications-Container Loading, 0/1 Knapsack Problem, Max Clique, Travelling Salesperson, Board Permutation			
	**Assignment Topics	Non-Crossing Subsets of Nets			
Module 5: < Branch And Bound & NP completeness >	in class	Branch and Bound Method, Applications-Container Loading, 0/1 Knapsack Problem, Max Clique, Travelling Salesperson. Basic Concepts, P NP, NP Complete, NP Hard problems, Travelling Salesman Problem.	8	5	
	**Assignment Topics	Board Permutations.			

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "Introduction to Algorithms", PHI.
2. Sartaj Sahni, "Data Structures, Algorithms amd Applications in C++", University Press.

Reference Books:

1. A. Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education.
2. S. Basse, A. Van Gelder, "Computer Algorithms-Introduction to Design and Analysis", Pearson.
3. Alfred V. Aho, John E. Hop croft, Jeffrey D. Ullman, "Data Structures and Algorithms", Addison Wesley.
4. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson Education.

Sub Code: IT222A3   **Credit: 4 (L-3, T-1, P-0)**

MICROCONTROLLERS

Questions to be set: 05 (All Compulsory)

Course Objectives: To know the difference between microprocessor and microcontroller, deal with several microcontroller-based embedded systems and know microcontroller-based assembly language programming.

Pre-requisites: Microprocessors.

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Understand different types of microcontrollers, their pin configurations, and internal architectures.
2. Understand the 8051 microcontroller's architecture, I/O operations, special function registers, and addressing modes.
3. Apply various instruction sets of 8051 microcontrollers for developing programs.
4. Apply knowledge of interrupts, timers, and serial communications within the 8051 microcontroller system.
5. Illustrate interfacing of peripheral devices with 8051 microcontrollers

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	In class	Introduction to Microcontrollers: Definition of a microcontroller- Difference between microprocessors and microcontrollers - Different types of microcontrollers - Intel MCS-51 family of microcontrollers – ATMEL AVR – INTEL MCS-96 - ARM	7	1		
	**Assignment Topics	A survey on 8,16 ,and 32-bit microcontrollers.				
Module 2: General architecture, I/O ports and special function registers, and addressing modes of 8051 microcontroller	In class	General architecture: Pins and signals – internal architecture -program memory and data memory – system clock and reset. I/O ports and special function registers: SFR map and functions – A – B - PSW – SP – port registers P0, P1, P2, P3 – PCON. Addressing modes: Instruction format – addressing modes	7	2		
	**Assignment Topics	Addressing modes of ATMEL AVR and ARM microcontrollers.				

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Instruction set of 8051 microcontroller	In **Module 3:** class	Data transfer instructions: forms of MOV instructions, 8/16 bit data load. Arithmetic instructions: – ADD – SUBB – INC – DEC instructions. Program branching instructions: – unconditional jumps – conditional branching. Subroutines and stack: – LCALL – ACALL – RET instructions – nesting of subroutines. Logical instructions: – ANL – ORL – XRL – CPL – rotate instructions. Boolean variable manipulation: – SETB – CLR – MOV – JC – JNC – JB – JNB – ANL – ORL – CPL instructions. Advanced instructions: – MOVC – MOVX _ XCH – XCHD – MUL – DIV – DAA – JMP – SWAP – JBC – RETI instructions.	8	3		
	**Assignment Topics	Programming examples: – Copy block – shift block – sum of series – bubble sorting etc using 8051 instruction sets.				
Module 4: Interrupts in 8051 microcontroller	In class	External interrupts: – INT0 – INT1 – related SFRs – ISR. Timer/Counter interrupts: – functioning of Timer 0 and Timer 1 – related SFRs – ISR – Timer. Serial communication and serial interrupts: – overview – related SFRs – serial communication modes – serial communication issues	7	4		
	**Assignment Topics	Examples of interrupts based on case study				
Module 5: Interfacing and Power Management	In class	Interfacing – memory – keyboard – display ADC – DAC – Motors – software examples	7	5		
	**Assignment Topics	Power management – power saving modes – case study				

Textbooks:
1. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing, Subrata Ghoshal, 2010, Pearson Education.

Reference Books:
1. Microcontrollers: Architecture, Programming, Interfacing and System Design, Raj Kamal, 2009, Pearson Education
2. Embedded systems and Robots: Projects using the 8051 microcontroller by Subrata Ghoshal, 2009, Cengage Learning India.
3. The 8051 Microcontroller by Kenneth J. Ayala, 2008, Cengage Learning India

Sub Code: IT223A3   **Credit**:4 (L-3, T-1, P-0)

COMPUTER GRAPHICS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course highlights the overview of display devices and peripherals, software and techniques used in computer graphics. Study of the principles of interactive computer graphics; systems organization and device technologies for raster and vector displays; region filling techniques; 2-D and 3- D viewing, clipping, segmentation and interaction handling; 3-D geometrical transformations, projections andhierarchical data structures for graphics modelling including hidden lines and surfaces, lighting, texturing, shading and colour models.

Pre-requisites: Programming concepts and Basic Mathematics

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Describe the competence in application of mathematical modelling to computer graphics

2. Explain an ability to interpret a solution plan and methodology for an engineering problem using computergraphics

3. Discuss an ability to conduct investigations of technical issues related to computer vision with their levelof knowledge and understanding

4. Illustrate an ability to advance an engineering design to defined end state

5. Compare different algorithms used to solve a computer vision problem.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction, overview of graphics systems & Output primitives>	In Class	Display devices, Hard copy devices, Interactive input devices, Display processors. Points and lines, Line drawing algorithm, Anti-aliasing lines, Circle generating algorithms (Bresenham's), Ellipse, Other curves, Character generation.	8	1		
	**Assignment Topics					
Module 2: < Attributes of output primitives & Two dimensional transformations>	In Class	Line styles, Color and intensity, Solid area scan conversion, Character attributes, Inquiry functions, Bundled attributes. Basic Transformations, Homogenous co-ordinates, Composite Transformations, Reflections, Shear	8	2,4		
	**Assignment Topics					
Module 3: < Windowing and clipping, Segments,	In Class	Windowing concepts, Clipping Algorithms, Line clipping (Cohen Sutherland & Mid-point sub division), Area Clipping, Text Clipping, Window to view port transformation.	9	2,3		

Interactive input methods>		Concepts, Segment files, Attributes, Segment naming schemes, Default error conditions. Physical input devices, Logical classification of input devices, Interactive picture construction techniques.				
	**Assignment Topics					
Module 4: < Modelin gmethods &Three dimensional concepts>	in class	Basic modeling concepts, Master co-ordinates & modeling transformations, structured display files, symbol operations, combining modeling & viewing operations. 3-D Co-ordinate system, Display techniques, 3-D Representation, Polygon surfaces, Curved surfaces, 3-D transformations.	7	4		
	**Assignment Topics					
Module 5: < 3-D viewing & Hidden surface & hidden line removal:>	in class	Projections, Viewing transformations, Implementations of viewing operations. Depth buffer algorithms, Scan line coherence algorithms, Area coherence algorithm, Priority algorithms, Shading & color model.	8	5		
	**Assignment Topics					

Text Books:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics", PHI.
2. William M. Newman Robert F. Spronill, "Principles of Interactive Computer Graphics, McGraw-Hill.

Reference Books:

1. Steven Harington, "Interactive Computer Graphics", Tata McGraw Hill.
2. Dabod G. Rfgers, "Procedure elements for Computer Graphics", McGraw Hill.
3. A. Plastick & Gordon Kalley , "Computer Graphics, Schaum's Outline series", McGraw Hill.
4. Amarendra N Sinha and Arun D Udai , "Computer Graphics", McGraw Hill.

Sub Code: IT311A3   **Credit:3 (L-3, T-0, P-0)**

USER INTERFACE / USER EXPERIENCE DESIGN (UI/UX DESIGN)

Questions to be set: 05 (All Compulsory)

Course Objectives: To understand the basic process of web designing. To grasp the concept of user experience with respect to the user interface. To understand the trends of UI/UX development.

Pre-requisites: Coordinate Geometry, Basic Computing Knowledge

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Select and utilize design thinking processes and UX/UI tools

2. Differentiate between user interface and user experience design

3. Discover how typography and layout enrich the user experience

4. Distinguish various tools available for user interface design

5. Assess various HCI (human-computer interaction) and the psychology behind user decision-making.

** not more than 20% of total topics to be allotted for assignment.

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction to UI/UX design history>	In Class	What is UI? What is UX? History of UI and UX Design	7	1,2		
	**Assignment Topics					
Module 2: < UI Design Tools & UX Design>	In Class	Wireframing - Introduction, Designing Process, Picking Tools, Setting a grid and determine a layout box, Typography, Grayscale, Conclusion, UI Design and Prototyping – Introduction, General Prototyping Scheme, Other Tools – Golden Ratio Typography Calculator, Zeplin. Introduction – An overview of UX Design Process and Documentation, How They All Relate, Guiding Principles, Objective Processes In a Subjective Environment.	8	2,4		
	**Assignment Topics					
Module 3: < Defining and Researching a Product before Diving Into Design &>	In Class	Why Product Definition Matters, The Kickoff Meeting, Lean & Business Model Canvas, Concept Maps & Mockups, Defining Your Vision. Why Research Matters, Market Segmentation Report, Survey Results, Heuristic Evaluations, User Research Report, Analytics Reports, Research, Test, Validate.	9	3		
	**Assignment Topics					

Module 4: < Analyzing Users Before Diving Into Design & Product Design Process & Documentation Essentials>	in class	Why Analysis is Important, Personas, User Stories & Job Stories, Defining Your Vision, User Task Matrix, User Content Matrix, Prioritized Requirements Spreadsheet. Iterated Sketching & Wireframing, Detailed Mockups, Prototypes, Design Specifications, Define, Design and Refine.	8	3,4			
	**Assignment Topics						
Module 5: <Product Implementation & lunch Process & Documentation Essentials>	in class	Build It, Eat Your Own Dogfood, Feed Your Dogfood to Others, Use What Works and Scrap the Rest. Create a Product Launch, Plan, Create content to empower customers and sales teams, Pack a punch with your product launch.	8	4,5			
	**Assignment Topics						

Text Books:

1. Dominik Pacholczyk, Web UI Design Best Practices, UXPin
2. Jerry Cao, Chris Bank, The Guide To UX DESIGN PROCESS & DOCUMENTATION ,- UXPin – 2015
3. Frank Chimero, The Shape of Design, First Edition 2012, Licensed under the Creative Commons Attribution Non-Commercial Share-Alike 3.0 Unported License http://creativecommons.org/licenses/by-nc-sa/3.0/

Reference Books:

1. https://pidoco.com/en/help/ux/user-interface-design
2. https://www.interaction-design.org/literature/topics/ui-design
3. https://ebooks.webflow.com/ebook/the-modern-web-design-process

Sub Code: IT312A3   **Credit: 3(L-3, T-0, P-0)**

DIGITAL IMAGE PROCESSING

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to provide the students a general understanding of the fundamentals of digital image processing. It also introduces analytical toolswhich are currently used in digital image processing. By the end of the course student will be able to develop any software/programs that uses image enhancement, segmentation, restoration, enhancement, representation and description, etc.

Pre-requisites: Computer Graphics, Engineering Mathematics and Probability & Statistics

Course Outcomes: On successful completion of this course, students will be able to:

1. Describe the fundamental concepts of a digital image processing system.

2. Analyze images in the spatial domain using mathematical transformation function.

3. Write the procedure for implementing various image enhancement techniques.

4. Interpret image segmentation and representation techniques.

5. Select the morphological operation for extracting different features from an image.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction & Digital Image Fundamentals>	in class	Introduction to Digital Image, Digital image representation, Fundamental steps in Image Processing, Elements of DIP systems., Image formation, Sampling and Quantization, Relationships between pixels, Linear and Nonlinear operations, Basics of Image Interpolation and Re-sampling: Zooming and Shrinking.	7	1		
	**Assignment Topics	**<u>Elements of Visual Perception</u>**				
Module 2: < Image Enhancement in Spatial domain and frequency Domain >	in class	Enhancement by Point Processing, Histogram Processing, Mask Processing examples, Different noise model,Various Spatial Filtering. Introduction to the Fourier Transform, The discrete Fourier Transform, Properties of the two-dimensional Fourier Transform, Smoothing Frequency-domain filters, Sharpening Frequency domain filters.	9	2, 3		
	**Assignment Topics					

Module 3: < Image Compression	in class	Fundamentals, Image Compression Models. Similarity based and dissimilarity based image segmentation, various threshold techniques, Point,	9	4		
& Segmentation>		Line and Edge detection, Region Growing, K-means segmentation. Various Color models and color image Segmentation and Other color image processing.				
	**Assignment Topics	Error Free Compression, Lossy Compression.				
Module 4: < Image Morphology, Representation and Description Schema>	in class	Introduction of image morphology and its properties. Basic morphological operation-erosion and dilation and its application. Advanced morphological operation- open, close and hit-or-misstransformation. Other advanced morphologicaloperation- thickening, thinning, skeletonization, boundary extraction, region filling. Various Representation and description Schemes, Different types of Boundary Descriptors and RegionalDescriptors	9	5		
	**Assignment Topics					
Module 5: <Object Recognition >	in class	Patterns and Pattern Classes, Recognition based on Decision-theoretic methods, structural methods.	6	4		
	**Assignment Topics					

Text Books:
1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson EducationPublications.
2. RajjanShinghal, "Pattern Recognition", Oxford Publications.

Reference Books:
1. Chanda and Majumder, "Digital Image Processing and Analysis", Prentice Hall Publications.
2. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing with Matlab",Pearson EducationPublications.
3. S. Sridhar, "Digital Image Processing", Oxford University Press.
4. Jayaraman, "Digital Image Processing", McGraw Hill.

INFORMATION RETRIEVAL

Questions to be set: 05 (All Compulsory)

Course Objectives:
The course explores information retrieval models, Web Search Engines, Link Analysis, Hadoop, Map Reduce, and document text mining techniques for a holistic understanding.

Pre-requisites: Data Mining, Artificial Intelligence

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Define information retrieval models.

2. Develop Web Search Engine.

3. Analyze the different tools, techniques and algorithms with an experiment.

4. Experiment with Hadoop and Map Reduce.

5. Select appropriate tools and techniques.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction>	in class	The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.	7	1		
	**Assignment Topics	Introduction -History of IR- Components of IR - Issues –Open source Search engine Frameworks				
Module 2: <Information Retrieval >	In Class	Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion.	7	2		
	**Assignment Topics	Boolean and vector-space retrieval models-				
Module 3: <Web Search Engine– Introduction and Crawling >	In Class	Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - metacrawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval.	9	3		
	**Assignment Topics	Web search overview, web structure, the user, paid placement, search engine optimization/ spam.				

Module 4: <Web Search –Link Analysis and Specialized Search >	in class	Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation -Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling "invisible" Web - Snippet generation, Summarization, Question Answering, Cross-Lingual Retrieval.	10	4		
	**Assignment Topics	Link Analysis –hubs and authorities – Page Rank and HITS algorithms -				
Module 5: <Document Text Mining >	in class	Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).	7	5		
	**Assignment Topics	Information filtering; organization and relevance feedback – Text Mining -Text classification and Clustering				

Text Books:

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval , Cambridge UniversityPress, 2008.
2. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts andTechnology behind Search 2 nd Edition, ACM Press Books 2011.

Reference Books:

1. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice,1st Edition Addison Wesley, 2009.
2. Mark Levene, An Introduction to Search Engines and Web Navigation, 2 nd Edition Wiley, 2010.
3. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing andEvaluating Search Engines, The MIT Press, 2010.

Sub Code: IT314A3   **Credit: 3(L-3, T-0, P-0)**

DESIGN THINKING

Questions to be set: 05 (All Compulsory)

Course Objectives: Design Thinking is a systematic approach to innovation and creative problem-solving that can be used in many disciplines. Design Thinking applies the methodologies of design to challenges in business and society—which makes it central to innovation and creativity.

Pre-requisites: Innovative Problem-Solving ability, design and design theory, organizational behavior, and social psychology.

Course Outcomes (CO): On successful completion of this course, students will be able to:
 1. Express the design process as a tool for innovation
 2. Understand the unique needs of a company around specific challenges
 3. Demonstrate the value of developing a local network and assist students in making lasting connectionswith the business community.
 4. Develop communication skills necessary to facilitate high performance team formation and maintenanceand build empathy for target audiences from different "cultures".
 5. Develop and test innovative ideas through a rapid iteration cycle.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be Covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction>	in class	Introduction to design thinking, History, creativity, innovation and design, Design Thinking Mindset, Various approaches to design thinking i.e. Empathy, Analysis, Solution, Testing.	7	1		
	**Assignment Topics					
Module 2: <Design thinking in practice>	in class	Process Stages of Designing for Growth, Empathy and Understanding, Clarify, Aim of empathize in design thinking process, purpose, importance and its use in design thinking, Customer journey Map, Case Study 4- stage Karmic Design Thinking process, Interviewing & Empathy-building Techniques.	8	2,3		
	**Assignment Topics					
Module 3: <Analysis & Solution>	in class	5 whys, Use of multi-whys method in design thinking- an Example, Conflict of interest, Principles of a design sprint and how to make it happen, Create a Set of Scenarios for the Case Study. TRIZ (Theory of Inventive Problem Solving), Exercise on Tea-cup story, Business Model Canvas and Design Research.	9	3,4		

	Assignment Topics					
Module 4: < Prototype and Testing & General Design Thinking Practices >	in class	Types of Prototypes, Target Audience Testing, Customer reactions to prototype, Forms of testing in Design Thinking, testing as an iterative process, Developing and Testing Prototypes, case study on ReMotion Knee by DRev, Story on elephant andblind men, Defining & Testing Business Models & Business Cases. Visualization Techniques and Diagrams, Use of Diagrams and Maps in Design Thinking, Exercise: Create an Empathy Map, Create a Mind Map, Create a Journey Map	8	4		
	Assignment Topics					
Module 5: < Adopt and Adapt Design Thinking & Design Thinking for strategic innovations >	in class	Cautions and Pitfalls, Assumptions, Exercise: Assumptions, Pitfalls and Cautions in Design Thinking Workgroups, Final Words and Best Practices, Exercise: Take the Practices Back to the Office. Story telling - Predictability – Strategic Foresight - Change – Sense Making -Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.	8	4,5		
	Assignment Topics					

Text Books:

1. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown Kindle Edition
2. HBR's 10 Must Reads on Design Thinking (with featured article "Design Thinking" By Tim Brown) Paperback by Harvard Business Review (Author), Tim Brown (Author), Clayton M. Christensen (Author), Indra Nooyi (Author), Vijay Govindarajan (Author)

Reference Books:

1. Design Thinking: Understanding How Designers Think and Work , Kindle Edition by Nigel Cross (Author) Format: Kindle Edition.
2. Solving Problems with Design Thinking: Ten Stories of What Works (Columbia Business School Publishing) Kindle Edition by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013. (Unit IV).
4. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), kevin Bennett (Author).

DATA WAREHOUSING AND DATA MINING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course is indent for understanding the techniques behind the recent development in data warehousing and data mining. The data warehousing part of the module aims to give students a good overview of the ideas and the techniques, which are behind recent developments in the data warehousing and On-Line Analytical Processing (OLAP) fields, in terms of data models, query languages, conceptual design methodologies, and storage techniques. The data mining part discusses various tools and techniques used to find out the interesting patterns from data.

Pre-requisites: Data structures, Concepts of Algorithms, Fundamentals of probability & statistics and programming skills

Course Outcomes: On successful completion of this course, students will be able to:

1. Distinguish the concepts of data warehousing and data mining

2. Illustrate the dimensional modelling technique for designing a data warehouse and data warehouse architectures and OLAP

3. Explain the knowledge discovery process.

4. Deduction of data mining tasks and study their well-known techniques

5. Apply various data mining techniques in varied problem scenarios

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Data Warehousing & Data Mining>	In Class	Introduction, Definition, Multidimensional data transformation, OLAP operations, Warehouse schema, Ware house Server, Meta data, OLAP engine. Introduction, Definition, KDD vs. DM, DBMS vs. DM, DM techniques, Issues and challenges in DM.	10	1,2		
	**Assignment Topics	DM applications				
Module 2: < Association Rules & Classification: Parametric and Non-Parametric Technology >	In Class	A prior algorithm, Partition, Incremental, Dynamic item set counting, FP-tree growth, Incremental and border algorithms. Bayesian classification, Two class and generalized class classification, Classification error, Decision boundary,Non-parametric methods for classification.	11	3		
	**Assignment Topics	Discriminant functions				

Module 3: < Clustering >	in class	Clustering analysis, Types of data in cluster analysis, Partitioning algorithms, Hierarchical, Density based, Grid based, Model based algorithms.	7	3,4		
	**Assignment Topics	High dimensional & Categorical data clustering				
Module 4: <Decision Trees >	in class	Decision tree induction, Tree pruning, Extracting classification rules from decision trees, Decision tree construction algorithms.	7	4		
	**Assignment Topics	Decision tree construction with presorting				
Module 5: <Unstructured Data Mining>	in class	Text mining, Web mining, Spatial data mining.	5	5		
	**Assignment Topics	Multimedia data mining.				

Text Books:

1. Jiawei Han, MichelineKamber, "Data Mining: Concepts and Techniques", Elsevier.

2. A K Pujari, "Data Mining Concepts", University Press.

Reference Books:

1. Ian H. Witten, Eibe Frank, "Data Mining Practical Machine Learning Tools and Techniques with JavaImplementations", Morgan Kaufmann Publishers.

2. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", Tata McGrawHill.

3. Richard O. Duda, Peter E. Hart, "Pattern Recognition and Scene Analysis", Wiley.

4. VikramPudi, P. Radha Krishna, "Data Mining", Oxford University Press.

Sub Code: IT316A3   **Credit: 3(L-3, T-0, P-0)**

BIG DATA ANALYTICS

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide an in-depth understanding of a Big Data system and its features.

Pre-requisites: Basic knowledge of DBMS.

Course Outcomes (CO): At the end of the course, the student will be able to
1. Understand NoSQL.
2. Understand Properties of a Big Data system.
3. Understand Computing on the batch layer
4. Apply Storing real-time views
5. Analyze performance metrics and develop solutions for serving layer databases, focusing on normalization and dynamic data management.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be Covered	Topics	Hrs	CO	PO	PSO
Module 1: **A New Paradigm for Big Data**	In class	Scaling with a traditional database – NoSQL is not a panacea -- Desired properties of a Big Data system – The problems with fully incremental architectures – Lamda Architecture – Recent trends in technology.	7	1		
	**Assignment Topics					
Module 2: **Data model for Big Data**	In class	The properties of data – The fact-based model for representing data – Graph schemas.	7	2		
	**Assignment Topics					
Module 3: **Data storage on the batch layer**	In class	Storage requirements for the master dataset – Choosing a storage solution for the batch layer – How distributed filesystems work – Storing a master dataset with a distributed filesystem.	7	4		
	**Assignment Topics					
Module 4: **Batch layer**	in class	Computing on the batch layer – Recomputation algorithms vs. incremental algorithms – Scalability in the batch layer – MapReduce : a paradigm for Big Data computing.	7	3		
	**Assignment Topics					

Module 5: Serving layer	in class	Performance metrics for the serving layer – The serving layer solution to the normalization problem – Requirements for a serving layer database. Storing real-time views	7	5		
	**Assignment Topics					

TEXT BOOK

1.   Nathan Marz, James Warren, "Big Data: Principles and best practices of scalable real-time data stems, Manning Publishing.

REFERENCE BOOK(S)
1.   Research Articles

Sub Code: IT317A3   **Credit:3(L-3, T-0, P-0)**

OPTIMIZATION TECHNIQUES

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to understand the need and origin of the optimization methods andto get a broad picture of the various applications of optimization methods used in engineering. This course is indentfor designing and controlling complex systems, solving hard problems of efficiently allocating scarce resources usingin complete information, and developing sustainable strategies to master situations of conflict and co-operation usingscientific methods and information technology.

Pre-requisites: Quantitative Analysis using C/C++, Design and Analysis of Algorithms and Probability & Statistics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Demonstrate the knowledge and understanding of the basic ideas underlying optimization techniques.
2. Apply the mathematical approach to optimization problems relevant to engineering
3. Analyze the robustness of continuous linear optimization problems solutions using sensitivity analysis.
4. Ability to understand and interpret the results and information provided by a particular method.
5. Compare the robustness of continuous linear optimization problems solutions using various techniques

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction to Operations Research >	in class	Introduction to OR modeling approach and various real-life situations, Linear programming problems and applications, Solving Linear Programming problem using simultaneous equations and Graphical Method, Simplex Method and extensions, Sensitivity analysis - Duality theory. Transportation model.	8	1		
	**Assignment Topics	Transshipment problems and Assignment problems.				
Module 2: < Dynamic Programming and Network Analysis >	in class	Bellman's principle of optimality, Examples on the application on routing problem, Inventory problem Simplex problem. PERT and CPM, Probability of achieving completion data, Cost analysis, Graph reduction theory, Updating.	10	2		
	**Assignment Topics	Marketing problem. Resource allocation, Resource smoothing.				

Module 3: < Inventory Method >	in class	Inventory problem, Variables in an inventory problem, Inventory models with penalty, Storage andQuantity discount, Inventory models with probability, Demand, Multi item deterministic model. Simulation, Types of simulation models.	8	3		
	**Assignment Topics	Safety stock, Applications of simulation for Inventory problems.				
Module 4: < Queuing Theory >	in class	Poison arrivals and Exponential service times, Waiting time and Idle time cost, Single channel and Multi- channel problem. Monte Carlo technique applied to queuing problems.	7	3,4		
	**Assignment Topics	Applications of simulation for Queuing problems. Poisson arrivals and service time.				
Module 5: < Theory of Games >	in class	Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points– Rectangular games without saddle points – 2 X 2 games, Examples on the application of theory of games. – Dominance principle – mX2 & 2Xn games - Graphical method and Linear programming method for different problems.	7	4,5		
	**Assignment Topics	Decision trees.				

Text Books:

1. Hamdy A. Taha, "Operations Research", Fifth edn., Macmillan Publishing Company.

2. Kumar Gupta, Prem and Hira, D.S., "Operations Research", S Chand & Company Limited.

3. Swarup, Kanti, Gupta, P.K. and Manmohan, "Operations Research", Sultan Chand & Sons.

Reference Books:

1. Operations Research – Schaum outline series, MH

2. V.K. Kapoor-- Operations Research

3. Hiller F. and Leibermann G. J., "Operation Research", Holder Day Inc.

4. Srinath L.S., "PERT & CPM Principles and Applications", Affiliate East West Press (P).

Sub Code: IT318A3   **Credit: 3(L-3, T-0, P-0)**

INTERNET OF THINGS

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide students with a foundation in computing, communication and information technologies.by making student to realize the revolution of Internet in Mobile Devices, Sensor Networks and Cloud technology. Also, to develop the teamwork skills, multidisciplinary approach, and an ability to relate information technology to overcome real world and social issues inducing students with good computing andcommunication knowledge so as to understand, analyze, design, and innovate a new system.

Pre-requisites: Computer Networks, knowledge of basic Wireless & Wired Networking, Wireless Sensor Networks and programming language.

Course Outcomes (CO): On completion of the course, it is expected to endow the students with skills to:
1. Visualize the impact of information technology solutions on the society.
2. Identify the application areas of IOT.
3. Identify building blocks of Internet of Things and characteristics.
4. Establish interconnection and integration of the physical world and the cyber space.
5. Design & develop IOT Devices.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction to Internet of Things (IoT)>	in class	Introduction to Internet of Things (IoT): Fundamentals of Internet of Things, IoT Definition, Characteristics of IoT, IoT Vision, IoT Functional View, Application Areas.	4	1		
	**Assignment Topics					
Module 2: < Domain Specific IOTs >	in class	Domain Specific IOTs : Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.	6	2		
	**Assignment Topics					
Module 3: < IoT Technology Fundamentals>	in class	Architectural overview, Components of IoT system, Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, IoT analytics, Knowledge management	10	3		
	**Assignment Topics					
Module 4: < Design principle for IoT >	in class	Design principle for connected devices, IoT system layers and design standardization, Networks and Communication: Networking Technology and Communication Technology, Protocols in IOT, Security, Privacy & Trust in IoT.	10	4		
	**Assignment Topics					
Module 5: < Hands-on-IoT & IoT	in class	Hands-on-IoT : IoT Physical Devices & Endpoints: What is an IoT Device, Exemplary Device, Board, Linux on Raspberry Pi, Interfaces, Types of sensors.	10	5		

opportunity and challenges >		IoT opportunity and challenges : Various case studies, opportunity and challenges in IoT.				
	**Assignment Topics					

Text Books:
1. Ovidiu Vermesan,Peter Friess"Internet of Things –From Research and Innovation to market Deployment",River Publishers.
2. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand,
3. David Boyle "From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence",Academic Press Elsevier.
4. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-onApproach)", 1 st Edition, VPT, 2014.

Reference Books:
1. "Internet of Things" Copyright 2016 by Tutorials Point (I) Pvt. Ltd.
2. Tim O'Reilly & Cory Doctorow "Opportunities and Challenges in the IoT",O'Reilly publication.
   Pethuru Raj, Anupama C.Raman,"The Internet of Things, Enabling Technologies,platforms and use cases", CRC Press.

Sub Code: IT321A3   **Credit: 4(L-3, T-1, P-0)**

MACHINE LEARNING

Questions to be set: 05 (All Compulsory)

Course Objectives: It reflects recent developments while providing a comprehensive introduction to the fields of pattern recognition and machine learning. It is aimed at advanced undergraduates assuming no previous knowledge of pattern recognition or machine learning concepts.

Pre-requisites: Knowledge of multivariate calculus and basic linear algebra and basic probability theory.

Course Outcomes (CO): On completion of the course it is expected to endow the students with skills to:

1. Identify methods to solve ML problems.
2. Design pattern recognition program systems using approaches of these theories for solvingvarious real-world problems.
3. Identify importance of tolerance of imprecision and uncertainty for design of robust andlow-cost intelligent machines.
4. Describe areas of application of ML.
5. Formulate solution strategies for solving ML problems in real life.

** ** not more than 20% of total topics to be allotted for assignment**

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction and Linear Models for Regression >	In Class	Polynomial Curve Fitting, Probability Theory: Expectations and Co-variances, Bayesian probabilities, The Gaussian distribution, Curve fitting re-visited. Linear Basis Function Models: Maximum likelihood and least squares, Sequential learning, Regularized least squares.	8	1		
	Assignment Topics	The Bias-Variance Decomposition: Bayesian Linear Regression, Parameter distribution, Predictive distribution.				
Module 2: < Linear Models for Classification >	In Class	Discriminant Functions: Two classes, Multiple classes, Least squares for classification, Probabilistic Generative Models: Continuous inputs.	7	2		
	Assignment Topics	Maximum likelihood solution, Probabilistic Discriminative Models: Fixed basis functions, Logistic regression.				
Module 3: < Sparse Kernel Machines and Kernel Methods >	In Class	Maximum Margin Classifiers: Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, Dual Representations, Constructing Kernels, Radial Basis Function Networks.	9	3		
	Assignment Topics					
Module 4: < Neural Networks >	in class	Basic concepts: The artificial neuron, The McCulloch-Pitts neural model, The perceptron neural network architectures: Single layer feed forward ANNs.	7	4		

	Assignment Topics	Multi-layer feed forward ANNs, Activation function, Generalized delta rule, The Back propagation Algorithm: Learning, Parameter optimization, Convolutional networks: Auto-sparse encoders.				
Module 5: < Mixture Models and EM, Continuous Latent Variables and Sequential Data >	in class	K-means Clustering, Mixtures of Gaussians, Maximum likelihood. Principal Component Analysis: Maximum variance formulation, Markov Models, Hidden Markov Models, Maximum likelihood for the HMM,	9	5		
	Assignment Topics	EM for Gaussian mixtures, Applications of PCA, PCA for high-dimensional data, The forward- backward algorithm.				

Text Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer.
2. David J.C. Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003.

Reference Books:

1. Andrew Ng, "Lecture Notes on Machine Learning".

Sub Code: IT322A3   **Credit: 4(L-3, T-1, P-0)**

NATURAL LANGUAGE PROCESSING

Questions to be set: 05 (All Compulsory)

Course Objectives:
1. To introduce the fundamental concepts and theory of Natural Language Processing and its practical applications

2. To highlight Linguistic (knowledge-based) and statistical approaches to language processing in the three major subfields of NLP: syntax (language structures), semantics (language meaning), and pragmatics/discourse (the interpretation of language in context).

Pre-requisites: A strong mathematical background, Proficiency with algorithms, Critical thinking and problem-solving skills

Course Outcomes(CO): On completion of the course it is expected to endow the students withs kills to:

1. Describe the fundamental concepts and techniques of natural language processing.
2. Distinguish among the various techniques of NLP, taking into account the assumptions, strengths, and weaknesses of each.
3. Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.
4. Analyze large volume text data generated from a range of real-world applications.

5. Employ semantic models in NLP for various applications, including social media monitoring and market analysis

* not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Natural Language Processing	in class	Origins And Challenges Of NLP, Empirical Laws, Text Processing, Spell Correction, Edit Distance, Weighted Edit Distance, Noisy Channel Model for Spelling Correction	7	1		
	**Assignment Topics	Application of NLP in different domain		1		
Module 2: Language Modelling	in class	N Gram Language Models, Evaluation of Language Models, Basic Smoothing, Advanced Smoothing Models	7	2		
	**Assignment Topics	Application of Language Models in auto-completion of sentences, auto spell-check, and semantic analysis		2		
Module 3: Computation Morphology	in class	Introduction, Finite State Method for Morphology, Introduction to POS Tagging, HMM For POS Tagging, Viterbi Decoding For HMM, Parameter Learning, Baum Welch	7	3		

		Algorithm, Maximum Entropy Models, Conditional Random Fields				
	**Assignment Topics	Application of POS Tagging in Entity Recognition and Question Answering		3		
Module 4: Syntactic Analysis	in class	Introduction, Parsing, CKY, PCFGs, Inside-Outside Probabilities, Dependency Grammar and Parsing Transition Based Parsing, MST Based Dependency Parsing	7	4		
	**Assignment Topics	Application of Syntactic Analysis in Information Extraction		4		
Module 5: Semantics in NLP	in class	Distribution semantics Models, Word Embedding, Lexical Semantics, Word Sense Disambiguation, Novel Word Sense Detection, Topic Modelling, Latent Dirichlet Allocation, Gibbs sampling for LDA, LDA Variants and Applications	7	5		
	**Assignment Topics	Application of Semantics in Social Media Monitoring, Market Research and Product Analysis		5		

Text Books:
1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014David J.C. Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge UniversityPress, 2003.

Reference Books:
1. James Allen, "Natural Language Understanding", 2/e Pearson Education
2. L.M. Ivansca, S. C. Shapiro, "Natural Language Processing and Language Representation", University Press
3. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana. 2020. Practical Natural Language Processing. O'Reilly.
4. Hobson Lane, Cole Howard, Hannes Hapke. 2019. Natural Language Processing in Action

Sub Code: IT323A3   **Credit: 4(L-3, T-1, P-0)**

LATEST TRENDS IN INFORMATION TECHNOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to create awareness and provide exposure to the changing trends and advances in the chosen topics in Information Technology.

Pre-requisites: Nil

Course Outcomes(CO): On completion of the course it is expected to endow the students withs kills to:

1. Apply uninformed and heuristic search algorithms in artificial intelligence tasks.
2. Discuss the importance of big data in data analytics and evaluate methodologies for handling and processing big data.
3. Implement various machine learning techniques and analyze their applications in real-world scenarios.
4. Explain fundamental concepts of cyber security and assess challenges and vulnerabilities in information security systems.
5. Identify IoT architecture components, analyze IoT applications, and evaluate security measures and challenges in IoT implementation

* not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to Artificial Intelligence**	in class	Uninformed Search, Heuristic Search, Knowledge Representation and Reasoning, Natural Language Processing, Understanding, Learning.	6	1		
	**Assignment Topics	Application of NLP.		1		
Module 2: **Introduction to Big Data**	in class	Introduction, Handling and Processing Big Data, Data Model for Big Data, Data Storage, Methodological Challenges and Problems in Big Data.	6	2		
	**Assignment Topics	Importance of Big Data in Data Analytics.		2		
Module 3: **Introduction to Machine Learning.**	**In class Topics**	Introduction, Approaches and Techniques in Machine Learning, Ensemble Learning, Decision Tree Learning, Computational Learning Theory, Artificial Neural Networks, Support Vector Machines, Bayesian Learning, Challenges in Machine Learning. Introduction to Deep Neural Networks, Recent Developments, Challenges in Deep Learning.	7	3		
	**Assignment Topics	Application of various ML techniques. Application of Deep Learning.		3		

Module 4: **Introduction to Cyber Security**	in class	Information Security Concepts, Security Threats and Vulnerabilities, Security Law and Standards, Challenges in Cyber Security.	8	4		
	**Assignment Topics	Importance of cyber security.		4		
Module 5 **Introduction to Internet of Things.**	in class	Introduction, Use of Devices in IoT, IoT Architecture, Applications of IoT, IoT Protocols, IoT Security, Challenges in IoT.	7	5		
	**Assignment Topics	Limitation of security in IoT devices and applications of IoT.	6	5		

Text books:

Artificial Intelligence, Elaine Rich and Kevin Knight, 3rd ed., 2009, McGraw Hill.

Reference books:
1. Latest Research articles as decided by the instructor.
2. Machine Learning for Dummies, *John Paul Mueller and Luca Massaron, 1st ed. 2016, For Dummies.*
3. Pattern Recognition and Machine Learning, Christopher Bishop, 2016, Springer New York.
4. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani & Jerome Friedman, Springer.
5. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, 2016, MIT Press.
6. Securing the Internet of Things, Shancang Li Li Da Xu, 2017, Syngress, Elsivier.
7. Internet of Things and its Applications, Satish Jain, Shashi Singh, 1st ed. 2020, BPB Publications.
8. Introduction to Information Security and Cyber Laws, Surya Prakash Tripathi, 2014, Dreamtech Press.

Sub Code: IT324A3   **Credit: 4(L-3, T-1, P-0)**

SYSTEM PROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on systems programs: operating systems, assemblers, compilers, interpreters, macro processors and loaders. This course also discusses the design of the system programs: assembler, linkers and loaders.

Pre-requisites: Programming language Design, Data Structures and Microprocessor and Peripheral Devices.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Describe the evolution of Programming and understand how an Operating and other system software haveevolved since its inception.
2. Examine various system programs and it's usage for proper functioning of Computer System.
3. Analyze the theory and design the procedure for implementing assembler and macro-processor systemprograms.
4. Compare various program loading schemes and discuss issues pertaining to design of some loadingschemes.
5. Understand the basic concepts of Compiler Program and issues related to its design.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Scope of Systems Programming and Background >	in class	Introduction to application software and systems software, Concept of hardware, System software concept, System design and methods of system design, Properties of good and structured system, Software and software hierarchy, Machine structure.	7	1,2		
	**Assignment Topics	Components of a system programming, Evolution of Operating Systems, Operating System functions				
Module 2: <General machine structure and machine language & Assemblers >	in class	General machine structure, Instruction set, Machine language, Assembly language (IBM-360). Assemblers, General design procedure, Design of assembler: One pass assembler	8	3		
	**Assignment Topics	Two pass assembler				
Module 3: < Macros>	in class	Macros language and macro processer: Macro instruction arguments, Conditional macro expansion, Macro calls within macros, Macro instructions defining macros.	8	3,4		
	**Assignment Topics	Implementation of restricted facility: A two pass algorithm.				
Module 4: < Loaders>	in class	Loaders, Loader schemes, Compile and go loaders, General loader scheme: Absolute loaders, Subroutine linkages, Relocating loader, Loader schemes binders, Linking loaders, Overlays, Dynamic binders, Design of an absolute loader.	8	4		
	**Assignment Topics	Design of a direct linking loader.				

| Module 5: < Language processor & Compilers> | in class | Introduction, Language processing activities, Fundamentals of language processing, Fundamentals of language specification.
Introduction to compilers, Aspects of compilation, Compilation of expressions, Compilation of control structures, | 9 | 5 | | |
| | **Assignment Topics | Language processor development tools.
Memory allocation, Code optimization, Interpreters. | | | | |

Text Books:

1. John J. Donovan, "Systems Programming", Tata McGraw Hill.
2. Srimanta Pal, "Systems Programming", Oxford.

Reference Books:

1. D M Dhamdhere, "Systems Programming & Operating Systems", Tata McGraw Hill.
2. Aho, Ulmann, Sethi , "Compiler Design", Pearson Education.
3. Leland L.Beck, D.Manjula, "System Software-An Introduction to System Programming", Pearson A.C. Shalini, "System Software", SCITECH Publication

BIO INSPIRED COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: The course aims to cover bio-inspired theorems and algorithms, including random walk, simulated annealing, genetic algorithm, differential evolution, swarm optimization, and ant colony for feature selection. Additionally, it explores their applications in image processing.

Pre-requisites: Programming language Design, Data Structures and Microprocessor and Peripheral Devices.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Understand bio-inspired computing algorithms, such as genetic algorithms and swarm optimization, for optimization tasks.
2. Apply random walk and annealing techniques in stochastic optimization and search problems.
3. Analyze meta heuristic algorithms, including firefly algorithm and particle swarm optimization, for solving complex optimization problems.
4. Comprehend the application of bio-inspired computing in image processing
5. Analyze the convergence and performance of bio-inspired algorithms through parameter tuning and control mechanisms.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module1: **Introduction**	in class	Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms - Nature Inspires Algorithms - Parameter tuning and parameter control.	6	1		
	**Assignment Topics	Application of Bio inspired computing		1		
Module 2: **Random Walk and Annealing**	in class	Random variables - Isotropic rand om walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm	6	2		
	**Assignment Topics	Stochastic Tunneling.		2		
Module 3: **Genetic Algorithms and Differential Evolution**	in class	Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA variants - schema theorem - convergence analysis - introduction to differential evolution - variants - choice of parameters convergence analysis - implementation.	7	3		
	**Assignment Topics	Application of Genetic Algorithm		3		

Module 4: **Swarm Optimization and Firefly Algorithm**	in class	Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.	6	4		
	**Assignment Topics	Application of Particle Swarm Optimization		4		
Module 5: **Application in Image Processing**	in class	Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization, Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search	10	5		
	**Assignment Topics	Case study: An application of Bio inspired computing in image processing		5		

Text Books:
1. Yang, Xin-She, et al., eds. Swarm intelligence and bio-inspired computation: theory and applications. Newnes, 2013.
2. Eiben, A.E., Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
3. Xin-She Yang, Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016

AUTONOMOUS MOBILE ROBOTICS AND COMPUTATIONAL INTELLIGENCE

Questions to be set: 05 (All Compulsory)

Course Objectives: The course will cover basic principles of design and practice of intelligent robotics systems including the algorithms for the analysis of the data obtained by vision and range sensors, basic principles of modeling kinematics and dynamics and design of basic control strategies. Emphasize will alsobe given on formulating interesting robotics tasks and show how they can be accomplished by individual robot or cooperative robot teams (such as flocking, foraging as well as robotic soccer).

Pre-requisites: Design and Analysis of Algorithms, Basic Mathematics (linear algebra, calculus andprobability), Soft computing.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Identify application of Robots
2. Describe the evolution, kind of robots and basics of design of a Robotics System
3. Choose correct choices of Locomotion, Kinematics, Perception techniques
4. Apply Intelligent Algorithms for decision making in Motion Planning and path optimization
5. Develop simple robot control systems integrating perception, planning, and action

** Not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introduction & Design of system and navigation architecture >	In Class	Definition, Applications of mobile robotics, History of mobile robotics, Reference control scheme of a mobile robotics environment, Temporal decomposition of architecture, Control decomposition, Hybrid architecture, Mobile architecture, Perception.	11	1,2		
	**Assignment Topics	Representation and the mapping process.				
Module 2: < Locomotion & Kinematics>	In Class	Issues for locomotion, Legged mobile robots, Wheeled mobile robots, Kinematics introduction, Forward and reverse kinematics, Wheeled kinematics and its constraints, Mobile system locomotion, Human biped locomotion as a rolling polygon.	12	3		
	**Assignment Topics	Representation of robot position through the reference frame.				
Module 3: < Perception & Navigation>	In Class	Sensors for mobile robots, Sensor classification, Characterization and sensor performance, Wheeled motor sensor, Ground bases beacon, Localization overview, Path planning.	7	3		
	**Assignment Topics	Active ranging, Motion/Speed sensor, Vision based sensors.		3		
Module 4: < Computational intelligence >	In Class	Swarm intelligence, Evolutionary computation.	5	4.		

	Assignment Topics	Artificial immune system, Ant algorithm.		4.		
Module 5: < Mobile robot programming >	In Class	This chapter is included to provide hands on introduction to the field of mobile robotics and various issues in designing and planning of robot work environment. It includes construction and programming of robotic agents using robotic kits and microcontrollers applying concepts of locomotion, perception.	5	5		
	Assignment Topics	Navigation and computational intelligent algorithms.		5		

Text Books:

1. Ronald Siegwart, Illah R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", MIT Press,
2. Andries P. Engelbrecht , "Computational Intelligence: An Introduction", Wiley 2nd Edition, 2007

Reference Books:

1. Ronald C. Arkin , "Intelligent Robotics and Autonomous Agents", MIT Press, 1997
2. Ulrich Nehmzow, "Mobile Robotics: A practical Introduction", Springer-Verlag London, 2003
3. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000
4. Leandro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new Computational Intelligence Approach", Springer-Verlag, Germany 2002

REAL TIME SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to provide a general understanding of the Real Time Systems (RTS). It covers the scheduling aspects of tasks with emphasis on timing constraints and scheduling principles. By the end of the course, the students shall be able to differentiate the scheduling, database and communication aspects of Real Time Systems from those of traditional Operating Systems (OS). Students will also be familiar with different programming platforms for developing Real Time Operating Systems (RTOS)

Pre-requisites: Operating System, Computer Network and DBMS.

Course Outcomes(CO): On successful completion of this course, students will be able to:

1. Discuss the concepts of Real-Time systems and interpret its model.

2. Recognize the characteristics of a real-time system

3. Develop and document on an architectural design of a real-time system

4. Express an ability to select appropriate algorithms for task scheduling and resource management in Real Time System.

5. Illustrate Real-time Operating Systems and Fault Tolerant applications of Real-Time Systems

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction>	in class	Definition and concepts of RTS, Issues in Real Time Computing, Broad categories and characteristics of Real Time (RT) systems, RT tasks classification, Modeling of Time constraints, Task Assignment and Scheduling	5	1,2		
	**Assignment Topics	Mode changes and Fault Tolerant Scheduling				
Module 2: < Real Time task scheduling>	In Class	Basics on RT task scheduling, RT task scheduling algorithms, Preemptive RT algorithms (Earliest deadline first, RMA), Static priority scheduling protocols, Resource sharing among RT Tasks, Priority inversion, Priority inheritance protocol (PIP), HLP, PCP, Different types of priority inversion under PCP, Scheduling RT tasks in multiprocessor and distributed systems	10	1,4		
	**Assignment Topics					
Module 3: < Real Time Operating System & Real time communication >	In Class	RTOS definition and characteristics, comparison with general-purpose OSs, light-weight vs. heavy-weight RTOSs, Commercial RTOS: UNIX V, UNIX based RTOS, RT POSIX, RT capabilities of Windows NT, Windows CE, Performance benchmarking of RTOS Characteristics of RT traffic, Models for traffic characterization,	11	1,5		

		Applications requiring RT communication, Soft and hard RT communication in a LAN, Network Topologies, Fault tolerant Routing, Fault Error containment Redundancy, Bounded access protocols for LANs, Performance comparison, QoS framework.			
	**Assignment Topics	QoS models			
Module 4: < Real time databases>	in class	Definition, Real time vs General Purpose Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two phase Approach to improve Predictability, Maintaining Serialization Consistency, Commercial RT databases	6	1,4	
	**Assignment Topics				
Module 5: < Evaluation Techniques and Clock Synchronization & Programming languages and tools >	in class	Reliability Evaluation Techniques, Software error models, Clock Synchronization, Fault Tolerant Synchronization in hardware and software. Programming Languages and Tools, Desired language characteristics, Data typing, Control Structures, Facilitating Hierarchical Decomposition, Packages, Programming Environments, Run time support	8	1,3	
	**Assignment Topics				

Text Books:

1. Rajiv Mall, "Real Time Systems, Theory and Practice", 2nd Edition, Pearson Education, 2007.

2. J.W. Liu, "Real Time systems", Pearson Education, 5th Edition, 2004.

Reference Books:

1. Phillip Laplante, Prentice Hall, "Real Time Systems Design and Analysis", 3rd Edition.

2. Krishna & Shin, "Real Time systems", Tata McGraw Hill, 1999.

Mark H. Klein, Thomas Ralya, "Practitioner's Handbook for Real-Time Analysis", 2nd

Edition, Kluwers Academic Publishers, 1994.

4. Hassan Gomaa, "Software Design Methods for Concurrent and Real-time Systems", AddisonWesley.

5. Stuart Bennett, "Real Time Computer Control – An Introduction", Prentice Hall of India, 1998.

6. S.T. Allworth and R.N.Zobel, "Introduction to real time software design", Macmillan, 2nd Edition, 1987.

Sub Code: IT328A3   **Credit: 4(L-3, T-1, P-0)**

CLOUD COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course gives an introduction to cloud computing and its techniques - Infrastructureas a Service (IaaS), Platform-as-a-Service (PaaS), Software as a Service (SaaS), issues, ecosystem and case studies

Pre-requisites: Operating Systems and Computer Network.

Course Outcomes(CO): On completion of the course it is expected to endow the studentswith skills to:
1. Analyse the Service Oriented Architecture and Cloud Computing paradigms.
2. Implement and evaluate a service mashup.
3. Analyse the enterprise models in cloud computing.
4. Evaluate a Software as a Service (SaaS) application.
5. Illustrate the Security issues associated with the Cloud Computing paradigm.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Understanding Cloud Computing and Privacy and Security in Cloud computing	In Class	Cloud computing, History of cloud computing, Cloud architecture, Cloud storage, Why cloud computing matters, Advantages of cloud computing, Disadvantages of cloud computing, Companies in the cloud today, Federation in the cloud, Presence in the cloud, Privacy and its relation to cloud-based information systems, Security in the cloud, Common standards in the cloud, End-user access to the cloud computing.	12	1,3		
	**Assignment Topics					
Module 2: Developing Cloud Services	In Class	Web-based application, Pros and cons of cloud service development, Types of cloud service development, Software as a service, Platform as a service, Web services, On demand computing, Discovering cloud services, Development services and tools, Amazon Ec2, Google app engine, IBM clouds	7	2,4		
	**Assignment Topics					
Module 3: Cloud Utility and Business profit	In Class	Software utility application architecture, Characteristics of a SaaS, Software utility applications, Cost versus value, Software application services framework, Common enablers, Conceptual view, to reality, Business profits, Implementing database systems for multitenant architecture	7	2,4		
	**Assignment Topics					
Module 4:	in class	Centralizing email communications, Collaborating on schedules, Collaborating on To-Do Lists	7	4,5		

Cloud Computing for Everyone		Collaborating contact lists, Cloud computing for the community, Collaborating on group projects and events, Cloud computing for the corporation				
	**Assignment Topics					
Module 5: Using cloud services	in class	Collaborating on calendars, Schedules and task management, Exploring online scheduling applications, Exploring online planning and task management, Collaborating on event management, Collaborating on contact management, Collaborating on project management, Collaborating on word processing, Collaborating on databases, Storing and sharing files.	7	5		
	**Assignment Topics					

Text Books:
1. Michael Miller, "Cloud computing: Web based applications that change the way you work andcollaborateonline", Pearson.
2. Haley Beard, "Cloud computing best practices for managing and measuring processes for on demandcomputing, Applications and data centers in the cloud with SLAs", Emereo.

Reference Books:
1. Guy Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons.
2. George Reese, "Cloud Application Architectures", O'Reilly.
3. Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer.
4. Brian J. S. Chee, Curtis Franklin, Jr., "Cloud Computing: Technologies and Strategies of theUbiquitous Data Center", CRC Press

AD HOC WIRELESS NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course will introduce the students to the diverse literature on ad-hoc wireless networks, and expose them to the fundamental issues in designing and analyzing ad-hocwireless network systems. A detailed study on related technologies and standards ranging from networking, OS support and algorithms, to security will constitute the syllabus. The primary concern will be protocol design, communication and computational challenges posed by ad hoc wireless networking systems.

Pre-requisites: Data Communication, Computer Network

Course Outcomes (CO): On completion of the course it is expected to endow the students with skills to:
1. Describe the unique issues in ad-hoc/sensor networks.
2. Enumerate current technology trends for the implementation and deployment ofwireless ad-hoc/sensor networks.
3. Discuss the challenges in designing MAC, routing and transport protocols forwireless ad-hoc/sensor networks.
4. Explain the challenges in designing routing and transport protocols for wireless Ad-hoc/sensornetworks.
5. Recognize the various sensor network Platforms, tools and applications.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Ad Hoc Wireless Networks	in class	Introduction to wireless networks, Infrastructure based and Infrastructure less wireless networks, issues and challenges of Infrastructure-less networks, Layered architecture in Ad hoc networks	5	1,2		
	**Assignment Topics					
Module 2: MAC Protocols for Ad Hoc Wireless Networks	in class	Introduction to MAC layer, Design issues and challenges, MAC layer protocols for Ad hoc networks –MACA, MACAW, BTMA, DBTMA, RI-BTMA	8	1,2		
	**Assignment Topics					
Module 3: Routing Protocols for Ad Hoc Wireless Networks	in class	Introduction to Routing, Design issues and challenges in Routing, Routing protocols for Ad hoc networks– DSDV, AODV, ZRP, CGSR and LAR, Multicast Routing – Issues in Multicast routing, Tree Based and Mesh based Multicast routing	10	3,4		
	**Assignment Topics					
Module 4: Transport Layer:	in class	Issues and challenges for designing transport layer protocol, Transport layer solutions – Feedback based TCP, Split TCP, Ad hoc TCP. Introduction on QoS	10	1,4		

Introduction to Transport Layer, Quality of Service in Ad Hoc Wireless Networks		services in Adhoc network, Issues and challenges in providing QoS in Ad hoc networks, Frameworks for Ad hoc networks – QoS Model, RSVP, SWAN				
	**Assignment Topics					
Module 5: Security in Ad hoc Network Energy Management in Ad Hoc Wireless Networks Recent Trends in Ad hoc networks	in class	Introduction on Security of ad hoc wireless networks, Issues and challenges in securityprovision for ad hoc wireless protocols, Network layer attack, transport layer attack, Requirement of secure routing protocol for adhoc wireless network – Security-Aware AODV protocol Introduction, Need for energy management in Ad hoc network. Battery management schemes – DLL solutions, Network layer solutions Unaddressed issues in Ad hoc networks.	7	3,4		
	**Assignment Topics	Ad hoc Internet, Ultra-Wide-Band-Radio communication Wireless Fidelity, Optical wireless networks				

Text Books:
1. C. Siva Ram Murthy, B.S. Manoj, "Ad Hoc Wireless Networks Architectures andProtocols",Pearson Publication.
2. Charles E Perkins, "Ad Hoc Networking" Addison-Wesley.

Reference Books:
1. Toh CK, "Ad Hoc Mobile Wireless Networks", PHI.
2. LabiodHouda, "Wireless Ad Hoc and Sensor Networks", Wiley.
3. William Stallings "Wireless Communication and Networks", Pearson.
4. Prashant Mohapatra, SrikanthKrishnamurthy,"Ad   Hoc   Networks TechnologyandProtocols",Springer.

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Sub Code: IT338A3   **Credit: 4(L-3, T-1, P-0)**

HIGH PERFORMANCE COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objective: The overall goal is to acquaint students with parallel computations in current hardware and software tools, and trends in parallel scientific computing, to provide an opportunity to build and executesample parallel codes, program in multicore and cluster architectures.
The theoretical and practical mix of the HPC Software development programs has the following objectives:
1. To explore the fundamental concepts of Parallel programming and HPC Solutions and their applications.
2. To develop in-depth knowledge and understanding of HPC domain.
3. To understand the various search methods and visualization techniques.
4. To learn to use various HPC tools.
5. To understand the applications using Map Reduce Concepts, OpenMP, CUDA, MPI, Xeon Phiprogramming.

Pre-requisites: Programming in C/C++, basic knowledge of UNIX/Linux shell, familiarity with basicnumerical algorithms and computer architecture.

Course Outcomes: On completion of the course it is expected to endow the students withskills to:
1. Define the fundamental concepts and techniques in parallel computation structuring and design.
2. Describe several parallelization methodologies and paradigms.
3. Choose various mathematical paradigms describing parallel computing systems.
4. Explain the architectures of high-performance computing systems.
5. Select appropriate application/platform for algorithm implementation.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Categories of machines	In Class	High performance computing: Why, and why now? Concepts and scientific applications, Parallel decomposition, basic architecture and OS concepts, Multi-core CPUs, High-speed interconnects, High performance file systems, GPU systems, Multicore and many core shared memory machines via the work-span model, distributed memory machines like clusters and supercomputers via network models, and sequential or parallel machines with deep memory hierarchies.	8	1		
	**Assignment Topics	**High performance clusters**				
Module 2: Parallel computing and HPC tools	In Class	Parallel computer architecture and parallel software, processor and memory systems of parallel computers, different types of parallelism (on instruction level, on computational task level and data parallelism), Profiling and Debugging of codes tools: gprof, Vtune, Performance library like mkl, Demo of the sample code by using the above tools.	8	2,3		

	Assignment Topics	**Performance models for parallel systems, gdb**, **lapack**, fft , **Analysis tools like : ITAC , MPI libraries.**				
Module 3: Programming of multicore systems	In Class	Shared memory multiprocessing programming (OpenMP). OpenMP Programming Model, OpenMP API Overview, Compiling OpenMP Programs, OpenMP, Synchronization Constructs, Directives, Data Scope Attribute Clauses, Directive Binding and Nesting Rules, Run-Time Library Routines, Environment Variables, Thread Stack Size and Thread Binding, Monitoring, Debugging and Performance Analysis Tools for OpenMP,	8	2,3		
	Assignment Topics	**Case-Studies (Algorithms and Parallelization Approaches), Matrix –Matrix-multiplication.**				
Module 4: Programming of cluster systems	in class	Message Passing Interface (MPI) and approaches for the parallelization of programs: General Introduction, Point-to-Point Communication, Blocking vs. Non-blocking sends, Collective Communication, MPI hybrid models, profiling, and debugging.	8	4,5		
	Assignment Topics	**Case Studies (Algorithms and Parallelization Approaches)**				
Module 5: MPI Implementations and Hybrid programming (OpenMP and MPI)	in class	Compilers, Environment Management Routines: Point to Point Communication Routines, MPI Message Passing Routine Arguments, Blocking Message Passing Routines, Non- blocking Message Passing Routines, Derived Data Types Group and Communicator Management Routines Numerical libraries & high performance I/O libraries, Introduction to multi-threading accelerators,	8	4,5		
	Assignment Topics	**Collective Communication Routines, Virtual Topologies, A Brief introduction on MPI-2 and MPI-3.**				

Text Books:
1. Michael J Quinn, "Parallel Programming in C with MPI and OpenMP", McGraw-HillHigher Education.
2. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar,"Introduction toParallel Computing", Pearson Education India.
3. V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers – Architecture andProgramming", Prentice-Hall of India, 2003.

Reference Books:
Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers",Chapman & Hall / CRC Computational Science series, 2011

Sub Code: IT329A3 **Credit: 4(L-3, T-1, P-0)**

DEEP LEARNING

Questions to be set: 05 (All Compulsory)

Course Objective: Deep Learning has received a lot of attention over the past few years and has been employed successfully by companies like Google, Microsoft, IBM, Facebook, Twitter etc. This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task.

Pre-requisites: Machine Learning, Calculus, Linear Algebra, Probability & Statistics

Course Outcomes: Upon successful completion of the course, the students are expected to be able to:

1. Describe deep learning techniques and computing environment that are suitable for the applicationsunder consideration.
2. Discuss various solution plans and methodologies for an engineering problem using Deep Learning.
3. Classify the different technical issues related to Deep Architectures consistent with their level ofknowledge and understanding.
4. Develop a set of alternative design solutions to problems for which standard algorithmic solutions do notexist.
5. Apply Deep Learning techniques to solve real-life problems which directly or indirectly benefits to thesociety.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Deep Feed Forward Networks	In Class	History, success stories, Basic Perceptron, linear and nonlinear reparability, Linear Regression, Learning Algorithms: Hebb Rule, Perceptron learning. Pitfalls: overfitting, underfitting, bias, estimators and variance, Multilayer Perceptrons(MLPs),Activation Functions:Sigmoid, Hyperbolic Tangent and ReLU. Gradient Descent, Backpropagation Algorithm.	8	1,2		
	**Assignment Topics					
Module 2: Regularization for Deep Learning and Optimization for Training Deep Models	In Class	Regularization, Parameter noise penalties, Dataset Augmentation, Noise Robustness, Learning Vs. Optimization, Challenges in Neural Network Optimization, Stochastic Gradient Descent, Stochastic Gradient Descent with momentum, Stochastic Gradient Descent with Nesterov momentum.	8	1,2		
	**Assignment Topics					

Module 3: Convolution Neural Networks	in class	Architectures, convolution /pooling layers, feature extraction, Convolution Algorithm, unsupervisedfeatures, applications of CNN in different areas.	8	3		
	Assignment Topics					
Module 4: Recurrent Neural Networks and Recursive Nets	in class	Recurrent Neural Networks, Bidirectional Neural Networks, Encoder-Decoder sequence to sequence architecture. Deep Recurrent Networks: Recursive Neural Networks, Long-Short Term Memory.	8	3,4		
	Assignment Topics					
Module 5: Applications of Deep Learning	in class	Applications of deep learning in computer vision,speech recognition, Natural Language Processing, Sentence Classification using CNN.	8	4,5		
	Assignment Topics					

Text Books:
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. "Deep Learning".
2. Duda, R.O., Hart, P.E., and Stork, D.G. "Pattern Classification". Wiley-
Interscience. 2ndEdition, 2001.
3. Laurene Fausett, "Fundamentals of Neural Networks".

Reference Books:
1. Theodoridis, S. and Koutroumbas, K. "Pattern Recognition". Edition 4. Academic
Press,2008.
2.Francois Chollet , "Deep Learning with Python"
3. Bishop, C. M. "Neural Networks for Pattern Recognition". Oxford University Press.
1995. 4.Hastie, T., Tibshirani, R. and Friedman, J. T"he Elements of Statistical Learning".
Springer.2001.

Sub Code: IT330A3   **Credit: 4(L-3, T-1, P-0)**

PATTERN RECOGNITION

Questions to be set: 05 (All Compulsory)

Course Objective: The objective of this course is to provide an introduction to basic concepts and methodologies for Pattern Recognition, and to develop a foundation that can be used as the basis for further study and research in this field.

Pre-requisites: Engineering Mathematics-III and IV

Course Outcomes: Upon successful completion of the course, the students are expected to be able to:

1. Describe the components and processes of a pattern recognition system. To understand supervised learning techniques of pattern recognition systems.
2. Explain decision trees and Bayes classification basics.
3. Discuss nearest neighbor and linear classification concepts
4. Summarize clustering techniques fundamentals.
5. Outline principles of syntactic pattern recognition

   ** Not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to a Pattern Recognition System	in class	Preview of Inductive Learning – A Specific-to-General Procedure – A General-to-Specific Procedure – Overview of Classifiers.	6	1		
	**Assignment Topics					
Module 2: Decision Trees, Bayes Classification,	in class	Basics – Building a Decision Tree – Classifying by using a Decision Trees, Simplifying Bayes Classification – Estimation of Probabilities – Naive Bayes with Binary Attributes – Continuous Attribute Values – Performance of Bayes Classifier.	8	2		
	**Assignment Topics					
Module 3: Nearest Neighbour Classification, Linear Classification	in class	Underlying Idea – Numeric Attribute Values – Non-numeric Attribute Values – Mixed Attribute Values – Performance of Nearest Neighbor Classifier, Training a Linear Classifier – The Two-class case – Higher Dimensional Attribute Space.	8	3		
	**Assignment Topics					

Module 4: Clustering: Basics	in class	Agglomerative Hierarchical Clustering – k-Means Clustering – Non-numeric Attributes.	7	4		
	Assignment Topics					
Module 5: Syntactic Pattern Recognition	in class	Strings and Grammars – Chomsky Normal Form – Parsing – Stochastic Grammars	7	5		
	Assignment Topics					

Text Book:

1. Pattern Recognition: Techniques and Applications, Rajjan Shinghal, Oxford University Press

Reference Books:

1. Pattern Recognition: Statistical, Structural and Neural networks, Robert Schalkoff, 2005, John Wiley & Sons Inc.
2. Pattern Classification, Richard O.Duda, Peter E. Hart & David G. Strok, John Wiley & Sons, Inc.

Sub Code: IT331A3   **Credit: 4(L-3, T-1, P-0)**

WEB CONTENT MANAGEMENT AND WEB 3.0

Questions to be set: 05 (All Compulsory)

Course Objective: This course enables students to understand the basic terminology and concepts of the Web 3.0, Distributed Computing Systems and Block Chains

Pre-requisites: Web Technology and Web Services

Course Outcomes: Upon successful completion of the course, the students are expected to be able to:
1. Describe the fundamentals of Web 3.0 is and its key features and applications.
2. Explain the concepts of distributed computing and decentralized systems.
3. Discuss symmetric key cryptography, including substitution and transposition techniques.
4. Outline the principles of public key cryptography and message authentication.
5. Summarize the types and uses of block chains.

** Not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction**	in class	What Is Web 3.0? Web 3.0, Cryptocurrency and Blockchain, Web 3.0 Technologies, Evolution of the Web 3.0 Technologies, Key Features of Web 3.0, Web 3.0 Applications	7	1		
	**Assignment Topics					
Module 2: **Distributed Computing and Decentralized System**	in class	Definition of Distributed Computing System, Relation to parallel systems, Synchronous vs Asynchronous execution, Design issues and challenges, Models of communication networks, Global state of distributed system, Models of process communication, Decentralized system.	8	2		
	**Assignment Topics					
Module 3: **Symmetric Key Cryptography**	in class	Symmetric Cipher Model – Substitution Techniques – Transposition Techniques –Block Ciphers and the Data Encryption Standards: Simplified DES – The Data Encryption Standard	7	3		
	**Assignment Topics					

Module 4: **Public Key Cryptography and Message Authentication**	in class	Principles of Public-Key Cryptography – The RSA Algorithm – Key Management – Diffie-Hellman Key Exchange – Authentication Requirements – Authentication Functions – Message Authentication and Hash Functions – MD5 Message Digest Algorithm – Digital Signature and Authentication Protocols	8	4		
	**Assignment Topics					
Module 5: **Blockchains**	in class	Blockchain, Types of blockchains- Public block chains, Private block chains, Hybrid block chains, Sidechains, Smart contracts, Uses of block chains-Cryptocurrencies, Financial services, Games, Supply chain, Domain names, Other uses.	8	5		
	**Assignment Topics					

Text Book

1. Blockchain and Web 3.0- Social, Economic, and Technological Challenges, 2019, Publisher: Taylor & Francis, Giuseppe Destefanis, Massimo Ragnedda
2. Distributed Computing, Ajay D. Kshemakalyani, Mukesh Singhal, 2008, Cambridge University Press
3. Cryptography and Network Security-Principles and Practices, William Stallings, 2003, Pearson Education

Reference Book(S)

1. Web 3.0 Startups- Online Marketing Strategies for Launching & Promoting Any Business on the Web, By R. L. Adams · 2013
2. Blockchain and Crypto Currency, 2020, Springer Singapore, Chris Dai, Kenichi Masuda, Makoto Yano, Yoshio Kishimoto

Sub Code: IT332A3   **Credit: 4(L-3, T-1, P-0)**

SOFT COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides a comprehensive study on various computational techniques (suchas Genetic Algorithm, ANN, Fuzzy Logic etc.) used in computer science for modelling or solving complex problems for which more conventional methods have not yielded low cost, analytic and complete solutions.

Pre-requisites: Data Structures, Design and Analysis of Algorithms and Artificial Intelligence.

Course Outcomes (CO): On completion of the course the students will be able to:
1. Identify Soft Computing principles and techniques and apply them in logical reasoning.
2. Identify fuzzy and predicate logic logic applications and implement them in solving basic engineeringproblems.
3. Visualize and employ Rough decision systems.
4. Formulate solutions to real life engineering problems Basic ANN models.
5. Employ Genetic Algorithms for solving real life optimization problems.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Introductio n& Fuzzy Set Theory >	in class	Introduction: Definition and Concept of Soft Computing, Aspects of Soft Computing, Dealing with Vagueness- Fuzzy Systems, Rough Sets, Modeling the Brain-Human Cognition, Artificial Neural Networks, Modeling Nature's Optimization Process- Natural Evolution, Genetic Algorithms, Other Evolutionary Processes, Synergy Among the Soft Computing Techniques Fuzzy Set Theory: Review of Crisp Set theory - Sets and subsets, Definitions, Concepts, Notations and Operations on sets, De Morgan's Law, Fuzzy Sets – Fuzziness/vagueness, Membership function - Crisp membership, Fuzzy membership, Membership profiles, Fuzzy sets - Definition, Notation, Features, Transformation. FuzzyMembership Functions -Some Popular Membership Function, Transformations on Membership Functions, Fuzzy set operations, Properties, De Morgan's Law, Fuzzy Relations, Operations on fuzzy relations	10	1		
	**Assignment Topics					
Module 2: < Fuzzy Logic & Propositional Logic >		Generalized Modus Ponens, Fuzzy Inference, Generalized Modus Tollens Propositional Logic: Propositions, Propositionallogic well-formed formulae, Properties of wffs, Interpretation of logical expression, Logical equivalence, Tautology/ Contradiction/ Consistency, Validity of an argument				
	**Assignment Topics					

Module 3: < Predicate Logic & RoughSets >	in class	Predicate Logic: Limitations of propositional logic, Predicate logic well-formed formulae, Properties of FOPL wffs, Rules of Inference, Deductive Rules, Modus ponens, Universal Specialization, Chain Rule, Simplification, Resolution, Modus Tollens, Addition, Non-deductive Rules, Abduction, Induction, Analogy. Rough Sets : Information Systems & Decision Systems, Indiscernibility, Set Approximations-Lower & Upper Approximations, Rough set properties, Rough Membership: Rough Membership Function, Properties, Rough set Categories, Roughly B-definable, Internally B-definable, Externally B- definable, Totally B-definable, Reducts: Reduct & Minimal Reduct, Discernibility Mattrix & Discernibility Function	11	2,3		
	**Assignment Topics					
Module 4: < Artificial Neural Networks >	in class	Artificial Neural Networks : Basic Concepts-The Biological Neuron, The Artificial Neuron, Characteristics of the Brain, Computation in Termsof Patterns -Pattern Classification, Pattern Association, The McCulloch- Pitts Neural Model,The Perceptron, Neural Network Architectures - Learning by Neural Nets, Multilayer Feed forward, The Back propagation Algorithm - Learning, Parameter Choice, Initialization, Stopping criteria, Training set, Data Representation, Hidden Layers.	5	4		
	**Assignment Topics					
Module 5: <Advanced Search Algorithms >	in class	Genetic Algorithms - Natural Evolution, Chromosomes, Natural Selection , Cross-over, Mutation, Basic GA, Encoding a solution as chromosome / decoding it, Fitness Function, Population, GA operators- Selection, Tournament, Roulette Wheel, Cross-over, Mutation, GA parameters , Convergence	5	5		
	**Assignment Topics					

Text Books:
1. J.-S.R. Jang, C. -T. Sun, E.Mizutani, "Neuro-Fuzzy And Soft Computing-A Computational Approach to Learning and Machine Learning", Pearson Education.
2. LaureneFausett, "Fundamentals of Neural Networks – Architechture, Algorithms andApplications", Prentice Hall.

Reference Books:
1. Simon Haykin, "Neural Networks – A Comprehensive Foundation", Prentice Hall.
2. Jerry M. Mendel, "Uncertain Rule-Based Fuzzy Logic Systems: Introduction and NewDirections", Prentice Hall
3. Melanie Mitchell, "An Introduction to Genetic Algorithms", MIT Press.
4. Jan Komorowski, Lech Polkowski, Andrej Skowron, "Rough Sets- A Tutorial",(Electronic Copy)
5. ZbigniewSuraj, "An Introduction to Rough Set Theory and Its Applications- A Tutorial", , ICENCO'2004, Cairo, Egypt, (Electronic Copy).

Sub Code: IT333A3　　　　　　　　　　　　　　　　　　　　　　**Credit: 4(L-3, T-1, P-0)**

CYBER PHYSICAL SYSTEMS

Course Objective: The objective of this course is to develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective, but based equally on the principles of automated control. The course aims to expose the student to real world problems in this domain and provide a walk through the design and validation problems for such systems.

Pre-requisites: Nil

Course Outcomes: Upon successful completion of the course, the students are expected to be able to:

1. Understand the basic building blocks of Cyber Physical Systems (CPS), and basic principles of design and validation of CPS.
2. Apply the principles of dynamical systems for designing controller.
3. Identify the CPS implementation issues.
4. Illustrate safe reinforcement learning, secure task mapping, and partitioning.
5. Understand the principles of secure task mapping and partitioning in Cyber-Physical Systems (CPS) deployments, as well as the concept of state estimation for attack detection.

** Not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to Cyber-Physical Systems(CPS) and CPS Platform Components**	**In Class**	Cyber-Physical Systems (CPS) in the real world – Basic principles of design and validation of CPS – Industry 4.0 – AutoSAR – IIOT implications – Building Automation – Medical CPS, Processors – Sensors – Actuators – CPS Network - WirelessHart – CAN – Automotive Ethernet – Scheduling Real Time CPS tasks	7	1		
	**Assignment Topics	Applications of Industry 4.0				
Module 2: **Principles of Dynamical Systems**	**In Class**	Dynamical Systems and Stability – Controller Design Techniques – Performance under Packet drop and Noise .	7	2		
	**Assignment Topics	Survey of a few dynamical systems.				
Module 3: **CPS implementation issues**	**In Class**	From features to automotive software components – Mapping software components to ECUs – CPS Performance Analysis - effect of scheduling – bus latency – sense and actuation faults on control performance – network congestion – Building real-time networks for CPS	8	3		
	**Assignment Topics	Metrics for CPS performance analysis.				

Module 4: **Intelligent CPS**	**In Class Topics**	Safe Reinforcement Learning – Robot motion control – Autonomous Vehicle control – Gaussian Process Learning – Smart Grid Demand Response – Building Automation	7	4			
	**Assignment Topics	Applications of smart grid systems.					
Module 5: **Secure Deployment of CPS**	**In Class Topics**	Secure Task mapping and Partitioning – State estimation for attack detection – Automotive Case study: Vehicle ABS hacking – Power Distribution Case study: Attacks on SmartGrids.	7	5			
	**Assignment Topics	Detection and diagnosis of attacks on SmartGrids.					

Text Book

1. Alur, Rajeev. *Principles of cyber-physical systems*. MIT Press, 2015.
2. Lee, Edward Ashford, and Sanjit A. Seshia. *Introduction to embedded systems: A cyber-physical systems approach*. MIT Press, 2016.

Reference Book(S)

1. Lee, Edward A., and Sanjit A. Seshia. "An introductory textbook on cyber-physical systems." *Proceedings of the 2010 Workshop on Embedded Systems Education*. ACM, 2010.
2. Talcott, Carolyn. "Cyber-physical systems and events." *Software-Intensive Systems and New Computing Paradigms*. Springer, Berlin, Heidelberg, 2008. 101-115.

Sub Code: IT334A3   **Credit: 4(L-3, T-1, P-0)**

SOCIAL NETWORK ANALYSIS

Questions to be set: 05 (All Compulsory)

Course Objectives: To understand how the world is connected -- socially, strategically and technologically and why it matters and to introduce the basic notions and model used for social networkanalysis.

Pre-requisites: Graph Theory

Course Outcomes (CO): On completion of the course, it is expected to endow the students with skills to:
1. Define competence in Social Network Analysis fundamentals.
2. Explain and extend the competence in structural models of Social Network fundamentals.
3. Illustrate the ability to formulate and interpret several Social Network.
4. Represent the Social Network analysis results.
5. Analyze Social Network Graphs to reach a valid conclusion

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	in class	Motivation, Social Network Perspectives, Introduction to Network, Centrality measures, Balance and Homophily.	8	5		
	**Assignment Topics					
Module 2: SNA Models	in class	Basic Graph Theory for Social Network, Models for Network Growth, Link Analysis	12	4,3		
	**Assignment Topics					
Module 3: Social Networks	in class	Community Detection, Link Prediction, Clustering of connectivity	6	1		
	**Assignment Topics					
Module 4: Analysis	in class	Cascade Behavior, Link Analysis	6	3		
	**Assignment Topics					
Module 5: Graphs	in class	Graph Representation, Graph Mining, Case Studies	8	2, 1		
	**Assignment Topics					

Text Books:
1. S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications,Cambridge University Press, 1994
2. D. Easley and J. Kleinberg, Networks, Crowds and Markets: Reasoning about a highlyconnected world, Cambridge University Press, 2010

Reference Books:
1. Peter R. Monge, Noshir S. Contractor, Theories of communication networks. OxfordUniversity Press, 2003.
2. Duncan Watts. Six degrees: the science of a connected age. Norton, 2004.

Sub Code: IT335A3   **Credit: 4(L-3, T-1, P-0)**

REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

Questions to be set: 05 (All Compulsory)

Course Objectives: Introduce the principles of remote sensing to students who are beginners in this field. Much as the text book has laid out, fundamental knowledge on the physics of remote sensing, aerial photographic techniques, photogrammetric, multispectral, hyper-spectral, and thermal imaging, and RADAR and LIDAR image analysis will be introduced. The newest technology in the field will also be discussed. The subject will be synthesized by developing an overall application of the discipline, not just knowledge in one aspect. The course will be taught with an emphasis on the geographical applications of remote sensing; however, in certain instances other disciplines will be introduced as well. Lab assignments will supplement classroom discussion and reading assignments. At the end of the semester students should have a good understanding and basic skills of remote sensing.

Pre-requisites: Real Time System, Digital Image Processing

Course Outcomes (CO): On completion of the course, it is expected to endow the students with skills to:
1. Define the concepts and recognize the characteristics of a real-time system.
2. Identify and implement important software engineering principles for real-time system development.
3. Produce an architectural design of a real-time system.
4. Evaluate the real-time systems in appropriate terminology and the real-time characteristics of a given system to assist in deciding which software or kernel is appropriate for a problem.
5. Interpret and contrast the design of a real-time system in a range of commonly understood formats

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Physics of Remote Sensing >	in class	Introduction of Remote Sensing-Electromagnetic spectrum, physics of remote sensing-Effects of atmosphere-scattering-Different types- Absorption-Atmospheric Window-Energy interaction with surface features-Spectral Reflectance of vegetation, soil and water- atmospheric influence on spectral response patterns- multi concept in Remote Sensing	5	1		
	**Assignment Topics					
Module 2: Data Accquistion	In Class	Data Acquisition: Types of platforms- Different types aircraft- Manned and Unmanned space crafts– sun synchronous and geo synchronous satellites-Types and characteristics of different platforms LANDSAT,SPOT,IRS,INSAT,IKONOS,QUICKBIRD, etc. – Photographic products, B/W, colour, colour IR film and their characteristics – resolving power of lens and film–Opto mechanical electro optical sensors – across track and along track scanners – multi spectral scannersn and thermal scanners – geometric characteristics of scanner imagery – calibration	7	2,3		
	**Assignment Topics					

Module 3: Scattering System	in class	Microwave scatterometry – types of RADAR – SLAR – resolution – range and azimuth – real aperture and synthetic aperture RADAR. Characteristics of Microwave images- topographic effect – different types of Remote Sensing platforms –air borne and space borne sensors – ERS, JERS, RADARSAT, RISAT – Scatterometer, Alimeter- LiDAR Remote Sensing, principles, applications	7	3,4		
	**Assignment Topics					
Module 4: Multi Spectral & Hyper Spectral Remote Sensing and Thermal Radiation Principles and Thermal Imaging	in class	Multi Spectral & Hyper Spectral Remote Sensing: Sensors characteristics – principle of spectroscopy – imagine spectroscopy – field conditions, compound spectral curve, Spectral library, radiative models, processing procedures,derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications. Thermal Radiation Principles and Thermal Imaging: Thermal remote sensing– thermal sensors, principles, thermal data processing, applications	9	4		
	**Assignment Topics					
Module 5: Data analysis & Applications of remotesensing	in class	Data analysis: resolution- spatial, spectral, radiometric and temporal resolution- signal to noise ratio- data products and their characteristics – visual and digital interpretation –basic principles of data processing –radiometric correction –image enhancement –image classification – principles of lidar, aerial laser terrain mapping. Applications of remote sensing: Remote sensing of soils and geomorphology, Remote Sensing of vegetation, Remote sensing of water resources and Urban applications using remote sensing imagery.	12	5		
	**Assignment Topics					

Text Books:

1. Jensen, John R., 2000, Remote Sensing of the Environment: An Earth Resource Perspective, NewJersey: Prentice Hall, 544 pages. ISBN 0-13-489733-1.

Reference:

1. Lillsand T.M. and Keifer, R.W. Remote sensing and Image Interpretation, VI edition of John Wiley& Sons-2000.
2. John R. Jesen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition,1995.
3. John A.Richards, Springer-Verlag, Remate Sensing Digital Image Analysis 1999.
4. Paul Curran P.J. Principles of Remote Sensing, ELBS, 1995.
5. Charles Elachi and JakobJ.vanZyl, Introduction to the Physics and Techniques of Remote Sensing,Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F.Jr, Remote Sensing Principles and Image Interpretation, W.H. Freeman &co, 1978.

Sub Code: IT336A3   **Credit:4 (L-3, T-1, P-0)**

WIRELESS SENSOR NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides an introduction to the area of wireless sensor networks. A detailed study on related technologies and standards ranging from networking, OS support and algorithms,to security will constitute the syllabus. Its primary concern will be protocol design, communication and computational challenges posed by Wireless Sensor based networking systems

Pre-requisites: Data Communication, Computer Networks, Knowledge of Ad Hoc WirelessNetworks desirable.

Course Outcomes: On completion of the course, it is expected to endow the students with skillsto:

1. List and describe the engineering fundamentals of wireless communication applied insensor network.

2. Identify and relate the complex engineering problem relating to sensor network architectures and functions.

3. Formulate a solution plan and methodology by Applying appropriate theory, practicesandtools to the development of wireless sensor network with respect to its applications area.

4. Differentiate and select optimal design scheme suitable for wireless sensor network.

5. Discuss and compare the design principles and implementation of a variety of key sensor networking protocols and algorithms.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Wireless Sensor Networks and Infrastructure Control & Communication Networks	In Class	Definition, Requirement and Evolution of Wireless Sensor Networks (WSN), Examples of WSNs, Difference between WSNs and Ad Hoc Wireless Networks, IEEE 1451 and Smart Sensors, Transducers and Physical Transduction Principles, Sensors for Smart Environments, Commercially Available Wireless Sensor Systems, Self-Organization and Localization. Network Topology, Communication Protocols and Routing, Topology Control, Clustering, Time Synchronization, Power Management, Network Structure and Hierarchical Networks, Historical Development and Standards.	8	1		
	**Assignment Topics					
Module 2: Canonical Problem	In Class	A Tracking Scenario, Problem Formulation, Distributed Representation and Inference of States, Tracking Multiple Objects, Sensor Models and Performance Comparison and Metrics,	9	2		

Localization and Tracking, Signal Processing and Decision Making and Medium Access Control protocols		Localization, ranging techniques, range-based localization, GPS-based localization; range-free localization; event-driven localization. Signal Conditioning, Digital Signal Processing, Decision Making and User Interface. Carrier Sense Multiple Access, Multiple Access with Collision Avoidance (MACA) and MACAW, MACA By Invitation, IEEE 802.11, IEEE 802.15.4 and ZigBee; Characteristics of MAC Protocols in Sensor Networks, Types of MAC Protocols.				
	**Assignment Topics					
Module 3: Networking Sensors and Routing	In Class	Introduction, Key Assumptions, Medium Access Control, routing metrics, Issues and Challenges for Routing in WSN, Routing Based on Network Structure, Routing Based on Protocol Operation, categories of routing protocol, flooding and gossiping, data-centric routing, proactive routing, on- demand routing, hierarchical routing, location-based routing	7	2,3		
	**Assignment Topics					
Module 4: Security for Sensor Networks	in class	Requirement, Issues and Challenges for different security protocols for WSNs, Security Parameters, Sensor Network Limitations, Requirements for Bootstrapping Security in Sensor Networks, Evaluation Metrics, Single Network-Wide Key, Using Asymmetric Cryptography, Pairwise-shared Keys, Bootstrapping Security off a Trusted Base Station.	8	4		
	**Assignment Topics					
Module 5: Sensor Network Databases and Applications and Future Directions	in class	Sensor Database Challenges, Query Interfaces, High Level Database Organization, In Network Aggregation, Data Centric Storages, Distributed Hierarchal Aggregation, Temporal Data. Emerging Applications, Future Research Directions.	8	5		
	**Assignment Topics					

Text Books:
1. Feng Zhao &Leonidas Guibas, Wireless Sensor Networks: An InformationProcessing Approach, Elsevier Publication.
2. Jun Zheng & Abbas Jamalipour, Wireless Sensor Networks: A NetworkingPerspective, Wiley Publication.

Reference Books:
2. Waltenegus Dargie & Christian Poellabauer, Fundamentals of Wireless SensorNetworks: Theory and Practice, Wiley Publication,
3. Holger Karl &Andreas Willig, Protocols and Architectures for Wireless SensorNetworks, Wiley Publication.
4. Robert Faludi, Building Wireless Sensor Networks, O'Reilly Publication.
5. Shahin Farahani, ZigBee Wireless Networks and Transceivers, 1st Edition, ElsevierPublication

Sub Code: IT339A3   **Credit: 4(L-3, T-1, P-0)**

AUGMENTED REALITY

Questions to be set: 05 (All Compulsory)

Course Objectives: The syllabus is aimed to provide students with a solid background in alternative 3D compositing techniques using computer vision with applications in interactive interfaces – most notably augmented reality interfaces on mobile devices. It also provides students with a comprehensive knowledgein 3D vision and develop skills in the design and development of interactive augmented reality games.

Pre-requisites: Students must have successfully completed a course in computer graphics.

Course Outcomes: On successful completion of this course, students will be able to:

1. Develop interactive augmented reality applications for both PC based mobile devices using a varietyof novel input devices.
2. Describe a knowledge of the research literature in Augmented Reality for both compositing andinteractive applications.
3. Create environment using AR/VR technology which can help us in our life.
4. It is easy to use this kind of technology to illustrate applications with AR toolkit and mobile AR.
5. Estimate the knowledge of the research literature in Augmented Reality for both compositing andinteractive applications.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Augmented Reality	In Class	Definition of Augmented Reality, History of Augmented Reality, AR Systems Overview. Input and Output Devices for AR · Optical vs. Video See-Through AR · Sample Applications – medical, military, manufacturing. Research Directions – tracking, interaction techniques, outdoor AR.	6	2		
	**Assignment Topics					
Module 2: Tracking for Augmented Reality	In Class	The Importance of Accurate Head Tracking / The Tracking Problem · The Choice of the Tracking Technologies · Registration + Calibration – static and dynamic · Real Time Performance Characteristics - spatial, temporal, system robustness · Scheduling and Fusing Sensor Information · Approaches to head motion prediction.	7	1		

	Assignment Topics					
Module 3: Interaction Techniques for Augmented Reality	In Class	The Importance of Effective AR Interface Design · Basic Properties of AR Environments used in Designing AR Interfaces · Interaction Techniques Based on Traditional Tracking Techniques – magnetic, etc · Novel Input Devices - InfoPoint device from Sony CSL · Tangible and Graspable Interaction Approaches - ARgroove · Augmented Reality Information Browsers · AR Widgets and Graphical Interface Elem ents · Evaluating AR	9	3		
	Assignment Topics					
Module 4: Collaborative Augmented Reality & Heterogeneous AR User Interfaces	In Class	Introduction to Computer Supported Collaboration AR Collaboration vs. Traditional Computer Supported Collaborative Work • Methods for Developing Collaborative AR Interfaces • Case Studies: - Face-to-Face Collaboration – Shared Space - Remote Collaboration – AR Conferencing, Wearable AR Conferencing - Seamless Collaboration– The MagicBook. Flavors of augmented reality: video mixing, optical blending, projection devices, spatially augmented reality, Combining AR with other user interface metaphors: Immersive virtual reality, desktop metaphor, mobile/wearable computing, ubiquitous computing, tangible user interfaces, computer supported collaborative work , Distributed graphics Sample, Application Areas.	9	4		
	Assignment Topics					
Module 5:Mobile AR & Developing Applications with ARToolKit		Introduction to Wearable and Situated Computing AR in a Mobile Setting , Current Implementations/Examples –Outdoor AR, Tracking a Mobile User , Mobile Display and Computing Hardware, Environmental Modeling, User Interface Issues , Example Solutions for Mobile Applications.Overview of ARToolKit, Computer Vision Based Tracking and Registration Methods used in ARToolKit. Steps for Developing a Simple AR Application.ARToolKit-based Interaction Methods. Future Developments with ARToolKit. Demonstrations: MagicBook, VOMAR, ExView, SimpleTest.	9	5		

	Assignment Topics					

Text Books:

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

References Books:

1. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

SCIENCE, TECHNOLOGY AND SOCIETY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course aims to foster an understanding of science as a cultural and societal practice, exploring its historical, philosophical, and sociological dimensions and the dynamic interplay between science, technology, and society.

Pre-requisites: Nil

Course Outcomes (CO): On completion of the course it is expected to endow the students with skills to:

1. Understand science as a socio- cultural product in specific historical context.
2. Analyze philosophical, historical, and sociological perspectives on science and technology, recognizing science as a practice deeply embedded in culture and society
3. Emphasize the dynamic nature of the relations between wider cultural practices, on the one hand, and, scientific practices, on the other in a comparative analytical framework.
4. Explain the perspectives on the relationships between science and technology, and between science, technology, and society
5. Identify the essential theories needed to analyze the dynamics between science and society across various contexts and disciplines.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Science as Culture**	in class	Methods of Science: Issues and Perspectives, Social Context of Production of Scientific Knowledge, Demarcation, Autonomy and Cognitive Authority of Science, Challenges: Cognitive, Legal, Ethical, Feminist and Ideological.	7	1		
	**Assignment Topics					
Module 2: **Organisation of Production of Scientific Knowledge and Professionalisation of Science**	in class	Science as Social Institution and Ethos of Science, Inequalities in Science, Critique of the Mertonian Paradigm, Knowledge Production: Social and Cultural Contexts.	5	1		
	**Assignment Topics					
Module 3: < **Society and Culture: Resourcesand Legitimation of Knowledge**	in class	Social Legitimation, Meanings, Interests, Values and the Modern State..	5	2		
	**Assignment Topics					

Module 4: **Perspectives on Science - Technology Relationship:**	in class	Hierarchical, Symbiotic and Coalescing, Science and Technology, and their Human Roots: Philosophy of Science and Technology, Technology as Knowledge, Technological Shaping of Society and Social Shaping of Technology	6	2		
	**Assignment					
Module 5: **Science in Colonial and Post-colonial India**	in class	Science in Colonial India, Reception of Modern Science in India, Science after Independence	5	3		
	**Assignment					
Module 6: **Emerging Technologies**	in class	Information and Communication Society - Implications for Work, Social Relations, Governance and Control, Biotechnology - Implications for the Meanings of Life and Life, Processes, Application in Agriculture, Healthcare and Environment.	6	4		
	**Assignment					
Module 7: **New Ethical Codes for New Technologies**	in class	Responses of the Civil Society.	2	4		
	**Assignment					
Module 8: **Science: From Public Resource to Intellectual Property**	in class	Changing Context of the Production of Knowledge, The Intellectual Property Rights Regime, Science: From Curiosity- driven Research to Contract Obligations	4	5		
	**Assignment					

References:

1. A.F. Chalmers (1976) What is this thing called Science? Milton Keynes: The Open University Press
2. T.S. Kuhn (1970) The Structure of Scientific Revolutions. Chicago: Chicago University Press (first published in 1962).
3. D. Oldroyd (1986) The Arch of Knowledge: An Introductory Study of the Philosophy and Methodology of Science. New York and London: Methuen.
4. D. Bloor (1991) Knowledge and Social Imagery. Chicago: The University of Chicago Press (first published in 1976).
5. M. Biagioli ed., (1999) The Science Studies Reader.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Questions to be set: 05 (All Compulsory)

Course Objectives: To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

Pre-requisites: Nil

Course Outcomes (CO): On completion of the course it is expected to endow the students with skills to:

1. Understand the concept of Traditional knowledge and its importance.
2. Know the need and importance of protecting traditional knowledge
3. Know the various enactments related to the protection of traditional knowledge
4. Understand the concepts of Intellectual property to protect the traditional knowledge
5. Understand the traditional knowledge in different sectors.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to traditional knowledge**	in class	Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	8	1		
	**Assignment Topics					
Module 2: **Protection of traditional knowledge**	in class	The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK	8	2		
	**Assignment Topics					
Module 3: **Legal framework and Traditional Knowledge**	in class	A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003	8	3		
	**Assignment Topics					

Module 4: **Traditional knowledge and intellectual property**	in class	Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.	6	4	
	**Assignment				
Module 5: **Traditional knowledge in different sectors**	in class	Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK	5	5	
	**Assignment				

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.

References:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
2. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

Sub Code: IT210A2/ IT210A8   **Credit:4 (L-3, T-1, P-0)**

INTRODUCTION TO CRYPTOGRAPHY

Questions to be set: 05 (All Compulsory)

Course Objectives: Objectives: The objective of this subject is to understand the principles of various encryption algorithms including symmetric and public key cryptography. It also deals with various hashing algorithms and network security mechanisms.

Pre-requisites: Computer Networks.

Course Outcomes (CO): On successful completion of this course, students should be able to:

1. Identify the services, mechanisms, and attacks outlined in the OSI Security Architecture relevant to information security

2. Explain the principles of symmetric ciphers, including substitution and transposition techniques, and analyze the strengths and operations of block ciphers and DES.

3. Apply public-key encryption techniques such as RSA and Diffie-Hellman, calculate using basic number theory, and evaluate digital signature and authentication protocols.

4. Implement secure communication protocols for electronic mail and IP security, and assess the effectiveness of these security measures.

5. Implement secure communication protocols for electronic mail and IP security, and assess the effectiveness of these security measures.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction>	in class	Services, Mechanisms and Attacks – The OSI Security Architecture	8	1		
	**Assignment Topics					
Module 2: **Symmetric Ciphers**	in class	Substitution Techniques – Transposition Techniques – Stenography –Block Ciphers and the Data Encryption Standards: Simplified DES – Block Cipher Principles – The Data Encryption Standard – The strength of DES – Block Cipher design principles – Block Cipher modes of Operation –Traffic Confidentiality – Key Distribution – Random Number Generation	8	2		
	**Assignment Topics					
Module 3: <**Public-Key Encryptio n**	in class	Number Theory: Prime and Relatively Prime Numbers, Modular Arithmetic, Fermat's and Euler's Theorems, Testing for Optimality, Euclid's Algorithm, Discrete Logarithms – The RSA Algorithm – Key Management – Diffie-Hellman Key Exchange – Message Authentication and Hash Functions – MD5 Message Digest Algorithm –	8	3		

		Digital Signature and Authentication Protocols				
	**Assignment Topics					
Module 4: **Network Security**	in class	Electronic mail Security: Pretty good Privacy – S/MIME – IP Security: IP Security Overview – IP security architecture – Authentication Header – Encapsulation Security	8	4		
	**Assignment Topics					
Module 5: **Web Security**	in class	Web Security considerations – Secure Socket and transport layer security – Secure Electronic Transaction – Viruses and related threats – Firewalls: Firewall Design Principles	8	5		
	**Assignment Topics					

Text Book

1. Cryptography and Network Security-Principles and Practices, William Stallings, 2003, Pearson Education

Reference Books

1. Cryptography and Network Security, B.A. Forouzan,2008, MaGraw Hill
2. Internet Cryptography, Richard E. Smith, 1997, Addison Wesley
3. Internet Security, Professional Reference, Derek Atkins et al, 1997, TechMedia
4. Cryptography and Network Security, Atul Kahate, 2007, McGraw Hill
5. Applied Cryptography, Bruce Schneier, 1995, John Wiley and Sons Inc.
6. Modern Cryptography: Theory and Practice, Wenbo Mao, 2004, Pearson Education

Sub Code: IT220A2/ IT220A8   **Credit:4 (L-3, T-1, P-0)**

INTRODUCTION TO CYBER SECURITY

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is designed to present the basic concepts of cyber security. It addresses the key issues of security vulnerabilities on software development, operating system and the web. Solutions provided by cryptography has been discussed especially based on intrusion detection system. The syllabus also gives a brief introduction to cyber forensics.

Pre-requisites: Basics of Computer Networks

Course Outcomes (CO): On completion of the course, it is expected to endow the studentswith skills to:
1. Discover the concepts of cyber security and its social, technical and political techniques.
2. Illustrate on the various Intrusion detection and prevention techniques.
3. Analyze various algorithms based on Cryptography and Network security.
4. Assess various methods of handling investigations in the field of cyber forensics.
5. Explain the legal and social issues in the development and management of cyber security.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction to Cyber Security Cyber Security Vulnerabilities and Cyber Security Safeguards	In Class	Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:-Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems,	10	1		

		Response, Scanning, Security policy, Threat Management.					
	**Assignment Topics						
Module 2: Securing Web Application, Services and Servers Intrusion Detection and Prevention	In Class	Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Networkbased Intrusion detection Systems, Network based Intrusion Prevention	10	1,2			
		Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation					
	**Assignment Topics						
Module 3: Cryptography and Network Security	i n c l a s s	Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls-Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer-PGP and S/MIME, Security at Transport Layer- SSL and TLS, Securityat Network Layer-IPSec	10	3			
	**Assignment Topics						
Module 4: Cyberspace and the Law	in class	Introduction, Cyber Security Regulations, Roles ofInternational Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013	5	4			
	**Assignment Topics						
Module 5: Cyber Forensics	in class	Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-	5	4,5			

		time				
	**Assign ment Topics					

Text Books:
1. John R Vacca, "Computer and Information Security Handbook", 3rd Edition, Elsevier,2013, ISBN: 9780128038437.
2. Albert Marcella, Jr., DougMenendez, "Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Second Edition, CRC Group, Taylor & Francis, ISBN 9780849383281.
3. William Stallings, "Cryptography and Network Security", Pearson.

Reference Books:
1. George K Kostopoulus, "Cyber space and Cyber Security ", Second Edition, CRCGroup, Taylor & Francis, ISBN 9781138057715
2. Behrouz A Frouzan, "Cryptography and Network Security", Tata McGraw Hill.

Sub Code: IT310A2/ IT310A8   **Credit:4 (L-3, T-1, P-0)**

CYBER SECURITY SOLUTIONS

Questions to be set: 05 (All Compulsory)
Course Objectives: To make aware of existing cybersecurity solutions

Pre-requisites: Internet Technology, Data Communication and Computer Networks.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1.   Understand different cyber-attacks and their solutions.
2.   Understand the concept related to security in embedded system.
3.   Analyze and apply different techniques for intrusion detection and firewall system security.
4.   Evaluate wireless network security measures, and design security enhancements using WEP, WPA, and other protocols in wireless network environments.
5.   Understand the technology for network perimeter security and know the operations of different malicious software.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	in class	Major Cyber Attacks Past One Year, Cyber-Security Solutions, Antivirus & Mobile App Security, Authentication: Biometrics, Cryptography, Data Loss Prevention (DLP), DDOS Attack Protection.	8	1		
	**Assignment Topics					
Module 2: Embedded System Security	in class	Fraud Detection and Prevention, IAM- Identity & Access Management, Intrusion Detection: Log Analysis & Management, Mainframe Security.	6	2		
	**Assignment Topics					
Module 3: Intrusion Detection, Firewall Security	in class	Log Analysis & Management, Mainframe Security, Password Management, Patch Management, Penetration testing, Privileged Access Management (PAM), Public Key Infrastructure (PKI), Risk Analysis.	6	3		
	**AssignmentTopics					
Module 4: Wireless Network Security	in class	Wireless Communications and WLAN Standards, WLAN Architecture, Essentials, Wireless Security Vulnerabilities, WEP, Device Authentication and Access Control, WPA Encryption and Decryption, WPA Security Strength and Weaknesses, Bluetooth Security, Wireless Mesh Network Security.	8	4		
	**AssignmentTopics					
Module 5: Network	in class	General Framework, Packet Filters, Stateless Filtering, Application Gateways, Cache	8	5		

Perimeter Security, Malicious Software		Gateways, Firewall Configurations, Single-Homed Bastion Host System, Network Security Topology, Network Address Translations, Dynamic NAT, Virtual Local-Area Network, Viruses, Virus Types, Virus Infection Schemes, Virus Structures, Compressor Viruses, Virus Disseminations, Win Virus Infection Dissection, Virus Creation Toolkits, Worms, Common Worm Types, The Email Attachments.				
	Assignmen tTopics					

Text Books:
1. Computer Network Security Theory and Practice, Jie Wang, ISBN 978-3-540-79697-8 Springer Berlin Heidelberg New York.
2. Cyber Security Solutions, N K Goyal.

Reference Books:
1. Cryptography and Network Security, B.A. Forouzan,2008, MaGraw Hill.
2. Internet Cryptography, Richard E. Smith, 1997, Addison Wesley.
3. Internet Security, Professional Reference, Derek Atkins et al, 1997, TechMedia.
4. Cryptography and Network Security, Atul Kahate, 2007, McGraw Hill.
5. Applied Cryptography, Bruce Schneier, 1995, John Wiley and Sons Inc.
6. Modern Cryptography: Theory and Practice, Wenbo Mao, 2004, Pearson Education.

Sub Code : IT320A2/IT320A8   **Credit: 4 (L-3, T-1, P-0)**

<div align="center">Cyber Forensics</div>

Questions to be set: 05 (All Compulsory)

Course Objectives: This is a basic undergraduate-level course covers the fundamentals of cyber forensics, types of forensic systems, evidence collection, cyber law and cyber crime.

Pre-requisites: Nil
Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Evaluate various types of computer forensics technologies for uncovering hidden data and identifying malicious software..

2. Employ a range of cyber forensics tools to investigate digital security systems and analyze case studies.

3. Assess the significance of evidence collection in cyber forensics investigations.

4. Analyze the basic principles of law as they apply to cyberspace, including jurisdictional issues and legal precedents.
5. Analyze the concepts of digital signatures, public-key infrastructure, and certification authorities in the context of cybercrime investigation.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to Cyber forensics**	in class	Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases. Analyzing malicious software. Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems	7	1		
	**Assignment Topics					
Module 2: **Types of Computer Forensics Systems**	in class	Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite	7	2		

		Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft, Biometric Security Systems ,Router Forensics. Cyber forensics tools and case studies. Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking.				
	**Assignment Topics					
Module 3: **Evidence Collection and Data Seizure**	in class	Why Collect Evidence, Collection Options Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Controlling Contamination: The Chain of Custody, Reconstructing the Attack, The digital crime scene, Investigating Cybercrime, Investigating Web attacks, Investigating network Traffic ,Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events.	7	3		
	**Assignment Topics					
Module 4: **Cyber Law**	in class	Basic of law, Understanding cyber space, Defining cyber law, Scope and jurisprudence, Concept of jurisprudence, Overview of Indian legal system, Introduction to IT Act 2000, Amendment in IT Act.	7	4		
	**Assignment Topics					
Module 5: **Cyber Crimes**	in class	Types of cyber crimes –against individuals institution, and states-various offenses and punishments, digital signature-concepts of public key and private key, certification authorities and their role, creation and authentication of digital signature. E-contracting –salient features of Econtracts, formation of E-contracts and types, E-governance, E-governance models, E-commercesalient features and advantages.	7	5		
	**Assignment Topics					

Text Book(s):
1. Cyber Forensics - Concepts and Approaches, Ravi Kumar &B Jain, 2006, Icfai University Press
2. Cyber Law Crimes, Barkha and U. Rama Mohan, Third Edition ,2017, Asia LawHouse .

Reference Books:

1. Understanding Cryptography: A Textbook for Students and Practitioners,ChristofPaar, Jan Pelzl, 2010, Second Edition,Springer.
2. Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri,First edition, 2009
3. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press 12 Series: Computer Forensics),2010
4. "Internet Complete Reference, Harley Hahn, Second Edition, 1996, Osborne/McGraw- Hill
5. Internet and Web design, , Ramesh Bangia Firewall Media, (An imprint of Lakshmi Publications Pvt. Ltd.). Second Edition 2006.
6. Cyber Laws Simplified,ViveekSood, Fourth reprint 2008,McGrawHill.

Sub Code: IT410A2/ IT410A8   **Credit: 4(L-3, T-1, P-0)**

BLOCKCHAIN TECHNOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: The syllabus is aimed at giving a basic understanding of cryptocurrency, its importanceand the use of block chain technology. It is focused on defining the technological backbone of Bitcoin fundamentals and expands the concepts to building the block chain technology. It guides us to understand the history of digital currency, the polices involving laws and organizations, the latest trends, and the communities involved; which facilitates us to construct, visualize and understand the ecosystem of block chain technology and its environment on which it is deployed.

Pre-requisites: Basics of Cryptography and Economics

Course Outcomes (CO): On completion of the course it is expected to endow the students with skills to:
1. Describe crypto currencies and block chain fundamentals.
2. Explain individual building blocks and understand the working mechanism of any block chaintechnology.
3. Discover the modern engineering tools, techniques and resources in the field of block chain technology.
4. Differentiate between different versions of block chain technology.
5. Illustrate use of block chain technology in a broader context like health, banking sector and identifysecurity concerns in block chain technology.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction Basics	In Class	Trustless system, Decentralized transactions. History: How and when Block chain & Bitcoin started, Milestones on the development of bit coin: creation, exchanges, Bitcoin: Nakamoto consensus, Research Perspectives & Challenges, Bitcoin mining strategy and attacks, Bitcoin community, economics & politics. Block Chain: What is Block chain? Distinction between Blockchain vs Cryptocurrency vs Token, Pillars of Block chain , Industry Applications of Blockchain.	10	1		
	**Assignment Topics	Crypto currencies: Bitcoin / Ethereum, How to Buy Bitcoin/Ethereum - How to Set up a Wallet.				
Module 2: Working Mechanism Mining and Cryptocurrencies	In Class	How Blockchain (and Bitcoin) Work, Peer to Peer network, What is a block?, block chain drive Proof of Work, Byzantine Generals, Distributed consensus, Cryptography: Hashing, Data Integrity, Merkle Trees, Public v Private Key Cryptography, Bitcoin and block sizes Mining : Proof of Work v Stake, how miners make money- business model, overview, the purpose, impact to the world, Motivations, incentives, strategy. Pools : CPUS and GPUs.	10	1,2		
	**Assignment Topics	Revenue at a Protocol Level : Block Rewards/Fees/ETC				

Module 3: Blockchain Types	in class	Public and Private Blockchains, JP Morgan Quorum, IBM's stuff, Using blockchain - Numerai,DAO, etc. Lightning networks and plasma, Sidechains, Digital Rights - ownership and accessibility, Industry - healthcare, identity, finance, Paradigm shift/future/big picture.	6	3		
	**Assignment Topics					
Module 4: Consensus Building, Regulation and Anonymity Problems with Blockchain	in class	What is it?, Security Implications, 1 PC 1 vote , Environmental, Segwit and Forks, What is a smart contract? Smart contract legal issues. Regulation and Anonymity: ICO and SEC ruling, its anonymity, Governments regulating bitcoin, Anti Money Laundering ,Political Implications on blockchain, Government's current position and its effects on blockchain. Anonymity - Zcash, Security and Safeguards, Protection from attackers, Hacks on exchanges, What is stopping adoption?, Scalability problems, Network attacks to destroy Bitcoin, Case Study: Failed currencies & Blockchain	9	4		
	**Assignment Topics					
Module 5: Bitcoin and Ethereum Blockchain applications	in class	Bitcoin creation and economy, Limited Supply and Deflation, Hacks , Ethereum concept and Ethereum classic, Altcoins : Major Altcoins - Zcash, Ripple, NEO Building on the Blockchain - Pros and cons of different implementations , Use cases of the different types Government, Identity management, Auto executing contracts, Three signature escrow, Triple entry accounting, Elections and voting?, Ethereum Interaction - Smart Contract and Token , Languages , How to create your own blockchain.	5	4,5		
	**Assignment Topics					

Text Books:
1. Arvind Narayanan, Joseph Bonneau, Edward Felten, "Bitcoin and CryptocurrencyTechnologies: A Comprehensive Introduction", Kindle Edition.
2. Andreas M. Antonopoulo,"Mastering Bitcoin: Programming the Open Blockchain",2ndEdition, Kindle Edition.

Other References:
1. https://bitcoin.org/bitcoin.pdf
2. http://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf.
3. http://chimera.labs.oreilly.com/books/1234000001802/ch07.html#_introduction_2
4. https://www.evry.com/globalassets/insight/bank2020/bank-2020---block chain-powering-the-internet-of-value---whitepaper.pdf

ETHICAL HACKING AND DATA PRIVACY

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is focused at understanding and analyzing the behavior of hackers to learn and evaluate their thought and actions which is aimed at harnessing information and hardware that they are not authorized to use. It also helps the learner understand the architecture of modern communication tools and protocols to apprehend their limitations, vulnerability and places of security issues and concerns. The course introduces the modern practices used by hackers and also reflects on the countermeasures taken by the system to keep a check on the vulnerabilities it is being exposed to.

Pre-requisites: Basics of Computer Network, Operating System, Web technology.

Course Outcomes: On completion of the course it is expected to endow the students with skills to:
1. Demonstrate competence in applying acquired expertise in computer networks.
2. Determine an ability to interpret and evaluate behavior of malwares and their counter measures.
3. Evaluate the approaches used by hackers and work on its countermeasures to reach a valid conclusion.
4. Explain an ability to identify the limitation of tools used to break an insecure web application.
5. Decide the problem in the decision-making process between possible options using tools.

** not more than 20% of total topics to be allotted for assignment

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	in class	Fundamentals of computer networking. TCP/IP protocol stack, Understanding security goals and services, Introduction to hacking: Threat, Exploit, What is Penetration test? Vulnerability Vs Penetration testing, Categories of Penetration test. Phases involved in hacking, Foot printing, Scanning, System Hacking, Session Hijacking. Writing Reports, Structure of a Penetration Testing Report, Vulnerability Assessment Summary, Risk Assessment, Methodology, Linux Basics: File Structure, Cron Job, Users, Common Applications, BackTrack, Services.	8	1		
	**Assignment Topics					
Module 2: Information Gathering, Target Enumeration and Port Scanning Techniques	in class	Active, Passive and Sources of information gathering, Copying Websites Locally, Neo Trace, Intercepting a Response, WhatWeb, Netcraft, Interacting with DNS Servers, Fierce, Zone Transfer with Host Command and Automation, DNS Cache Snooping- Attack Scenario, Automating Attacks, SNMP - Problem, Sniffing Passwords. Target enumeration and Port Scanning Techniques.	8	3		
	**Assignment Topics					
Module 3:	in class	Basics, Pros and cons of Vulnerability Assessment, NMap, Testing SCADA Environments with Nmap,	8	1,4		

Vulnerability Assessment & Network Sniffing and Information security		Nessus, Sniffing: Active and passive sniffing, Man in the middle attacks, ARP Protocol Basics-working, Attacks, DoS Attacks, Dsniff tool: Using ARP Spoof to Perform MITM Attacks, Sniffing Pictures with Drifnet, Sniffing with Wireshark, Ettercap- ARP Poisoning, Hijacking Session with MITM Attack, ARP Poisoning with Cain and Abel, Sniffing Session Cookies with Wireshark, Automating Man in the Middle Attacks, DNS Spoofing, DHCP Spoofing, Introduction to cryptography, private-key encryption, public-key encryption. Key exchange protocols, cryptographic hash functions, applications. Steganography, biometric authentication, lightweight cryptographic algorithms. Elements of hardware security: side-channel attacks, physical unclonable functions				
	**Assignment Topics					
Module 4: Basics Of Exploitation	in class	Understanding Network Protocols, Attacking Network Remote Services, Common Target Protocols, Attacking SMTP, Attacking SQL Servers, Client Side Exploitation Methods: E- Mails Leading to Malicious Attachments & Malicious Links, Compromising Client Side Update, Malware Loaded on USB Sticks, Social engineering attacks. Malware threats, penetration testing by creating backdoors Post exploitation: Acquiring Situation Awareness, Privilege Escalation, Maintaining Access, Windows exploit basics: Buffer Overflows, Significance of Buffer Overflow Vulnerability.	8	2,5		
	**Assignment Topics					
Module 5: Wireless & Web Hacking	in class	Wireless Hacking: Requirements, Aircracking, Hidden SSIDs, Monitor Mode, Monitoring Tool-Beacon Frames on Wireshark, Airodump-ng, Wireless Adapter in Monitor Mode, Determining the Target, Cracking a WPA/WPA2 Wireless Network Using Aircracking, Capturing Packets and Four-Way Handshake, Web Hacking : Attacking the Authentication , Brute Force and Dictionary Attacks. Attacking Authentication: Attacking Session Management, Design Flaws in Authentication Mechanisms Attacking Forgotten Password Functionality, attacking Password change functions. Countermeasures to authentication attacks. SQL Injection: Attacking SQL Servers, Sniffing, Brute Forcing and finding Application Configuration Files, Input validation attacks. Preventive Measures. Web Application Threats, Web Application Hacking, Cross Site Scripting / XSS Flaws / Countermeasures Correct Web	8	3,5		

		Application Set-up.				
	**Assignment Topics					

Text Books:
1. Rafay Baloch,"Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.
2. Patrick Engebretson,"The Basics of Hacking and Penetration Testing: Ethical Hacking and PenetrationTesting Made Easy", Syngress Media, Second Revised Edition, 2013.

Reference Books:
2. Michael T. Simpson, Kent Backman, James E. Corley, "Hands On Ethical Hacking and NetworkDefense", Cengage Learning, 2012.

Sub Code: IT219A2/IT219A8   **Credit: 4 (L-3, T-1, P-0)**

MULTIMEDIA FUNDAMENTALS

Questions to be set: 05 (All Compulsory)

Course Objectives: This is a basic undergraduate-level course on Honours Specialization in Multimedia Computing & Communications that covers the fundamentals of Multimedia.The course covers different media such as text, image, audio, video, and also different compression techniques applicable to these media. The students will learn about the basics of text, image, video, and audio formation and processing, the basics of multimedia compression and representation. The students will be exposed to dealing with text, image, audio, and video data in various multimedia applications. Various approaches involved in multimedia communications are also covered in this course.

Pre-requisites: Basic Knowledge on Programming in C.
Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Understand multimedia data digitization principles of analog signals with encoder and decoder design, and to become familiar with multimedia data representation for text, images, audio, and video with special emphasis on PCM speech, and basic concept of broadcast Television.

2. Become acquainted with color fundamentals for images and video signals, digitization formats for video signals, and the basics of Image processing with special emphasis on filters, binary Image analysis, processing of 2D images, thresholding, convolution, edge and corner detection, mathematical morphology, and shape descriptors.

3. Implement various compression algorithms such as Static Huffman Coding, Arithmetic Coding, Lempel-Ziv-Welsh coding for text compression, and to understand various image compression techniques such as Joint Photographic Expert Group (JPEG) with special emphasis on Transform Coding.

4. Apply audio and video processing fundamentals with special emphasis on audio compression techniques such as Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Predictive Differential Pulse Code Modulation, Adaptive Differential Pulse Code Modulation (ADPCM) with subband coding, Perceptual Coding with special emphasis on sensitivity of the human ear, frequency masking, temporal masking, and key concepts of Linear Predictive Coding (LPC).

5. Explain basics of multimedia networks, multiplexing technologies in multimedia networks, wired and wireless networks, multipath fading with special emphasis on various fading models, radio propagation models, and to become familiar with multimedia network communications and applications with special emphasis on multimedia communication standards and protocols.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Multimedia and Representation of Multimedia Data**	in class	Definition of Multimedia, Components of Multimedia, Multimedia data and multimedia systems, Classification of Multimedia Systems, Characteristics of Multimedia Data, Uses of Multimedia**.** Analog signals, Digital signals, Nyquist sampling theorem, Digitization principle of analog signals with special emphasis on audio signals, Encoder design, Decoder design, Sound versus Music signals.	[7]	1	1,2,3	1,2

Module		Content				
		Representation of Text, Image, Audio, and Video.				
	Assignment Topics	Representation of images in digital camera.	[7]	1	1,2,3	1,2
Module 2:, **Color Fundamentals, Digitization Formats, and Basics of Image Processing**	in class	Color fundamentals, color signals, Chrominance and Luminance, digitization of audio (PCM speech), image, and video, basic concepts of scanning sequence for video signals, digitization formats of digital video. 1 bit images, 8 bit Gray level images, 24 bit color images, 8 bit color images, Color Look Up Tables(LUTs), filters, binary Image analysis, processing of 2D images, thresholding, convolution, edge and corner detection, mathematical morphology, and shape descriptors.	[7]	2	1,2,3	1,2
	Assignment Topics	Conversion from RGB to YC_bC_r format		2	1,2,3	1,2
Module 3: **Multimedia Data compression**	in class	The need for compression – lossless compression versus lossy compression, Examples of text compression algorithms, redundancy and relevancy of image data, image compression techniques, : Basics of Information Theory, Run Length Coding, Variable Length Coding, Huffman Coding, Dictionary Based Coding, Arithmetic Coding. Distortion measures, Fourier Transform, Fast Fourier Transform (FFT), Discrete Cosine Transform (DCT), Moving into the Frequency Domain, Relationship between DCT and FFT, 1D DCT and 2D DCT, Performing DCT Computations, 2D DCT on Image Blocks, 2D DCT Basis Functions, Transform Coding, Main steps of JPEG image compression.	[7]	3	1,2,3	1,2
	Assignment Topics	A comparative study on text compression algorithms.		3	1,2,3	1,2
Module 4: **Fundamentals of Audio and Video Processing**	in class	Basics of digital audio, quantization and transmission of Audio. The need for audio compression, Audio compression approaches such as Differential Pulse Code Modulation, Adaptive Differential Pulse Code Modulation, Adaptive Predictive Coding, Linear Predictive Coding, Perceptual Coding, MPEG audio coders. Fundamental concepts of video, video compression, MPEG video coding, MPEG4, 7, and beyond.	[7]	4	1,2,3	
	Assignment Topics	A comparative study on video compression algorithms.		4	1,2,3	1,2
Module 5:	in class	Basics of Multimedia Networks – Multiplexing Technologies – Wireless versus Wired	[7]	5	1,2,3	

Multimedia Networks and Multimedia Transmission		Technology – Basics of Wireless Communication – Wireless Networks – Radio Propagation Models. Quality of Multimedia Transmission – Multimedia over IP – Multimedia over ATM Networks – Multimedia Communication Standards and Protocols				
	**Assignment Topics	Multimedia transmission over the Internet.		5	1,2,3	1,2

Text Book(s):
1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu "Fundamentals of Multimedia", Springer, Third Edition, 2021

Reference Books:
1. P. Havaldar and G. Medioni "Multimedia Systems – Algorithms, Standards and Industry Practices", Cengage Learning – First Edition, 2009.
2. W. Burger & M. Burge "Digital Image Processing: An algorithmic introduction using Java", Springer - Second Edition, 2016
3. F. Halsall, "Multimedia Communications: Applications, Networks, Protocols, and Standards", Pearson, 2001.

Sub Code: IT229A2/ IT229A8   **Credit: 4(L-3, T-1, P-0)**

MOBILE COMPUTING AND COMMUNICATION

Questions to be set: 05 (All Compulsory)

Course Objectives: To introduce the characteristics, basic concepts and systems issues in mobile computing. To illustrate architecture and protocols in mobile computing and to identify the trends andlatest development of the technologies in the area. Location of mobile devices, judicious use of bandwidth, relocation of computation, are some of the key issues which will constitute the topics for further exploration. To evaluate critical design tradeoffs associated with different mobile technologies,architectures, interfaces and business models and how they impact the usability, security, privacy and commercial viability of mobile computing services and applications.

Pre-requisites: Data communication and Computer networks.

Course Outcomes (CO): On completion of the course it is expected to endow the students withskills to:

1. Examine fundamentals of wireless communications.
2. Analyze security, energy efficiency, mobility, scalability, and their unique characteristics inwireless networks.
3. Develop basic skills for cellular networks design.
4. Apply knowledge of TCP/IP extensions for mobile and wireless networking.
5. Measure the awareness of the life-long learning, business ethics, professional ethics andcurrent marketing scenarios.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Introduction, Mobile Network and Transport Layer >	in class	Introduction and evolution of mobile computing and wireless communication, mobile computing functions, mobile computing device, middleware and gateways, mobile computing architecture: 3tier design considerations for mobile computing, Mobile Network layer – mobile IP, goals, assumptions and requirement, entities, mobile Ipv6. Mobile transport Layer-Traditional and classical TCP, TCP over 2.5 (3.0) G wireless networks.	9	1		
	**Assignment Topics	Multiple access techniques: FDMA, TDMA, CDMA, SDM, TDD, FDD. IP packet delivery, agent discovery, registration, tunneling and encapsulation, optimizations,				
Module 2: < GSM and GPRS >	in class	GSM: Mobile services, system architecture, radio interface, protocols, localization and calling, handover, security. GPRS: introduction, network architecture, network enhancements, channel coding, protocol architecture, network operations, data services in GPRSapplications, limitations.	8	2		
	**Assignment Topics					
Module 3:	In	CDMA, EDGE, UMTS, UTRAN, OFDM, HSPA,	7	3		

< Cellular Technology >	Class	LTE, Wi-Max, mobile satellite communication.				
	**Assignment Topics					
Module 4: < Data Dissemination and Data Synchronizati onin Mobile Computing >	in class	Communication Asymmetry, classification of data delivery mechanism, data dissemination broadcast models, selective tuning and indexing techniques, synchronization, synchronization software for mobile devices, synchronization protocols.	9	4		
	**Assignment Topics					
Module 5: < Mobile Devices and Mobile Operating System >	in class	Mobile agent, applications framework, application server, gateways, service discovery, device management.	7	5		
	**Assignment Topics	Mobile file system, Mobile Operating Systems, Characteristics, Basic functionality of Operating Systems. Case Study: Android OS.				

Text Books:

1. Raj Kamal, Mobile Computing, 2/e , Oxford University Press-New Delhi.
2. J. Schiller, "Mobile Communication", Addison Wesley, 2000.
3. Asoke K Taukder, Roopa R Yavagal, Mobile Computing, Tata McGraw Hill Pub Co., NewDelhi, 2005.

Reference Books:

1. Reza B'Far (Ed), "Mobile Computing Principles", Cambridge University Press.
2. MukeshSinghal, NiranjanG.Shivaratri, "Advanced Concepts in Operating Systems", Tata McGraw- Hill.

Sub Code: IT319A2/ IT319A8   **Credit: 4 (L-3, T-1, P-0)**

DIGITAL SIGNAL PROCESSING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course aims to develop proficiency in analyzing signals and systems in both time and frequency domains, fostering strong analytical skills in digital filter design, and exploring various applications of digital signal processing.

Pre-requisites: Calculus

Course Outcomes (CO): Upon successful completion of the course, students should be able to:
1. Illustrate signals, systems and their significance.
2. Analyze the signals using various digital transforms DFT, FFT etc.
3. Design IIR filters with desired frequency responses.
4. Design FIR filters with desired frequency responses.
5. Use MATLAB/OCTAVE software in implementing real-world applications of digital signal processing.

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Signals and Systems	in class	Continuous-Time and Discrete-Time Signals, Continuous-Time and Discrete-Time Systems, Basic System Properties, LTI Systems and its properties, Generation of Signals and basic operations using MATLAB/OCTAVE.	8	1		
	**Assignment Topics					
Module 2: Frequency Analysis	in class	Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT) Discrete Cosine Transform (DCT), Z-Transform, ROC, Poles & Zeros, Estimating Power Spectral Density Frequency analysis of signals and systems using MATLAB/OCTAVE	8	2		
	**Assignment Topics					
Module 3: Design of IIR Filter	in class	Characterizing Digital Filters: Filter Coefficients, Filter Responses , Zeros and Poles Introduction to Analog IIR Filters; Design of Digital IIR Filters & Structures	8	3		
	**Assignment Topics					
Module 4: Design of FIR Filters	in class	Design of FIR filter using Window and Constrained Least-Squares methods, FIR filter structures	8	4		
	**Assignment Topics					

Module 5: Adaptive Filters and DSP Applications	in class	Basics of Adaptive filters; Real-world applications of digital signal processing in Engineering using MATLAB/OCTAVE	8	5		
	**Assignment Topics					

Text Books:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab (1996).*Signals and Systems* (2nd ed.). PHI
2. John G Proakis, Dimitris Manolakis (2007). *Digital Signal Processing* (4th ed.). Pearson
3. S.K.Mitra (2013). *Digital Signal Processing: A Computer - Based Approach* (4th edition). McGraw Hill Education.

Reference Books:

1. K.S. Thyagarajan (2019). *Introduction to Digital Signal Processing Using MATLAB with Application to Digital Communication*s (1st Edition)Springer
2. *Vinay K. Ingle and John G. Proakis (2011). Digital Signal Processing Using MATLAB* (3rd Edition). CL Engineering.

Sub Code: IT329A2/IT329A8   **Credit:4 (L-3, T-1, P-0)**

MULTIMEDIA ANIMATION AND MODELING

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objective of this course is to introduce various aspects of multimedia components like text, images and graphics, audio, sound, and video, and provide the students the fundamental knowledge of multimedia animation with special emphasis on the use of image and video editing tools with software.

Pre-requisites: Multimedia Fundamentals
Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Describe the various elements and aspects of multimedia and animation.

2. Understand the role played by various multimedia such as images and Graphics.

3. Learn to add pictures, graphics, sound and animation to prepare a project for the web.

4. Learn the fundamentals of Animation.

5. Apply tools and techniques to create basic 2D and 3D animation.

**** not more than 20% of total topics to be allotted for assignment**

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to Multimedia Animation, Multimedia Authoring and Tools**	in class	Multimedia: Concept of Multimedia, Multimedia applications, Advantage of Digital Multimedia, Multimedia system Architecture, Overview of Multimedia Animation, The Stages of a Multimedia Project, Using Text in Multimedia, Font editing and design tools, Hypermedia and Hypertext, Designing for the World Wide Web, Developing for the Web, Text for the Web, Images for the Web, Sound for the Web, Animation for the Web. Multimedia Authoring and Tools: Multimedia Authoring, Multimedia Authoring Metaphors, Multimedia Production, Multimedia Presentations, Some Useful Editing and Authoring Tools	[7]	1	1,2,3	1,2
	**Assignment Topics	Discuss the various applications of Multimedia Animation.		1	1,2,3	1,2
Module 2: **Images and Graphics**	in class	Images and Graphics: Making Still Images, Bitmaps, Vector Drawing, 3-D Drawing and Rendering, Color, Understanding Natural Light and Color, Computerized Color, Color Palettes, Image File Formats, Graphics Animation Files.	[7]	2	1,2,3	1,2
	**Assignment Topics	Explain principle of color fundamentals for images and Graphics.		2	1,2,3	1,2
Module 3: **Image Editing**	in class	Image Editing software: selection tools, working with layers, masks and channels, correcting and enhancing photographs, typographic design and vector drawing, working with 3D images, producing files for the web.	[7]	3	1,2,3	1,2

	**Assignment Topics	A survey of image enhancement tools.		3	1,2,3	1,2
Module 4: **Animation Fundamentals**	in class	Animation Fundamentals: Introduction and definition of animation, Principles, Types and uses, Methods and Techniques of animation, Basic animation, Text and image animation, Time line construction and management, Masking Motion and shape Tweening, Morphing, Onion skinning, Animation File Formats, Keyframe animation, Working with symbols and Animation Software.	[7]	4	1,2,3	1,2
	**Assignment Topics	An extensive literature review of various animation software.		4	1,2,3	1,2
Module 5: **Basic 2D and 3D animation**	in class	Basic 2D and 3D animation : Overview of 2D animation and its features, Drawing tools, types of panels, transformation, property panel, working with objects, group, bitmap, Controlling Movie clips with code, Working with Dynamic Text fields and Input Text Fields, Loading external content and other movies, Dynamic pre-loaders, Interactivity with code, Difference between 2D and 3D animation, Tweening and motion along a path, Controlling movie playback, Text and hyperlink, adding sound and movie. Introduction to 3D animation and its basic concepts, and its applications.	[7]	5	1,2,3	1,2
	**Assignment Topics	Implementation of a 2D animation for displaying dynamic text.		5	1,2,3	1,2

Text Books:

1. Tay Vaughan, "Multimedia: Making it Work", McGraw Hill Professional Ninth Edition, 2014
2. Ranjan Parekh, "Principles of Multimedia", Tata McGraw-Hill, Second Edition, 2012

Reference Books:

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu "Fundamentals of Multimedia", Springer, Third Edition, 2021
2. P. Havaldar and G. Medioni "Multimedia Systems – Algorithms, Standards and Industry Practices", Cengage Learning – First Edition, 2009.

Sub Code : IT419A2/ IT419A8   **Credit: 4 (L-3, T-1, P-0)**

SPEECH PROCESSING

Questions to be set: 05 (All Compulsory)

Course Objectives: The objectives of this course are for students to learn the fundamental theories and techniques of speech processing. This will be achieved through the mathematical derivation and treatment of the topics as well as through implementation in programming assignments.

Pre-requisites: Digital Signal Processing

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Identify speech production and classification, demonstrating proficiency in analyzing speech acoustics.
2. Apply windowing, spectral analysis, and time-domain parameters to discriminate speech from silence and estimate pitch periods using autocorrelation functions.
3. Explain principles of Automatic Speech Recognition (ASR) systems, including Linear Predictive Analysis and Hidden Markov Models, evaluate systems, and solve implementation issues.
4. Demonstrate proficiency in utilizing homomorphic systems for tasks such as pitch detection and formant estimation and understanding LP analysis methods.
5. Apply speech enhancement techniques like spectral subtraction, Wiener filtering, and multi-microphone approaches, understanding Text-to-Speech synthesis and its applications.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Basic Concepts:	in class	Introduction, Articulatory Phonetics – Production and Classification of Speech Sounds; The process of Speech Production, Acoustic Phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates; Applications of Speech Signal Processing, Digital Models for Speech Signals: Vocal Tract, Radiation, Excitation. Short-term Fourier transform (STFT): overview of Fourier representation	5	1		
	**Assignment Topics	Filter-Bank and LPC Methods with neumericals.		1		
Module 2: Speech Analysis	in class	Windowing and Spectra of Windows, Time-Domain Parameters: signal analysis in Time Domain, Short-Time average magnitude, Short-Time Average zero-crossing rate (ZCR), Speech Vs Silence discrimination using energy and zero crossing, Short-Time auto correlation function, Short-Time Average Magnitude Difference Function, Pitch period estimation using the autocorrelation function.	8	2		
	**Assignment Topics	Development of a signal processing algorithms to analyze speech signals and evaluate the performance of the developed algorithms using real-world speech recordings		2		
Module 3: Speech Modelling	in class	Introduction to Automatic Speech Recognition (ASR) systems. Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method. Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.	5	3		
	**Assignment Topics	Application of Automatic Speech Recognition in real life application through computer programming.		3		

Module 4: Homomorphic Systems with Linear Prediction (LP) Analysis	in class	Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder. Linear Prediction (LP) analysis: Basis and development, Levinson-Durbin's method, normalized error, LP spectrum, LP cepstrum, LP residual	8	4		
	**Assignment Topics	Explore a contemporary research paper or project that applies either homomorphic systems for convolution or linear prediction analysis in the domain of speech processing. Summarize the key findings, methodologies used, and discuss the potential implications of the study in advancing speech signal processing techniques.		4		
Module 5: Text-to-Speech Synthesis	in class	Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach. Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, subword units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.	6	5		
	**Assignment Topics	Design and implement challenges of a speech enhancement algorithm that combines both single microphone and multi-microphone approaches.		5		

Text Books:
1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, Pearson Education, 2003.

Reference Books:
1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

Information Theory and Error Correcting Codes

Questions to be set: 05 (All Compulsory)

Course Objectives: To introduce to the students the fundamentals of information theory and coding theory with special emphasis on the concepts of amount of information of a source, entropy of a source, channel capacity, error-detection and error-correction codes with illustrations of linear block codes, cyclic codes, BCH codes, convolution codes etc.

Pre-requisites: Probabilities and Statistics.

Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Explain concept of dependent and independent Sources, measure of information, Entropy, Mutual information, Entropy Rates of a Stochastic Process.
2. Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
3. Model the continuous and discrete communication channels using input, output and joint probabilities
4. Determine a codeword comprising of the check bits computed using Linear Block codes, Cyclic Codes, and Reed-Solomon codes.
5. Design the encoding and decoding circuits for BCH codes, Reed-Solomon codes, and Convolution codes.

** not more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs.	CO	PO	PSO
Module 1: Information Theory Fundamentals	in class	Information Theory Fundamentals: Uncertainty and Information –Measure of information- Entropy -Joint Entropy and Conditional Entropy- Relationship Between Entropy and Mutual Information- Chain Rules for Entropy, Relative Entropy, and Mutual Information - Entropy Rates of a Stochastic Process -Markov Chains-Markov Statistical Model for Information Sources-Entropy and Information rate of Markov Sources, General overview of digital communication systems. Source coding versus channel coding.	[7]	1	1,2,3	1,2
	**Assignment Topics	Discrete memoryless channel – channel capacity, fundamental theorem of information theory.	-	1	1,2,3	1,2
Module 2: Source Coding	in class	Source Coding: Purpose of encoding-Encoding of the Source Output- Shannon's Encoding Algorithm- Shannon Fano Encoding Algorithm -Source coding theorem- Optimal Codes-Bounds on the Optimal Code Length- Prefix Codes-Kraft Inequality for Uniquely Decodable Codes- Kraft McMillan Inequality property-Huffman Codes- Some Comments on Huffman Codes - Optimality of Huffman Codes- Shannon–Fano–Elias Coding- Competitive Optimality of the Shannon Code- Generation of Discrete Distributions from Fair Coins-	[7]	2	1,2,3	1,2

		Arithmetic Coding- Lempel–Ziv Coding-Optimality of Lempel–Ziv Algorithms.				
	Assignment Topics	A survey on Dictionary Based Coding	-	2	1,2,3	1,2
Module 3: Channel Capacity and Gaussian Channels	in class	Channel Capacity: Communication Channels- Channel Models – Channel Capacity – Channel Coding - Channel Matrix of Discrete Communication channels-Joint Probability Matrix-Binary Symmetric Channel-System Channel Capacity- Channel Capacity of Noiseless Binary Channel- Channel Capacity of Binary Symmetric Channel, Channel Capacity of Binary Erasure Channel, Channel Capacity of Noisy Channel with Nonoverlapping Outputs- Channel Coding Theorem- Information capacity theorem – The Shannon Limit-Zero-Error Codes, Source–Channel Separation Theorem Gaussian Channel: Definition of Gaussian Channels-Bandlimited Channels-Parallel Gaussian Channels-Channels with Colored Gaussian Noise - Gaussian Channels with Feedback.	[7]	3	1,2,3	1,2
	Assignment Topics	Various types of communication channels and comparative study on their channel capacities.	-	3	1,2,3	1,2
Module 4: Error Control Coding and Error Correcting Codes	in class	Error Control Coding: Introduction – Examples of Error Control Coding – Methods of controlling Errors –Types of Errors –Types of Codes. Linear Block Codes: Matrix description of Linear Block Codes – Error detection & Correction capabilities of Linear Block Codes – Hamming Codes – Standard Array and Syndrome Decoding Cyclic Codes: Algebraic Structure of Cyclic Codes– Generator Polynomial – Generator and Parity check Matrices- Encoding using an (n-k) Bit Shift register-Syndrome Calculation, Error Detection and Correction- Burst Error Correction – Golay codes – CRC (Cyclic Redundancy Check) codes.	[7]	4	1,2,3	1,2
	Assignment Topics	Error correcting codes, Decoding of cyclic codes.	-	4	1,2,3	1,2
Module 5: BCH Codes and Convolution Codes	in class	BCH codes: Description of BCH codes – Encoding and decoding – Reed Solomon Codes. Convolution Codes: Introduction – Tree codes and Trellis codes – Polynomial description of convolution codes – Distance notions for convolution codes – Generating function – Matrix description – Viterbi decoding – Distance Bounds – Performance bounds – Known good convolution codes – Turbo codes and decoding.	[7]	5	1,2,3	1,2
	Assignment Topics	An overview of non-cyclic codes for error detection.	-	5	1,2,3	1,2

Text Books:

1. J. A. Thomas and T. M. Cover, "Elements of information Theory", Wiley, 2006.
2. Shu Lin and Daniel J. Costello, "Error Control Coding", PHI Learning, 2004

Reference Books:

1. H. Bhat, G. Rao," Information Theory and Coding", Cengage, 2017.
2. T.R.N. Rao & E. Fujiwara," Error Control Coding for Computer Systems", PHI Learning, 1989.