ANNEXURE-VIII b

Appendix

DEPARTMENT

OF

COMPUTER SCIENCE &ENGINEERING

SMIT MAJITAR

COURSE CURRICULUM FOR B.TECH (CSE)ACCORDING TO NATIONAL EDUCATION POLICY-2020

APPLICABLE FOR 1ST YEAR FROM 2024-25 BATCH

AND

SUBSEQUENT BATCHES

Total Credits:

21+21+27 + 26 + 28 + 26 + 15 +16 = 180

1st Year



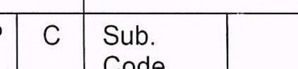
FIRST YEAR B. TECH CURRICULUM 2024 (Common to all branches)

Semester

GROUP A (FIRST SEMESTER) PHYSICS GROUP						GROUP B (FIRST SEMESTER CHEMISTRY GROUP					
Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
	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**					

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			

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



B.TECH. COURSE STRUCTURE – SEMESTER WISE

THIRD SEMESTER							
Year	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
2ND	MA205A1	Discrete Mathematics	3	1	0	4	4
	CS201A1	Digital Design and Computer Organization	3	1	0	4	4
	CS202A1	Data Structures	3	1	0	4	4
	CS203A1	Object Oriented Programming using C++	3	1	0	4	4
	CS2**A3	Program Elective-I	3	1	0	4	4
	CS2**A2/ CS2**A8	Open Elective-I/Minor/NCC	3	1	0	4	4
	CS201A4	Data Structures Laboratory	0	0	2	2	1
	CS202A4	Object Oriented Programming using C++ Laboratory	0	0	2	2	1
	CS201A5	Project Based Learning- I	0	0	2	2	1
TOTAL			18	6	6	30	27

FOURTH SEMESTER							
Year	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
2ND	MA206A1	Probability, Statistics, and Stochastic Processes	3	1	0	4	4
	CS204A1	Design and Analysis of Algorithms	3	1	0	4	4
	CS205A1	Database Management Systems	3	1	0	4	4
	CS2**A3	Program Elective-II	3	1	0	4	4
	CS2**A2/ CS2**A8	Open Elective-II/Minor/NCC	3	1	0	4	4
		Universal Human Values-II: Understanding Harmony and Ethical Human Conduct	3	0	0	3	3
	CS203A4	Algorithm Laboratory	0	0	2	2	1
	CS204A4	Database Management Systems Laboratory	0	0	2	2	1
	CS202A5	Project Based Learning- II	0	0	2	2	1
TOTAL			18	5	6	29	26

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FIFTH SEMESTER							
Year	**Course Code**	**Course Title**	**Total Number of Contact Hours**				**Credits**
			Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Total Hours**	
3rd	CS301A1	Artificial Intelligence	3	1	0	4	4
	CS302A1	Formal Languages and Automata Theory	3	1	0	4	4
	CS303A1	Operating Systems	3	1	0	4	4
	CS304A1	Computer Networks	3	1	0	4	4
	CS3**A3	**Program Elective-III**	2	1	0	3	3
	CS3**A2/ CS3**A8	Open Elective-III/Minor/NCC	3	1	0	4	4
	CS301A4	Operating Systems Laboratory	0	0	2	2	1
	CS302A4	Computer Network Laboratory	0	0	2	2	1
	CS301A5	Project Based Learning- III	0	0	2	2	1
	CS301A9	Industrial Training-I	0	0	2	2	1
	GN301A1	Quantitative Aptitude and Logical Reasoning-I	1	0	0	1	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		Industrial Management	2	0	0	2	2
	CS305A1	Software Engineering	3	1	0	4	4
	CS306A1	Compiler Design	3	1	0	4	4
	CS3**A3	**Program Elective-IV**	3	1	0	4	4
	CS3**A3	**Program Elective-V**	3	1	0	4	4
	CS3**A2/ CS3**A8	Open Elective-IV /Minor	3	1	0	4	4
	CS303A4	Software Engineering Laboratory	0	0	2	2	1
	CS304A4	Compiler Design Laboratory	0	0	2	2	1
	CS302A5	Mini Project	0	0	2	2	1
	GN302A2	Quantitative Aptitude and Logical Reasoning-II	1	0	0	1	1
TOTAL			16	5	08	31	26

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SEVENTH SEMESTER							
Year	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
4th	CS4**A2/ CS4**A8	Open Elective-V/Minor	3	1	0	4	4
	CS4**A3	Choice-Based Elective	2	1	0	3	3
	CS401A6	Major Project -Phase-I	0	0	14	14	10
	CS401A9	Industrial Training-II	0	0	2	2	1
TOTAL							18

EIGHTH SEMESTER							
Year	Course Code	Course Title	Total Number of Contact Hours				Credits
			Lecture (L)	Tutorial (T)	Practical (P)	Total Hours	
4th	CS4**A2/ CS4**A8	Open Elective-VI /Minor	3	1	0	3	4
	CS402A6	Major Project -Phase-II	0	0	24	24	09
TOTAL			0	0	0	24	13

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LIST OF ELECTIVES FOR 3rd SEMESTER			
PROGRAM ELECTIVE-I			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
2nd	CS201A3	Java Programming	4
	CS202A3	Fundamentals of Web Technologies	4
	CS203A3	User Interface/User Experience (UI/UX) Design	4
	CS204A3	Information Transmission and Coding Theory	4
	CS205A3	Computer Graphics	4
	CS206A3	Microprocessors and Peripheral Devices	4
	CS224A3	Information Systems and Security	4
	CS225A3	E-Commerce	4
	CS226A3	Digital Signal Processing	4
	CS227A3	Mathematical Foundation for Machine Learning	4

LIST OF ELECTIVES FOR 4TH SEMESTER			
PROGRAM ELECTIVE-II			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
2nd	CS207A3	Advanced Java Programming	4
	CS208A3	System Programming	4
	CS209A3	Discrete Structure	4
	CS210A3	Graph Theory	4
	CS211A3	System Simulation and Modelling	4
	CS212A3	Advanced Web Technologies	4
	CS213A3	Embedded Systems	4
	CS214A3	Social Network Analysis	4
	CS215A3	VLSI	4
	CS216A3	Signals and Networks	4
	CS217A3	Information Retrieval	4
	CS218A3	Data Warehousing and Analytics	4
	CS219A3	Advanced Computer Organization and Architecture	4
	CS220A3	Principles of Programming Languages	4
	CS221A3	Speech Processing	4
	CS222A3	Analog Electronic Circuits	4
	CS223A3	Microcontrollers	4

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LIST OF ELECTIVES FOR 5TH SEMESTER			
PROGRAM ELECTIVE-III			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS301A3	Latest Trends in Computer Science	3
	CS302A3	Design Thinking	3
	CS303A3	Speech and Natural Language Processing	3
	CS304A3	Remote Sensing	3
	CS305A3	Autonomous Mobile Robotics and Computational Intelligence	3
	CS306A3	Internet of Things	3
	CS307A3	Data Analytics	3
	CS308A3	Big Data	3
	CS309A3	Soft Computing	3
	CS310A3	Computer Vision	3
	CS311A3	Cryptography and Network Security	3
	CS312A3	Computational Number Theory	3
	CS313A3	Fault Tolerant Computing	3
	CS314A3	VLSI System Design	3
	CS315A3	Advanced Algorithm	3
	CS316A3	Artificial Neural Network	3
	CS353A3	ARM controller	3

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LIST OF ELECTIVES FOR 6TH SEMESTER			
PROGRAM ELECTIVE-IV			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS317A3	High Performance Computing	4
	CS318A3	Parallel and Distributed Algorithm	4
	CS319A3	Internet Technology and Society	4
	CS320A3	Deep Learning	4
	CS321A3	Cloud Computing	4
	CS322A3	Remote Sensing and Geographic Information System	4
	CS323A3	Ethical Hacking	4
	CS324A3	Ad-hoc Wireless Networks	4
	CS325A3	Mobile Computing	4
	CS326A3	Distributed Database Systems	4
	CS327A3	Computational Geometry	4
	CS328A3	Advanced Computer Network	4
	CS329A3	Machine Learning	4
	CS350A3	Bio Inspired Computing	4
	CS351A3	Real Time Systems	4
	CS352A3	DevOps Engineering	4
	PROGRAM ELECTIVE-V		
	CS330A3	Wireless Sensor Network	4
	CS331A3	Queueing Theory and Modelling	4
	CS332A3	Quantum Computing	4
	CS333A3	Cyber Security	4
	CS334A3	Future Internet Architecture	4
	CS335A3	Distributed Systems	4
	CS336A3	Optimization Techniques	4
	CS337A3	Engineering Research Methodology	4
	CS338A3	Human Computer Interaction	4
	CS339A3	Augmented Reality	4
	CS340A3	Blockchain	4
	CS341A3	Agile	4
	CS342A3	Object Oriented Analysis and Design	4
	CS343A3	Software Quality Management	4
	CS344A3	Pattern Recognition	4
	CS345A3	Web Content Management and Web 3.0	4
	CS346A3	Cyber Physical Systems	4
	CS347A3	Reinforcement Learning	4
	CS348A3	Generative AI and Prompt Engineering	4
	CS349A3	MERN Stack Development	4

LIST OF ELECTIVES FOR 7TH SEMESTER			
CHOICE BASED ELECTIVE			
Year	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
4th	CS401A3	Indian Music System	4
	CS402A3	History of Science	4
	CS403A3	Introduction to Art and Aesthetics	4
	CS404A3	Economic Policies in India	4

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OPEN ELECTIVE/ MINOR-Industry 5.0			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS201A2/ CS201A8	Industry Version 4.0	4
4th	CS202A2/ CS202A8	Programming with Data Structures	4
5th	CS301A2/ CS301A8	Latest Trends in Computer Science	4
6th	CS302A2/ CS302A8	Internet Technology & Society	4
7th	CS401A2/ CS401A8	Future Internet Architecture	4
8th	CS402A2/ CS402A8	Intellectual Property Rights/Human Computer Interaction	4

OPEN ELECTIVE/MINOR-Computational Social Science			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS203A2/ CS203A8	Python	4
4th	CS204A2/ CS204A8	Social Network Analysis/Information Retrieval/Data Mining	4
5th	CS303A2/ CS303A8	Soft Computing/ Data Analytics/Speech & Natural Language Processing	4
6th	CS304A2/ CS304A8	Internet Technology & Society/Block Chain/Machine Learning	4
7th	CS403A2/ CS403A8	Future Internet Architecture	4
8th	CS404A2/ CS404A8	Intellectual Property Rights/Human Computer Interaction	4

OPEN ELCTIVE/MINOR-Computer Graphics & Visualization			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS205A2/ CS205a8	Python/User Interaction (UI)-User Experience (UX)	4
4th	CS206A2/ CS206A8	Digital Image Processing	4
5th	CS305A2/ CS305A8	Latest Trends in Computer Science /Soft Computing/ Artificial Neural Network/ Computer Vision	4
6th	CS306A2/ CS306A8	Deep Learning/ Machine Learning	4
7th	CS405A2/ CS405A8	Future Internet Architecture	4
8th	CS406A2/ CS406A8	Intellectual Property Rights/Human Computer Interaction	4

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OPEN ELECTIVE/MINOR -Computational Mathematics			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS207A2/ CS207A8	Python	4
4th	CS208A2B/ CS208A8	Discrete Structures/Graph Theory/System Simulation & Modeling	4
5th	CS307A2/ CS307A8	Latest Trends in Computer Science /Soft Computing/Data Analysis/Big Data/ Computational Number Theory	4
6th	CS308A2/ CS308A8	High Performance Computing/ Computational Geometry/Queueing Theory & Modelling/Optimization Techniques	4
7th	CS407A2/ CS407A8	Future Internet Architecture	4
8th	CS408A2/ CS408A8	Intellectual Property Rights/Human Computer Interaction	4

OPEN ELECTIVE/MINOR-Artificial Intelligence Systems			
SEMESTER	**COURSE CODE**	**COURSE TITLE**	**CREDIT**
3rd	CS209A2/ CS209A8	Industry Version 4.0	4
4th	CS210A2/ CS210A8	Programming with Data Structures	4
5th	CS309A2/ CS309A8	Soft Computing	4
6th	CS310A2/ CS310A8	Prompt Engineering	4
7th	CS409A2/ CS409A8	Future Internet Architecture	4
8th	CS410A2/ CS410A8	Intellectual Property Rights/Human Computer Interaction	4

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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.

ot 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. 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.	9	2,3	1,2	2
	****Assignment Topics**					
Module 3:	in class	One-dimensional arrays: Declaration, initialization of 1D array, Two dimensional arrays: Declaration,	8	2,3	1,2	2

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Signature.....

Date.....

<Module Name>		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				
	**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:

a) Programming in ANSI C by E. Balaguruswamy

Reference Books:

a) Mastering in C by K. Venugopal.
b) Fundamentals of C by Gottfried.
c) The C Programming by Kerningham and Ritchie.
d) Let Us C by Y. Kanetkar.





Subject Code:CS101A4 **Credit: 1 (L-0, T-0, P-2)**

COMPUTER PROGRAMMING LAB

In Computational practice lab, each student is required to develop programs based upon each UNIT of Theory paper-Computer Programming using C

Course Objectives: The main aim of the course is:

- To teach basic computer programming concepts and apply themto 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.

erequisites: There are no specific prerequisites for this lab.

urse 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 file
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

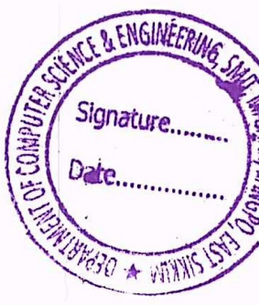
B. Write a C Program to:

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:

a) Programming in ANSI C by E. Balaguruswamy

Reference Books:

a) Mastering in C by K. Venugopal.
b) Fundamentals of C by Gottfried.
c) The C Programming by Kerningham and Ritchie.
d) Let Us C by Y. Kanetkar.

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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, Optimization. Group theory has applications coding theory, cryptography.

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

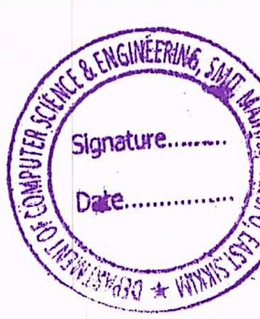
Course Outcomes (CO'S): On successful completion of this course, students will be able to:

1. Solve problems using Counting Principles, Relations, Functions lattices
2. Apply concepts of Group theory to model the real-world problems.
3. Analyze the use of graphs in engineering applications.
4. Critically think and arrive at solution for Permutation and Combination, Ordering, Recursion and generating functions.
5. Determine and solve problems related to predicate calculus that occur frequently in areas of computer science.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: < Set theory>	in class	Principle of inclusion and exclusion, Relations, and functions, Techniques of Proofs, Pigeonhole Principle; Partial ordering, lattice and algebraic systems, principle of duality, basic properties of algebraic systems defined by lattices, distributive and complemented lattices	10	1		
Module 2: < Group Theory>		Groups, subgroups, permutation group with simple examples. Cosets, normal subgroup, Burnside's theorem (statement only) and its simple applications, codes and group codes. Burnside's theorem (statement only) and its simple applications, codes and group codes.				
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			3		





Module 4: < Configuration, 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			4		
Module 5: < Predicate calculus>	in class	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			5		
	in class		8	3		

Text Books:

1. Jean-Paul Tremblay and Manohar, R: Discrete Mathematical Structures with application 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.

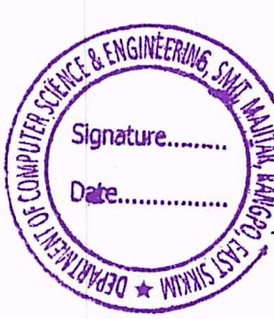
Reference Books:

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.





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Credit: 4 (L-3, T-1, P-0)

DIGITAL DESIGN AND COMPUTER ORGANIZATION

stions to be set: 05 (All Compulsory)

rse Objectives: To provide basic knowledge in digital electronics and internal architecture of a computer.

requisites: Knowledge of Number system and logic gates

rse Outcomes(CO): **On successful completion of the course, students should be able 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.

Module	Topics	Hrs	CO
dule 1: sic Logic Gates mbinational cuits	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
dule 2: quential 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
dule 3: rdware scriptive nguage (HDL)	Motivation and Introduction to HDL (VHDL/Verilog), Modules, Language origins, simulation and synthesis, Behavioral modeling, Structural modeling	8	3
dule 4: mputer chitecture, mory 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
dule 5: croarchitecture 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.

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Sub Code: CS202A1 **Credit:4 (L-3, T-1, P-0)**

DATA STRUCTURES

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on the organization of information, the implementation of lineardata 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 algorithmsand the analysis of algorithm complexity.

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

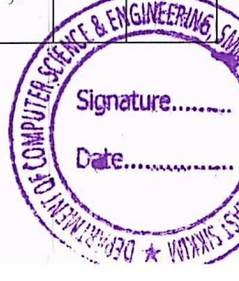
Course Outcomes (CO): On successful completion of this course, students should be able to:

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		





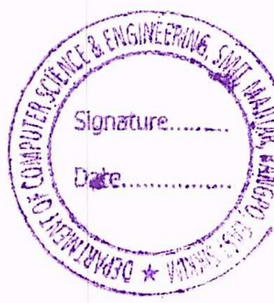
<Trees & Graphs>		tree traversal algorithms, Representation of n-ary trees using binary trees, Application of trees, Expression trees. Search trees: Definition, Insertion, Deletion and reversal, Height balanced search trees (using AVL trees illustrative example) and weight balanced search trees. Terminology 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: CS203A1 **Credit: 4 (L-3, T-1, P-0)**

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

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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

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Sub Code: CS201A4 **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 likeC 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	PS
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				

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Sub Code : CS202A4 **Credit: 1(L-0, T-0, P-2)**

OBJECT ORIENTED CONCEPTS & PROGRAMMING USING C++ LABORATORY

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

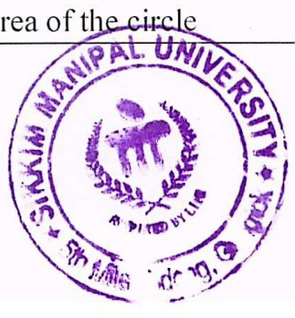
Pre-requisites: C Programming and corresponding theory paper CS 1308 Object Oriented Concepts &Programming using C++.

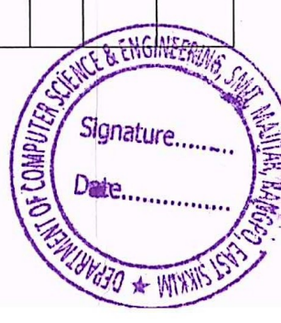
Course Outcomes(CO):

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		

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		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		

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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 :-





		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		

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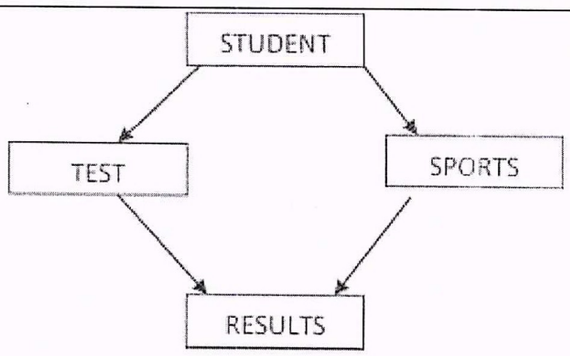

i. Create data member roll_no,reg_no and member function get_number() to take input and put_number() to display in the base class STUDENT.
ii. The class Test contains a data member part1 and part2.Redefine the above two functions.
iii. The class SCORE contains a member score. Redefine get_number and 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.

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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:

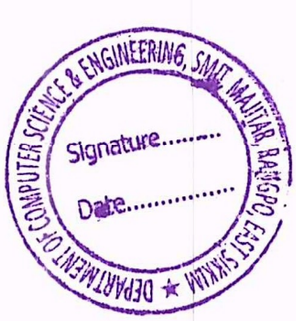
1. Bjarne Stroustrup, "C++ Programming Language", Pearson.

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 (All Compulsory)

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Probability Theory, Random Variables, and distribution >	in class	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	1		
	**Assignment Topics			1		
Module 2: < Conditional Probability and known distribution>	in class	Correlation coefficient, conditional distributions conditional expectations, and regression curves, Standard probability distributions (Binomial, Poisson, Uniform Normal, exponential, chi-square.), Reliability and MTTF	8	2		
	**Assignment Topics			2		
Module 3: < Introduction to Statistics>	in class	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	3		
	**Assignment Topics			3		
Module 4:	in class	Introduction to Stochastic Process, Poisson Process, Discrete parameter Markov Chains	6	4		

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< Stochastic Processes >	**Assignment Topics			4		
Module 5: < Queuing Models: >	in class	Concept of a queues: Basic idea of continuous parameter Markov chain, Birth and death processes, M / M /1/∞, M / M /1/N, queuing systems.	4	5		
	**Assignment Topics			5		

Textbook:

1. K.S Trivedi, Probability & Statistics with Reliability, Queuing and Computer ScienceApplications, 2008, Wiley.
2. P.L. Meyer : Introductory Probability theory and statistical Applications, Second Ed.Oxford & IBM Publishers.
3. 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, Brikhaus

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Sub Code: CS204A1 **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 algorithm design 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:

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

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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.

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Sub Code: CS205A1 **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	PSO
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		
	****Assignment Topics**	Data models: Definition, Purpose and Types, Hierarchical models, Network model, Relational model.				
Module 2: <Database design >	In Class	Database design process, Relational database design, Relation schema, Functional dependencies, Membership and minimal covers, Normal forms, Multivalued dependencies, Join dependencies, Converting EER diagrams to relations.	8	3		
	****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		

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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 Topics	Concepts of database security mechanisms, Case study 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		
	**Assignment 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, Implementation and 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.

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o Code: GN201A1 **CREDIT 3: [L-2,T-1, P-0]**

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*

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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

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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)

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Sub Code: CS203A4 **Credit:1 (L-0, T-0, P-2)**

ALGORITHM LABORATORY

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

Pre-requisites: Theory paper Design and Analysis of Algorithms and associated pre-requisites.

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

1. Calculate time and space complexities for algorithms using mathematical models
2. Calculate time and space complexities for algorithms by performing an empirical measurement
3. Select appropriate algorithm design technique to solve a given problem
4. Write a computer program to implement any algorithm using a programming language
5. Choose the most optimal algorithm by comparing time and space complexities

**** 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 Python	in class	Introduction to Python Programming, Working with Test Cases	7.2	1		
	****Assignment Topics**	Calculation of Execution time				
Module 2: Sorting	in class	Sorting Algorithms: Bubble Sort, Selection Sort	7.2	2,3		
	****Assignment Topics**	Insertion Sort				
Module 3: Divide and Conquer	in class	Divide and Conquer strategy: Merge Sort and Quick Sort	7.2	2,4		
	****Assignment Topics**	Binary Search using Divid e and Conquer strategy				
Module 4: Greedy and Dynamic Programming	in class	Greedy Algorithms and Dynamic Programming algorithms	7.2	5		
	****Assignment Topics**	Prim's and Kruskal's algorithm				
Module 5: Backtracking and Branch & Bound	in class	Backtracking and Branch & Bound algorithms: N-queen Problem, Subset sum problem	7.2	5		
	****Assignment Topics**	Knapsack problem using Branch and Bound				

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

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Sub Code: CS204A4 **Credit:1 (L-0, T-0, P-2)**

DATABASE MANAGEMENT SYSTEM 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.

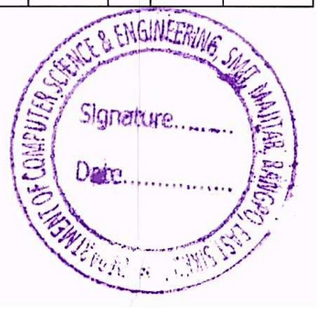
Pre-requisites: Corresponding theory paper Database Management Systems and associated prerequisites.

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 andconvert 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**

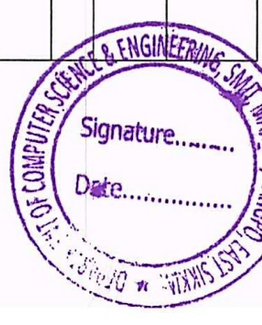
Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: **Implementation of DDL and DML commands, functions and operators of SQL**	In Class	Implementation of DDL and DML commands of SQL with suitable examples	0.5	1		
	****Assignment Topics**	**Write SQL queries for following question**: **Customer** (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		

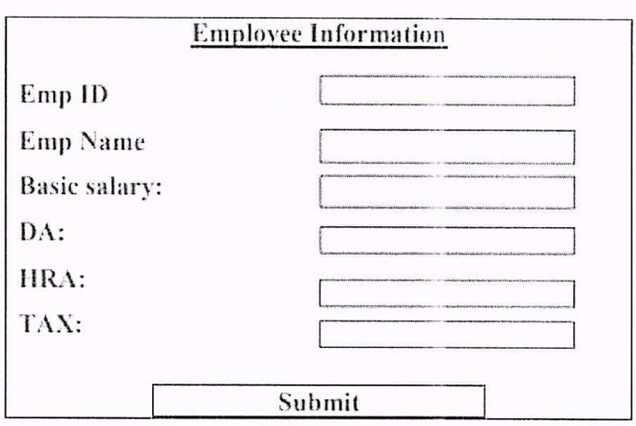




		i) Selected rows all columns ii) All rows selected columns iii) All rows selected columns iv) Selected rows selected columns m) Drop table Customer				
	in class	Implementation of different types of functions with suitable examples.	0.5	1		
	**Assignment Topics	**Create a table EMPLOYEE with following 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:  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		

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		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		

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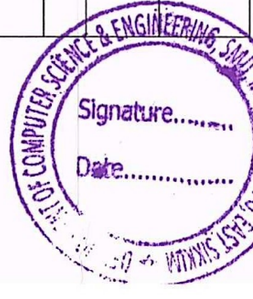
		1. Allow NULL for all columns except ename and job. 2. Add constraints to check, while entering the empno value (i.e) empno > 100. 3. Define the field DEPTNO as unique. 4. Create a primary key constraint for the table (EMPNO). 5. Create another table and add foreign key in table emp				
	in class	Implementation 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.

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Sub Code: CS301A1 **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 mathematicsspecially 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 completion of the course it is expected to endow the students with skills 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 Artificial Intelligence (AI), Overview of Artificial Intelligence- Problems of AI, AI techniques, Typical AI problems: Tic -Tac- Toe problem, 8-puzzle problem, **Essentials of Generative AI, Prompt Engineering and ChatGPT, Future Trends of AI.** Machine Learning: Learning- Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, **Introduction to Neural Networks and Its Applications**, The perceptron, **Multi-Layered Neural Networks**, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing **and Its Applications**	10	1,2		

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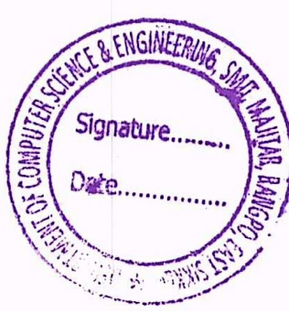
	****Assignment Topics**	Intelligent and Rational agents , Practical impact of AI, **Conversational AI, Explainable AI, Understanding AI Ethics and Safety, Latest Trends in AI, Hands on ML Model Development**				
Module 2: < Problem solving by Search & Informed Search Techniques>	In Class	Problem solving by Search : Tic -Tac- Toe problem, 8-puzzle 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, Hill Climbing Search. **Evolutionary Computation: Genetic Algorithm, Ant Colony Optimization, Differential Evolution**	11	2,3		
	****Assignment Topics**	Problems, Problem Space & search, Formulating problems: Pegs and Disks problem, Missionary Cannibals problem ,Simulated Annealing Search, Local Search, **Particle Swarm Optimization**				
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	7	4,5		
	****Assignment Topics**	**Application : Fuzzy Sets and Fuzzy Logics**				
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	**Representation & mapping, approaches to knowledge representation, representing simple fact in Logic**, Logic programming. **Proportional and Predicate Calculus, Semantic Nets**, forward verses backward reasoning, **Probabilistic Reasoning**, matching, control knowledge, **Automated Planning**.	8			





	**Assignment Topics	Knowledge representation issues, Syntax versus semantics, Horn clauses, First-order logic Resolution, Procedural verses declarative knowledge		4,5		





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





Sub Code: CS302A1 **Credit: 4(L-3, T-1, P-0)**

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.

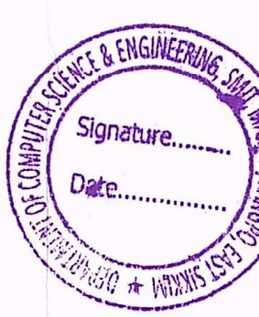
Course Outcomes (CO): On successful completion of this course, students will be able to:

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.

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Sub Code: CS303A1 **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.				

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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.				

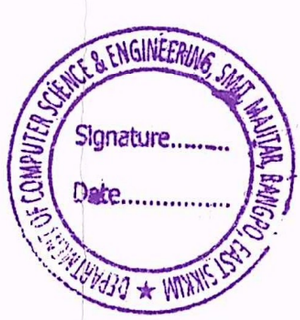
Text Books:

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





Sub Code: CS304A1 **Credit: 4(L-3, T-1, P-0)**

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 inData 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**					

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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

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Sub Code: CS301A4 **Credit:1(L-0, T-0, P-2)**

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 labclasses 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. Analyse 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		





		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:

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





Sub-Code: CS302A4 **Credit:1 (L-0, T-0, P-2)**

COMPUTER NETWORKS LABORATORY

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

Pre-requisites: Communication Technique and Data Communication

Course Outcomes (CO):

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	PS
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		

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	**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 KeyArchitectures", Tata McGraw-Hill

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Sub-Code: CS301A9 **Credit:1 (L-0, T-0, P-2)**

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.

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

INDUSTRIAL MANAGEMENT

uestions to be set: 05 (All compulsory)

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

re-requisites: No pre-requisites

ourse Outcomes (CO):

O1: To provide basic knowledge and application of functions of management
O2: To help students to understand and apply principles of management evolved by pioneers of management.
O3: To enable students to apply basic quantitative techniques for making decisions related to operations management
O4: To help student apply various techniques for optimal production management
O5: To apply concepts of materials management for maintaining optimal inventory

ot more than 20% of total topics to be allotted for assignment

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
troduction	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		
oneers in anagement	In Class	Taylor's Scientific Management, Contribution of Henry Fayol, Maslow, McGregor, Gilbreth and Mayo.	3	2		
	** Assignment Topics			2		
uantitative echniques in anagerial ecisions	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		
oduction anagement	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		
aterials anagement	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:

a) H. Koontz and H. Weihrich, "Management", McGraw Hill
b) Dobler W.D. "Purchasing & Materials Management", TMHC, New Delhi





ub Code: CS305A1 **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 to Software Engineering>	In class	• Software Development Challenges Software Scope
		• Software Engineering Discipline
		• Introduction to Agile Software Engineering
		• Evolution of Software
		• Process Models and Software Life Cycle Phases
		• Traditional Life Cycle Models
		  • Waterfall
		  • V
		  • Evolutionary
		  • Spiral
		• Alternative Techniques
		  • DevOps
		  • CICD
		Prototyping
			8	1		

	****Assignment Topics**	• Traditional Life Cycle Model Vs CBSE • Alternative Techniques • RAD PSP/TSP.				
Module 2: <Software Requirements and Requirement Engineering Process >	In class	• Definition and importance of software requirements • Feasibility study • Functional and Non-Functional Requirements • Requirements from the customer's perspective/WRSPM (World, Requirement, Specification, Platform, and Machine) model • Requirement elicitation and analysis • Good practices • SRS Validation	8	3		
	****Assignment Topics**	Real Time use of JIRA / Rally (can create real time mockups), CI/CD like Jenkins, how and why stories are blocked (blockers), or marked on various stages, addressing requirement ambiguities as developers				

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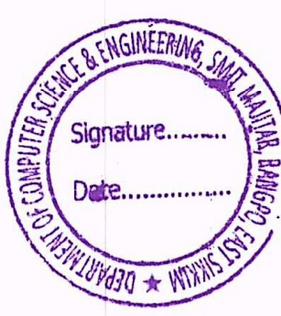
Module 3: <DESIGN>	In class	• Basic Design Concepts and Principle • Modularity • Cohesion • Coupling • Refactoring of Design • Object oriented design • Function oriented design • Software Architecture • Architectural Styles: Data-centric, Data-flow, function oriented metrics, Halstead metrics	8	2		
	**Assignment Topics	UML				
Module 4: < VALIDATION AND VERIFICATION >	in class	• Introduction to Validation and Verification • Verification & Verification Techniques: Unit, System & Integration, Black/White box testing, Regression, Use Case Testing, Acceptance Testing Fuzzy, Robustness, Security Testing, Automated Testing	8	4		
	**Assignment Topics	Evaluating the Efficacy of Validation and Verification in Software Development: A Case Study Approach				
Module 5: < SOFTWARE PROJECT MANAGEMENT AND RISK MANAGEMENT >	in class	• Project Estimation: Cost estimation techniques: COCOMO, Intermediate COCOMO, Function Point Analysis ,Delphi, PERT/CPM • software risks and Risk management: Reactive vs Proactive. • Risk identification and Projection	8	5		
	**Assignment Topics					





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

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Sub Code: CS306A1 **Credit: 4(L-3, T-1, P-0)**

COMPILER DESIGN

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is aimed at offering complete knowledge on compiler design and ends with the development of a working compiler in parts. Topics include compiler structure, symbol tables, regular expressions and languages, finite automata, lexical analysis, context-free languages, LL (1), recursive descent, LALR (1), and LR (1) parsing semantic analysis, and code generation. This will enable the learners to use formal attributed grammars for specifying the syntax and semantics of programming languages and their impact on compiler design.

Pre-requisites: Discrete Structures for Computer Science, Formal Language and Automata Theory and Programming skills.

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

1. Define the competence in designing compilers.
2. Describe the functioning in various problem domains.
3. Discover complex engineering problem and able to solve it using the concept of compiler design.
4. Analyze and select optimal design scheme using compiler design principles
5. Develop and experiment using knowledge of compilers for compiling different programs.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: <Compiler Structure & Lexical Analysis >	in class	Analysis-synthesis model of compilation, Various phases of a compiler, Tool based approach to compiler construction, Input Buffering. Interface with input, Parser and symbol table, Token, Lexeme and patterns, Regular definition, Transition diagrams.	9	1,4		
	****Assignment Topics**	LEX.				
Module 2: <Syntax Analysis >	in class	Ambiguity, Associativity, Precedence, Top down parsing, Recursive descend parsing, Transformation on the grammars, Predictive parsing, Bottom up parsing, Operator precedence grammars, LR parsers (SLR, Canonical, LALR), YACC.	8	2, 5		
	****Assignment Topics**	CFG's				
Module 3: < Syntax Directed Translation, Type Checking &	In Class	Inherited and synthesized attributes. Dependency graph, Evaluation order, Bottom up evaluation of Sattributed definitions L- attributed definitions and top down translation of attributes. Type system, Type expressions, Structural and name equivalence of types.	8	1, 3		





Run Time Environments >		Access to nonlocal names, Activation tree, Activation record, Parameter passing, Symbol table.				
	**Assignment Topics	Type conversion. Storage organization, Storage-allocation strategies, dynamic storage allocation.				
Module 4: <Intermediate Code Generation >	in class	Intermediate representations, Boolean expressions and procedure calls ,Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	8	2,3		
	**Assignment Topics	Translation of declarations, Assignments, Control flow,				
Module 5: <Code Generation >	in class	Issues in the design of a code generator, Basic blocks and flow graphs, Next use information, Register allocation, Code generation algorithm, Dag representation of programs. Peephole optimization and code generator generators.	7	5		
	**Assignment Topics	Code generation from dags.				

Text Books:

1. A.V. Aho, R. Sethi, J.D. Ullman, "Compilers: Principles, Techniques and Tools", Addison – Wesley.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Elsevier.

Reference Books:

1. W. Appel, "Modern Compiler Implementation in C: Basic design", Cambridge Press.
2. Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation", Addison-Wesley.
3. Dhamdhere, "Compiler Construction", McMillan.
4. A. V. Aho and J. D. Ullman, "Theory of Parsing, Translation and Compiling", Prentice Hall.

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Sub Code: CS303A4 **Credit: 1 (L-0, T-0, P-2)**

SOFTWARE ENGINEERING LABORATORY

Course Objectives: 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 Software Engineering and the associated prerequisites.

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. Intergrate an ability to identify/create modern engineering tools, techniques, and resources to solve software related problems.
5. Develop a quality software product by possessing the leadership skills as an individual or contributing to the team development and demonstrating effective and modern working strategies by applying both communication and negotiation management skill.

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Sub Code: CS304A4 **Credit: 1 (L-0, T-0, P-2)**

COMPILER DESIGN LABORATORY

Course Objectives: The course is aimed at offering complete knowledge on compiler design. The coursewill enable the learners to learn the process of translating a modern high-level language to executable code.

Pre-requisites: Programming skills, Formal Language and Automata theory.

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

1. Design & conduct experiments for NFA and DFA from a given regular expression or language.
2. Apply the knowledge of patterns, tokens & regular expressions in programming for solving aproblem.
3. Design & implement a front end of the compiler.
4. Develop program for solving parser problems.
5. Create the intermediate code forms.

Module	Topics to be covered	Topics	Hrs	CO	PO	PS
Module 1:	in class	Program to implement a Deterministic Finite Automata (DFA) for a given language. Program to implement Lexical analyzer for the a code snippet.	6	1,2		
	****Assignment Topics**					
Module 2:	in class	Program to implement recursive descent parsing, Recursive Predictive Parser. Program to perform left recursion.	9	2,3		
	****Assignment Topics**					
Module 3:	in class	Program to perform left factoring. Program to generate the FIRST and Follow set.	9	3,4		
	****Assignment Topics**					
Module 4:	in class	Program to construct a LL(1) parsing table and Non-Recursive Predictive Parser	6	3,4		
	****Assignment Topics**					
Module 5:	in class	Program to implement the shift-reduce parsing for a given grammar and check whether a string can be parsed or not. Program to implement Operator Precedence Parser for the given grammar. Program to implement Intermediate code generation for an arithmetic expression.	9	4,5		
	****Assignment Topics**					

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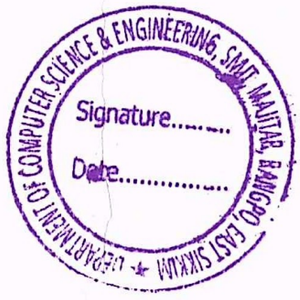
Text Books:

1. A.V. Aho, R. Sethi, J.D. Ullman, "Compilers: Principles, Techniques and Tools", Addison – Wesle
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Elsevier.

Reference Books:

1. W. Appel, "Modern Compiler Implementation in C: Basic design", Cambridge Press.
2. Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation", Addison-Wesley.
3. Dhamdhere, "Compiler Construction", McMillan.
4. V. Aho and J. D. Ullman, "Theory of Parsing, Translation and Compiling", Prentice Hall





Sub Code: CS302A5 **Credit:1 (L-0, T-0, P-4)**

MINI 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.





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 develo numerical skills among students and to prepare them for various examinations to enhance better job prospects. This initiative being taken to include essential mathematical principles to build students' confidence. It is expected to expand students' knowled and foster their logical reasoning and analytical thinking abilities.

Pre-requisites: NIL

Course Outcomes (CO): On successful completion of the course

CO	STATEMENT
CO1	Student will be able to solve variety of simple problems in the space of quantitative domain.
CO2	Students will be able to use data to determine or to deduce other facts from a set of given data of less complexity.
CO3	Students will be able to use shortcuts, tricks and techniques to solve the problems with moderate accuracy.
CO4	Students will be able to demonstrate essential skills pertaining to public speaking, resume writing and telephone etiquette.
CO5	Students will be able to 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**

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Sub-Code: CS401A9 **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.

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Sub Code: CS401A6 **Credit:7 (L-0, T-0, P-14**

MAJOR PROJECT-PHASE I

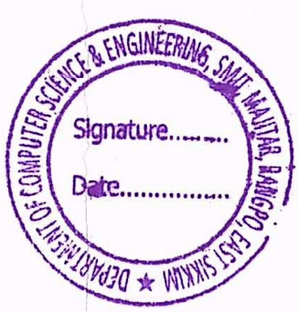
Course Objective: The students are required to undertake innovative and research-oriented project, not only to reflect their knowledge gained in the previous semesters but also to acquire additional knowledge and skill of their own effort.

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: CS402A **Credit:12 (L-0, T-0, P-24)**

MAJOR PROJECT-PHASE II

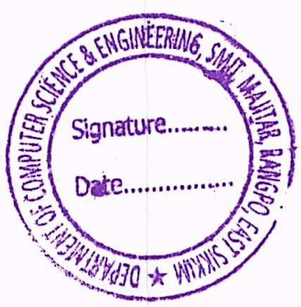
Course Objective: The students are required to undertake innovative and research-oriented project, not only to reflect their knowledge gained in the previous semesters but also to acquire additional knowledge and skill of their own effort.

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: CS201A3 **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. Ability to 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		

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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, TMH Publication.
4. Internet & Java Program: R.Krishnamoorthy& S. Prabhu, New Age Internet Publisher





Sub Code: CS202A3 **Credit: 4(L-3, T-1, P-0)**

FUNDAMENTALS OF WEB TECHNOLOGIES

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 andscalable 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		

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	**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.

yce Farrell, XueBai, Michael Ekedahl, "The Web Warrior Guide to Web Programming", Thomson

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Sub Code: CS203A3 **Credit: 4(L-3, T-1, 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

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Sub Code: CS204A3 **Credit:4 (L-3, T-1, P-0)**

INFORMATION TRANSMISSION AND CODING THEORY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course aims to offer a broad introduction to information theory and its real-wor applications. Emphasizes are given on the theory and applications of entropy and information.

Pre-requisites: Basic mathematics & higher algebra and Probability concepts.

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

1. Describe the principles and applications of information theory.
2. Differentiate the various types of coding schemes available in coding theory
3. Compare various error control encoding and decoding techniques
4. Compute amount of information in terms of entropy and apply in source coding and channel coding
5. Compose methods for analyzing the performance of error control 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: <Introduction & Discrete noiseless systems>	in class	An overview of communication systems, Discrete systems, Continuous systems, Mixed systems. Discrete sources, Information content ofdiscrete sources, Entropy as an information measure, Properties of entropy, Uncertainty andentropy, A source coding system, Fixed length and variable length codes. The Noiseless coding theorem (Source coding theorem for a noiseless channel), Discrete noiseless channels, Capacity of discrete noiseless channels, Compression techniques.	8	1		
	****Assignment Topics**	Unique decipherability, Prefix codes, Kraft's inequality and Kraft's theorem,				
Module 2: <Communication through discrete noisy channels>	in class	Representation of a discrete noisy channel, Discrete memory less channel, Examples of discrete noisy channels, Conditional entropy and mutual information, Properties of conditional entropy, Properties of mutual information, Average mutual information, Properties of average mutual information, Capacity of a discrete noisy channel, Properties of Channel Capacity.	8	1,2		
	****Assignment Topics**					
Module 3:	in class	Continuous amplitude signals, Information measure of continuous signals, Entropy	8	2,3		



<Continuous systems & Coding for reliable digital transmission>		continuous signals, Capacity of continuous signals. Types of channel codes, Maximum likelihood decoding, Types of errors, Error control strategies.				
	****Assignment Topics**					
Module 4: <Linear block, Cyclic codes>	in class	Introduction to linear block codes, Syndrome and error detection, Minimum distance of block code, Error detecting and correcting capabilities of block codes, Standard array and syndrome decoding. Generation of parity check matrices of cyclic codes, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes.	8	3,4		
	****Assignment Topics**					
Module 5: <BCH & Convolution codes>	in class	Encoding and decoding of BCH codes, Implementation of error correction. Encoding of convolution codes, Structural properties of convolution codes, Distance properties of convolution codes, Maximum likelihood decoding of convolution codes, Sequential decoding of convolution codes, Majority logic decoding of convolution codes.	8	3,5		
	****Assignment Topics**	Non binary BCH codes and Reed Solomon Codes				

Text Books:

1. S. Lin and D. J. Costello, "Error Control Coding- Fundamentals and Applications", Prentice Hall, Inc. Englewood Cliffs, 1983.
2. T. M. Cover and J. A. Thomas, "Elements of Information Theory", Second Edition, Wiley Interscience, 2006.

Reference Books:

1. Bose, Ranjan, "Information theory coding and cryptography", Tata Mcgraw Hill, 2010.
2. Mackay, "Information theory, inference and learning algorithm", Cambridge University, 2004.
3. Gravano, Salvatore, "Introduction to error control codes", Oxford University Press.
4. Robert B. Ash, "Information theory", Dover Publishing Inc.





Sub Code: CS205A3 **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 and hierarchical 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 computer graphics
3. Discuss an ability to conduct investigations of technical issues related to computer vision with their level of 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		

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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: < Modeling methods & Three dimensional concepts>	in class	Basic modeling concepts, Master co-ordinates & modeling transformations, structured displayfiles, 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: CS206A3 **Credit: 4(L-3, T-1, P-0)**

MICROPROCESSORS AND PERIPHERAL DEVICES

Questions to be set: 05 (All Compulsory)

Course Objectives: The course is intended to give students good understanding of internal architectura details and functioning of 8085 and 8086 microprocessors. The students will have thorough and in-dept knowledge of microprocessors, its architecture, working principles including timing diagrams and assembl language programming using hand assembly as well as assembler. This course also highlights 805 Microcontroller.

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 and various peripheral devices.
2. Sketch block diagrams of Microprocessors and peripheral devices. Illustrate the execution of instructions by 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 for creating 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		

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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, Penram International 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 M Bhurchandi, Tata Mcgraw Hill Publishing Company Limited, 2000.

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Sub Code: CS207A3 **Credit: 4(L-3, T-1, P-0)**

ADVANCED JAVA ROGRAMMING

Questions to be set: 05 (All Compulsory)

Course Objectives: This course covers the advanced topics in java programming such as collectior framework, language package, Network Programming, GUI programming using AWT and Swings, advanced Web Programming using Servlet and JSP, and Accessing Database with Java.

Pre-requisites: Object Oriented programming, Database Management System, Computer Network and Distributed System.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Write program codes displaying competence in basic object-oriented programming using Java
2. Compare and able to develop scalable network applications using Java
3. Illustrate and practice component-based software.
4. Explain and able to conduct investigations of technical issues consistent with their level of knowledge on distributed applications.
5. Design and implement the understanding pertaining to database 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: < Java fundamentals>	in class	Java I/O streaming, Filter and pipe streams, Byte code interpretation, Threading, Swing.	7	1		
	****Assignment Topics**					
Module 2: < Network programming in java>	in class	Sockets, secure sockets, custom sockets, UDP datagrams, Multicast sockets, URL classes, Reading data from the server, Writing data, Configuring the connection, Reading the header, Java messaging services.	8	2,3		
	****Assignment Topics**	Telnet application		2		
Module 3: < Applications in distributed environment >	in class	Remote method invocation, activation models, RMI custom sockets, Object serialization, RMI, IIOP implementation, CORBA, IDL technology, Naming services, CORBA programming models, JAR file creation.	9	2,3		
	****Assignment Topics**					
Module 4: < Multi-tier application development>	in class	Server side programming, Servlets, Java server pages, Applet to applet communication, Applet to servlet communication, JDBC.	9	5		





	**Assignment Topics	Applications on databases, Multimedia streaming applications, Java media framework.		5		
Module 5: < Enterprise applications >	in class	Server Side Component Architecture, Introduction to J2EE, Session Beans, Entity beans.	7	4		
	**Assignment Topics	Persistent entity beans.		4		

Text Books:

1. Elliotte Rusty Harold, "Java Network Programming", Shroff.
2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons.

Reference Books:

1. Patrick Naughton, "Complete Reference: Java2", Tata McGraw Hill.
2. Hortsmann& Cornell, "Core Java 2 Advanced Features, VOL II", Pearson education.
3. Amir Afzal, "Advanced Java Programming", Pearson.
4. Joe Wigglesworth, Paula McMillan, "Java Programming: Advanced Topics", Course Technology.

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Sub Code: CS208A3 **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 have evolved 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 system programs.
4. Compare various program loading schemes and discuss issues pertaining to design of some loading schemes.
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:

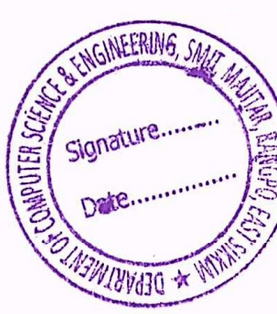
1. John J. Donovan, "Systems Programming", Tata McGraw Hill.
2. Srimanta Pal, "Systems Programming", Oxford.

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

C. Shalini, "System Software", SCITECH Publication





Sub Code: CS209A3 **Credit: 4(L-3, T-1, P-0)**

DISCRETE STRUCTURE

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on mathematical structures for describing data, algorithms and computing machines. Theory and Applications of sets, relations, functions, combinatorics, matrices, graphs and algebraic structures, which are pertinent to computer science are also covered.

Pre-requisites: Data Structures and Concepts of algorithms. Some programming experience is helpful but not necessary.

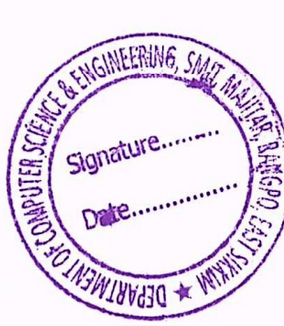
Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Identify effectively algebraic techniques to analyze basic discrete structures and algorithms.
2. Apply the concepts of sets, integers, reals and functions of such quantities to solve simple problems
3. Relate the graphs and related discrete structures to practical examples
4. Apply the notion of mathematical and algorithmic thinking for problem solving
5. Infer logical reasoning to solve a 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: < Sets & Ordered structures>	in class	Definition, Diagonalization, Limits of computability, Bags (multisets). Tuples, Lists, Strings and languages, Relations.	8	1		
	****Assignment Topics**	Operations, Counting, Comparing the size of sets, Countable sets				
Module 2: < Inductively defined sets, Recursive functions and procedures>	in class	Numbers, Strings, Lists, Binary trees, Cartesian products of sets. Lists, Binary trees, Infinite sequences, Recursion in programs, Repetitive program design.	8	1		
	****Assignment Topics**	Numbers, Strings,				
Module 3: < Propositional calculus & Predicate logic>	in class	Well-formed formulas and semantics, Equivalence, Truth functions and normal forms. Predicates, Qualifiers, Well-formed formulas, Semantics and interpretations, Validity, Equivalence, Normal Forms, Formalizing English sentences.	8	2,4		
	****Assignment Topics**					
Module 4:	in class	Equality, Imperative program correctness, Termination.	8	3		





< Program logic & Automatic reasoning>		Clauses, Propositions, Substitution and unification, Resolution, Logic programming: Family trees, Logic program, Logic programming techniques.				
	**Assignment Topics	Array assignment				
Module 5: < Algebraic structures and abstract data types>	in class	Natural numbers, Lists and strings, Stacks and queues, Binary trees and Priority queues, Abstract arrays, Container classes.	8	4,5		
	**Assignment Topics					

Text Books:

1. James L. Hein, "Discrete Structures, Logic and Computability", Narosa.
2. J.P. Tremblay, R.Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill

Reference Books:

1. Leon S. Levy, "Eastern, Discrete Structures of Computer Science", Wiley
2. C.L.Liu, "Elements of Discrete Mathematics", McGraw-Hill.
3. Bruce Mills, "Theoretical Introduction to Programming" , Springer.

etcher R. Norris, "Discrete structures: An introduction to mathematics for computer science" PrenticeHall.





Sub Code: CS210A3 **Credit: 4(L-3, T-1, P-0)**

GRAPH THEORY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides a detailed theory and applications of various types and classes ofgraphs Topics include Graphs, Sub graphs, path, walk, circuits, cut sets, tournaments,
connectivity, trees, Eulerian graphs, Hamiltonian graphs, planarity, graph colourings, matching,and domination independence, directed graphs, networks and applications in computer engineering.

Pre-requisites: Basic graph theory and graph algorithms, Basic mathematics and Programmingconcepts.

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

1. Illustrate the basic concepts of graphs, directed graphs, weighted graphs and bipartite graphs, Eulerian, Hamiltonian and plane graphs.
2. Demonstrate the various components of a graph.
3. Describe the various application of graph using suitable graph based algorithms.
4. Illustrate the various concepts of searching using breadth/depth first search and minimum weight spanning tree of a connected graph.
5. Perform advanced operations on a graph.

**** 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 & Tree>	In Class	Introduction: Definitions, applications of graph in Diagram tracing, Konigsberg bridge problem, Chinese postman problem, DNA fragment assembly, floor design, Knight's tour, Integer programming, Solution to the travelling salesman problem. Isomorphism, walks, paths, circuits, connected, disconnected, graphs, operations in graphs-Euler & Hamilton graphs. Tree: Properties, distance & centres, binary trees, fundamental circuits, minimal spanning tree. Tree traversal. Applications of Tree in manipulating hierarchical data, Parse tree, File system, manipulate sorted lists of data, workflow for compositing digital images for visual effects and Routing algorithms.	6	1		
	****Assignment Topics**					
Module 2: < Cut Sets & Planar and Dual Graphs >	In Class	Cut Sets: Properties, Fundamental circuits and cut sets, connectivity, separatability network flows, 1-2 isomorphism. Applications of cut sets to solve graph models for reliability analysis, identify potential single point failures in a modelled system, state equation for network and superposition network theorem.	7	1,2		

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		Planar and Dual Graphs: Combinational representation, planar graphs, Kuratowshi's graphs detection of planarity, dual graphs. Applications of planar graphs in image segmentation, shape matching, extended modelling capabilities, route planning.				
	****Assignment Topics**					
Module 3: < Matrix Representation of Graph & Vector Spaces Of A Graph>	In Class	Matrix Representation of Graph: Incidence matrix, circuit matrix, cut set matrix, fundamental matrices, relationships among matrices, path matrix, and adjacency matrix. Applications of Matrix in computer programming language for the computation of path or circuit. Vector Spaces Of A Graph: Sets with One Operation, Sets with Two Operations, Modular Arithmetic and Galois fields,Vectors and Vectors Spaces, Vector spaces Associated with a Graphs, Basis vectors of a Graph, Circuit and Cut-Set Subspaces , Orthogonal Vectors and Spaces, Intersection and join of W and Ws,.	11	2,3		
	****Assignment Topics**					
Module 4: < Coloring, Covering, Partitioning & Directed Graphs>	in class	Coloring, Covering & Partitioning: Chromatic number, chromatic partitioning, matching, covering, four color problem. Coloring and covering concepts used in pattern matching, register allocation, frequency assignment in GSM, timetabling, scheduling and computer network security. Directed Graphs: Different types, directed path, and connectedness, Euler digraphs, Trees, matrix representation, tournament. Directed graphs used in compiler construction, finite state machine, combinational circuit design and traffic flow problem.	9	3,4		
	****Assignment Topics**					
Module 5: < Enumerations Of Graphs , Graph Theoretic Algorithms and Applications>	in class	Enumerations Of Graphs: Types of Enumeration, counting labeled Trees, Counting Unlabeled Trees, Polya's Counting Theorem, Graph Enumeration with Polya's Theorem. Graph Theoretic Algorithms: Computer representation of graphs, Input / output. Devising algorithms for connectedness, a spanning tree, fundamental circuits, cut vertices, directed circuits, shortest paths. Applications of Graph theoretic algorithm in worm propagation, workflow for compositing digital images for visual effects, routing algorithms. Applications: Graph in sequential switching networks, graph in coding theory, graph in signal flow graph, graph inmarkov process, and graphics in computer programming. Applications in code generation, sequential switching networks, graphics.	7	4,5		

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	**Assignment Topics					

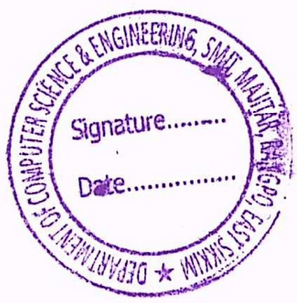
Text Books:

1. N.Deo, Graph Theory with applications to Engineering and Computer Science, Prentice Hall of India
2. Jonathan L. Gross and Jay Yellen, Graph Theory and Its Applications

Reference Books:

1. Tulasiraman& MNS Swamy, Graphs, Networks & Algorithms, Mily,
2. F. Harary, Graph Theory, Addison Wessly
3. Jonathan L. Gross and Jay Yellen , Handbook of Graph Theory,
4. Jonathan L. Gross and Thomas W. Tucker, Topological Graph Theory, Dover publications.





Sub Code: CS211A3 **Credit: 4(L-3, T-1, P-0)**

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.

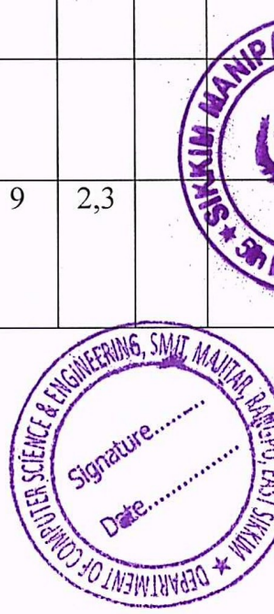
Pre-requisites: Probability & Statistics and System Analysis concepts.

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.

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Sub Code: CS212A3 **Credit: 4(L-3, T-1, P-0)**

ADVANCED WEB TECHNOLOGIES

Questions to be set: 05 (All Compulsory)

Course Objectives: To enable learners to understand and apply the various steps in designing a creative a dynamic website using latest web technologies.

Pre-requisites: Fundamentals of Web Technologies.

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

1. Define the basic terms of HTML, CSS and JavaScript
2. Identify appropriate web based technologies for developing dynamic webpages
3. Choose an appropriate database language and technologies for connecting front end to backend
4. Distinguish major frameworks for development of web services and cloud applications
5. Test appropriate content management system for developing scalable websites

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < Mark-up Language>	in class	Mark-up languages, XML, Uses of XML. WELL-FORMED XML: Parsing XML, Tags,text, elements, attributes, comments and empty elements. XML Declaration, Processing Instructions, Errors in XML XML NAMESPACES: Need for namespaces, How XML namespaces work, URIs.	8	1,2		
	****Assignment Topics**	When to use namespace.				
Module 2: < Javascript >	In Class	Introduction, Obtaining user inputs, memory concepts, Operators, Control Structures, Looping constructs, break, continue statements, Programmer defined functions, Scoping rules, Array declaration and allocation, passing arrays to function, Objects: String, Date, Boolean, Window, document; using cookies, Handling Events Using JavaScript.	8	3		
	****Assignment Topics**	Recursion and iteration				
Module 3: < Web Optimization & SEO >	In Class	Web Browsers, Caching, Downloading and Rendering, Persistent Connections, DNS caching and prefetching, Buffering, Weblog Optimization and Security: Parallel Downloading, Controlling caches, Content compression, Load balancers, Tuning MYSQL, Using query caching.	8	4		
	****Assignment Topics**	Optimizing query execution and optimization				
Module 4:	in class	Installing and Configuring MySQL and PHP, Basic Security Guidelines, Variables, Data Types, Operators	8	4,5		





<Advanced PHP >		and Expressions, Constants, Flow Control Functions; Switching Flow, Loops, Form processing, Connecting to database, using cookies, dynamic contents, Validating User Input, Handling and Avoiding Errors, Configuring email with PHP.				
	****Assignment Topics**	Code Blocks and Browser Output, Configuring email with PHP.				
Module 5: <Web services & Content Management System >	in class	Web services, Design and modelling of web services, Introduction to Service Oriented Architecture, combining protocols to build Web services – clarifying web services, REST Services, WS-* Web services. using SOAP and WSDL, , Case Study: Drupal as open source content management system - Module development.	8	5,2		
	****Assignment Topics**	REST vs WS-* services, Site building, Site configuration				

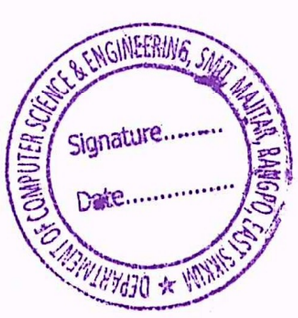
Text Books:

1. Deitel H.M., Deitel P.J., "Internet & World Wide Web: How to program", Pearson Education.
2. Boronczyk, Naramore, "Beginning PHP, Apache, MySQL Web Development", Wiley India Pvt. Ltd.

Reference Books:

1. Peter Smith, "Professional Website performance", Wiley India Pvt. Ltd.
2. Kogent Learning, "Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX Black Book", Wiley India Pvt. Ltd.





Sub Code: CS213A3 **Credit: 4(L-3, T-1, P-0)**

EMBEDDED SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: Explores the fundamentals of embedded system hardware design. Issues such as embedded processor selection, hardware/software partitioning, glue logic, circuit design,circuit layout, circuit debugging, development tools will be discussed in reference of microcontrollers.

Pre-requisites: Digital Logic and Circuit Design, Computer Organization and Architecture, Micro-processors and peripheral devices, PC hardware and peripherals.

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

1. Identify the internal architecture and interfacing of different peripheral devices with Microcontrollers
2. Understand hardware and software design requirements of embedded systems
3. Analyze the role of embedded systems in industry
4. Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems
5. Design real time embedded systems using the concepts of RTOS.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: An overview and application of embedded system	In class	Definition and Categories of embedded systems, Requirements of embedded systems, Challenges and issues in embedded systems. Application market segments, Control systems and industrial automation, Networks information appliances, telecommunications, Wireless communications.	8	1		
	****Assignment Topics**	**Trends in embedded software development.**				
Module 2: Hardware architectures for embedded systems	in class	Hardware architecture, Processor, Memory, Latch and buffers crystal, Reset circuit, ADC & DAC, Application specific control circuitry, Display units, Keypads, Example 8031 based control systems, DSP architecture, communication interface standards, Development tools.	8	2		
	****Assignment Topics**	**The Smart card case study, A micro controller architecture, The 8051 architecture 16 bit and 32 bit processors, Hardware and software interaction.**				
Module 3: Developing for embedded systems	In class	Embedded system development process coding issues, Verification of software on host and embedded system, Embedded software development environments operating systems, Embedded operating systems, Task scheduling in embedded systems, Context switch, Task synchronization timers, Java programming language development tools for target processors,	8	3		

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		Implementing embedded systems.				
	**Assignment Topics	**Types of embedded operating systems Programming languages, Structure of a C compiler,**				
Module 4: Mobile network and RT embedded system, embedded application	in class	Serial communication programming, Development of a navigation system development environment, Project overview, Embedded applications over mobile networks development environment, Example projects, Real time embedded development. Development environment, Salary survey.	8	4,5		
	**Assignment Topics					
Module 5: Networked Java enabled information appliances and Future Trends in embedded systems	in class	Development environment, Customer relations management software embedded process control system, Software development in windows XP embedded development environment, Typing speed indicator, Electronic voting.	8	5		
	**Assignment Topics	**Mobile Java Applications, Remote control of an air conditioner**				

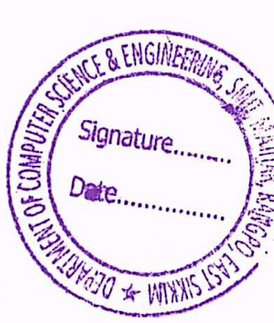
Text Books:

1. Dreamtech S/W. team, "Programming for embedded systems cracking the code", Wiley.
2. Arnold S. Berger, "Embedded systems design: An introduction to processes, tools and techniques", CMP Books.

Reference Books:

1. Jean J. Labrosse, "Embedded systems building blocks", CMP Books.
2. Jack Ganssle, "The art of designing embedded systems", Elsevier.
3. Tammy Noergaard, "Embedded systems architecture: A comprehensive guide for engineers and programmers (Embedded technology"), Elsevier.
4. Qing Li, "Real time concepts for embedded systems", Elsevier.





Sub Code: CS214A3 **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

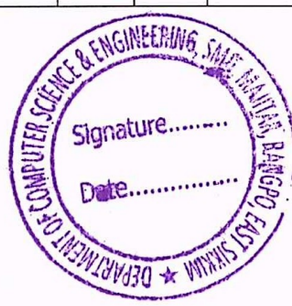
Course Outcomes (CO): On completion of the course, it is expected to endow the students with skills to:

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 highly connected world, Cambridge University Press, 2010

Reference Books:

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





ıb Code: CS215A3 **Credit: 4(L-3, T-1, P-0)**

VLSI

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objective of this course is to introduce the technology, design concepts and testing of Very Large-Scale Integrated Circuits. This course is designed to give clear idea about the basics of VLSI design and its importance. This also highlights about the operating principles of MOS transistor, CMOS and Bi-CMOS based logic gates and its construction.

Pre-requisites: Basic Electronics, Digital Circuits and Logic Design and Computer Organization and Architecture.

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

1. Identify the various IC fabrication methods.
2. Discuss the layout of simple MOS circuit using Lambda based design rules.
3. Apply the lambda-based design rules for subsystem design.
4. Design an application using Verilog HDL.
5. Evaluate a digital system using Hardware Description 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: < VLSI Physical Design Automation and Fabrication of VLSI Devices >	in class	VLSI design cycle, New trends in VLSI design cycle, Physical design cycle, New trends in Physical design cycle, Design styles: Full custom, Standard cell based, Gate Array based, Field programmable gate array based, Sea of gates, Comparison of different design styles. Fabrication materials, Fabrication process flow, nMOS fabrication process, The CMOS n-well process, Issues related to fabrication process, Layout design rules, Full custom mask layout design, Layout of basic devices.	8	1		
	****Assignment Topics**			1		
Module 2: < Design of VLSI Devices >	in class	The MOS structure and operation, Gradual channel approximation method, Channel length modulation, MOSFET scaling and small geometry effects, The Level 1 model equations, Level 2 model equations, Level 3 model equations, Characteristics of various MOS inverters, Power and Area considerations of MOS inverters, Design of CMOS inverters, Supply voltage scaling in CMOS inverters, Delay-time definitions, Calculation of delay times, Inverter design with delay constraints, Calculation of interconnect delay , Switching power dissipation of CMOS inverters, Power-delay product, Super buffer design	8	2		
	****Assignment Topics**			2		
Module 3: < Low Power Design of VLSI Circuits and CAD Tools for VLSI Design >	in class	Overview of power consumption, Low power design through voltage scaling, Estimation, and optimization of switching activity, Adiabatic logic circuits. Introduction to CAD tools, Overview of VHDL/Verilog, Modeling concepts, Logic synthesis, Technology mapping, High level synthesis.	8	3		
	****Assignment Topics**			3		
Module 4:	in class	Problem formulation, Design style specific partitioning problems, Classification of Partitioning algorithms,	8	4		

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< Partitioning and Floor planning and Pin Assignment >		Kernighan-Lin algorithm, Fiduccia-Mattheyses algorithm, Ratio-Cut algorithm, Simulated annealing and evolutionary based algorithms, Performance driven partitioning. Problem formulation, Design style specific issues, slicing floorplan, Non-slicing floorplan, Classification of Floor planning algorithms, Constraint based floor planning, Integer programming based floor planning, Rectangular dual graph approach, Hierarchical tree based methods, Simulated annealing based approach, Theoretical advancement in floor planning, Recent trends, Pin Assignment: Problem formulation and design style specific issues, Pin assignment algorithms.				
	****Assignment Topics**			4		
Module 5: < Placement and Routing >	in class	Problem formulation and design style specific issues, Interconnection topologies, Estimation of wire length, classification of placement algorithms, Simulation based placement algorithms, partitioning based placement algorithms, Cluster growth algorithm, Performance driven placement. Global routing: Problem formulation, Classification of global routing algorithms, Steiner tree based considerations, routing models, Channel routing problems, Design style specific detailed routing problems, Detailed routing algorithms. Integer programming based approach. Detailed routing: Routing	8	5		
	****Assignment Topics**			5		

Text Books:

1. Naveed A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer AcademicPublishers.
2. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TataMcGraw-Hill.

Reference Books:

1. Douglas A. Pucknell, Kamran Eshraghian, "Basic VLSI design", Prentice Hall.
2. Wayne Hendrix Wolf, "Modern VLSI Design", Prentice Hall.
3. David Money Harris, Neil H. E. Weste, "CMOS VLSI design: A Circuits and Systems Perspective",Addison Wesley.

eil West, Kamran Eshraghian, Michael John Sebastian Smith, "Principles of CMOS VLSI design: A Systems Perspective with erilog/VHDLManual", Addison Wesley





Sub Code: CS216A3 **Credit: 4(L-3, T-1, P-0)**

SIGNALS AND NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform &Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To characterize LTI systems in the Time domain and various Transform domains

Pre-requisites: Digital Circuits, Embedded Systems.

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

1. Compute mathematical description and representation of continuous and discrete time signals and networks
2. Illustrate input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system
3. Measure the signals in frequency domain using Fourier series and Fourier transforms
4. Predict the limitations of Fourier transform and need for Laplace transform
5. Develop the ability to analyze the system in S- domain and Z- domain

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: <Classification of signals and systems >	In Class	Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems- Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.	12	1		
	****Assignment Topics**	DT systems-Classification of system				
Module 2: <Analysis of continuous time signals >	In Class	Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties	8	2		
	****Assignment Topics**	CT Signal Analysis - Properties				
Module 3: < Linear time invariant-continuous time systems >	In Class	Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier	6	3		
	****Assignment Topics**	Laplace transforms in Analysis of CT systems.				

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Module 4: < Analysis of discrete time signals >	in class	Baseband Sampling - DTFT – Properties of DTFT	4	4		
	**Assignment Topics	Z Transform – Properties of Z Transform				
Module 5: < Linear time invariant-discrete time systems >	in class	Difference Equations-Block diagram representation-Impulse response - Convolution sum- Discrete Fourier a	8	5		
	**Assignment Topics	Z Transform Analysis of Recursive & Non-Recursive systems.				

Text Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2007.

2. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.

Reference Books:

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.

2. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

3. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill, 2007.

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Sub Code: CS217A3 **Credit: 4(L-3, T-1, P-0)**

INFORMATION RETRIEVAL

Questions to be set: 05 (All Compulsory)

Course Objectives:

- Learn the information retrieval models.
- Be familiar with Web Search Engine.
- Be exposed to Link Analysis.
- Understand Hadoop and Map Reduce.
- Learn document text mining techniques.

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	PSC
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.				

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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 University Press, 2008.
2. Ricardo Baeza -Yates and Berthier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology 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 and Evaluating Search Engines, The MIT Press, 2010.

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Sub Code : CS218A3 **Credit: 4(L-3, T-1, P-0)**

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	PS
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.

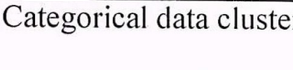
Reference Books:

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: CS219A3 **Credit: 4(L-3, T-1, P-0)**

ADVANCED COMPUTER ORGANIZATION AND ARCHITECTURE

Questions to be set: 05 (all compulsory)

Course Objectives:

This course introduces the principles of computer organization and the basic architecture concepts. The course emphasizes performance and cost analysis, instruction set design, pipelining, memory technology, memory hierarchy, virtual memory management, and I/O systems.

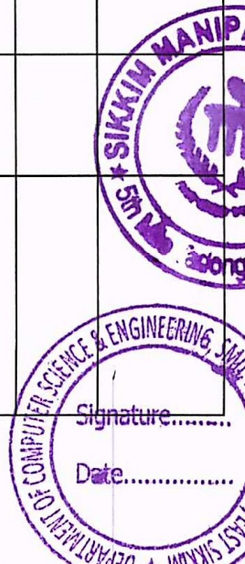
Prerequisites: Computer Organisation and Logic Design.

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

1. Identify various components of a computer and their interconnection.
2. Identify basic components and design of the CPU: the ALU and control unit.
3. Compare and select various Memory devices as per requirement.
4. Compare various types of IO mapping techniques.
5. Critique the performance issues of cache memory and virtual memory.

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: < ntroduction to rganization of the computers and I/O sub systems >	in class	Basic organization of the computer and block level description of the functional units from program execution point of view, Fetch, Decode and Execute cycle. External devices, I/O Modules, Programmed I/O, Interrupt driven I/O, DMA, I/O channels and processors.	6	1		
	**Assignment Topics			1		
Module 2: Inside CPU and Arithmetic Operations>	in class	Fundamental concepts: Fetching a word from memory, storing a word in memory, register transfers, performing an arithmetic or logic operations, Addressing modes, Instruction format: Three, Two, One, and zero address instruction (Stack evaluation architecture), Control Unit: Hardwired control unit, Micro programmed control unit. Computer arithmetic: addition, subtraction (2's complement method only), Booth's multiplication technique, restoring and non-restoring divisions.	8	2		
	**Assignment Topics			2		
Module 3: CPU design undamentals and ntroduction pipelining>	in class	Working components of CPU (ALU, CU, registers etc), Processor micro architecture, Principles of processor performance, Vector processing and array processing. RISC, CISC architectures. Concepts of data path. Principles of linear and non-linear pipelining, Classification of pipeline processors (Flynn's	7	3		



		classification: SISD, SIMD, MISD, MIMD). Concepts of instruction-level parallelism (ILP), very large instruction word (VLIW).				
	**Assignment Topics			3		
Module 4: < Pipelined array processor And multi-processor architectures with shared memory>	in class	SIMD array processors: SIMD computer organization, Masking and data routing mechanisms, SIMD interconnection networks: static v/s dynamic, blocking and non-blocking n/w, Mesh connected ILLIAC network, Shuffle-exchange and Omega network., Hypercube SIMD model, butterfly networks. UMA, NUMA, COMA, bus arbitration methods (daisy-chaining, polling), Crossbar switch and multiport memories, Comparison of multiprocessor interconnection structure, multistage networks for multiprocessors.	9	4		
	**Assignment Topics			4		
Module 5: <Fundamentals of parallel processing And An introduction to GPU >	in class	Criteria for judging the architecture, Architectural classification schemes, Trends towards parallel processing, Parallelism in uniprocessor systems, Parallel computer structure, Performance evaluation of Processors – Amdahl's law, Applications of parallel processing. Developing algorithms for multi-processor computers, introduction to PRAM model. Inter-Process Communication and synchronization on MIMD, Deadlock, task scheduling on MIMD. A brief introduction of Graphics Processing Unit(GPU), its benefits, and interfacing with CPU as host-device model.	8	5		
	**Assignment Topics			5		

Textbooks:

1. V. C. Hamacher, Zaky, Vranesic, "Computer Organization", McGraw Hill
2. William Stallings, "Computer organization & Architecture – Designing for Performance", Pearson Education.
3. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications", 5th Ed., Penram International.

eference Books:

D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software terface", Morgan Kaufmann.
J. P. Hayes, "Computer Architecture and Organization", McGraw Hill.
Morris Mano, "Computer System Architecture", Pearson



Sub Code: CS220A3 **Credit: 4(L-3, T-1, P-0)**

PRINCIPLES OF PROGRAMMING LANGUAGES

Questions to be set: 05 (All Compulsory)

Course Objectives: The objective of this course is to identify the conceptual building blocks from whichlanguages are assembled and specify the semantics, including common type systems, of programming languages.

Pre-requisites: Programming languages & Concepts

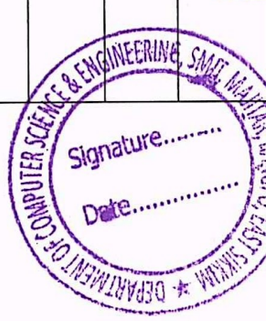
Course Outcomes(CO): On successful completion of this course, students will be able to:

1. 1. Solve basic problems using fundamental principles of Artificial Neural Networks.
2. Identify the type of network suitable for a given problem category.
3. Estimate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
4. Mitigate problems arising out of improper design of networks or data variations using basic techniques.
5. Design appropriate networks to solve real life 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: <Introduction: Names, Scopes, and Bindings >	In Class	The art of language design; Programming language spectrum; Why study programming languages? Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-decent – bottom up parsing. Syntactic Structure - Language representation, Abstract Syntax tree, Lexical syntax, Context Free Grammars, Variants of CFG, Issues involved and Normal Forms for CFG. Compilation and interpretation; Programming environments. Names, scope, and bindings: The notion of binding time; Object lifetime and storage management; Scope rules; Implementing scope; The meaning of names within a scope; The binding of referencing environments; Macro expansion. High Level Languages	7	1		
	****Assignment Topics**	Issues in Programming - Case studies, Programming paradigms, Language implementation.				
Module 2: < Data Types & Control Structures, Subroutines and Control Abstraction >	In Class	Type systems; Type checking; Records and variants; Arrays; Strings; Sets; Pointers and recursive types; Lists; Files and Input/Output; Equality testing and assignment. Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types –union types – pointers and references – Arithmetic expressions –	8	2		





		overloaded operators –type conversions – relational and boolean expressions – assignment statements – mixed mode assignments. Control structures – selection – iterations – branching – guarded statements. Review of stack layout; Calling sequences; Parameter passing; Generic subroutines and modules; Exception handling; Coroutines; Events.				
	****Assignment Topics**					
Module 3: < Imperative languages & Object oriented languages>	In Class	Control Flow: Expression evaluation; Structured and unstructured flow; Sequencing; Selection; Iteration; Recursion; Non-determinacy, Structured Programming - Need and Design issues. Block Structures (Pascal), types arrays, records, sets, pointers, procedures, parameter passing, scope rules (in C). Grouping of data and Operations - Constructs for Programming Structures, abstraction Information Hiding, Program Design with Modules, Defined types, Object oriented programming - concept of Object, inheritance, Derived classes	9	3		
	****Assignment Topics**	Information hiding - Templates- Exception handling (Using C++ and Java as example language).				
Module 4: < Functional Programming>	in class	Features, Implementation, Types - values and operations, Introduction to lambda calculus Product of types. Introduction to lambda calculus. Lists and Operations on Lists, Functions from a domain to a range, Function Application, Lexical Scope. Bindings of values and functions (Using soft / Lisp as example language). Reactive programming and its concepts	8	3,4		
	****Assignment Topics**					
Module 5: < Logic Programming & Concurreny>	in class	Formal Logic Systems, Working with relations and their implementation (Using Prolog as example). Database query Languages, Exception handling (Using SQL as example) . Background and motivation; Concurrency programming fundamentals; Implementing synchronization; Language-level mechanisms; Message passing. Run-Time Program Management: Virtual machines; late binding of machine code; Inspection/introspection	8	4,5		
	****Assignment Topics**					

Text Books:

1. Michael L. Scott: Programming Language Pragmatics, 3rd Edition, Elsevier, 2009.
2. Programming Language Design Concepts by David A. Watt, Wiley publications

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Reference Books:

1. Ravi Sethi: Programming languages Concepts and Constructs, 2nd Edition, Pearson Education, 1996.
2. R Sebesta: Concepts of Programming Languages, 8th Edition, Pearson Education, 2008.
3. Allen Tucker, Robert Nonan: Programming Languages, Principles and Paradigms, 2nd Edition, Tata McGraw-Hill, 2007.
4. Programming Languages: Principles and Practice (English) 1st Edition (Paperback) by Kenneth C. Louden.





Sub Code: CS301A3 **Credit: 4(L-3, T-1, P-0)**

LATEST TRENDS IN COMPUTER SCIENCE

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides students with:

- Introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks.
- An opportunity to explore the research issues in augmented Reality and Virtual Reality (AR &VR).
- It also acquaints the learners with basic concept and framework of virtual reality.
- It addressed to overview 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.

Pre-requisites: Design and Analysis of Algorithms, Basics of Soft computing and AI will be preferable

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

1. Discuss various recent technologies used in computer science associated with research and application.
2. Select optimal design scheme suitable for data analytics techniques and tools for extraction of knowledge
3. Identify modern engineering tools, techniques and resources to solve various Computer Vision, Big Data, Block chain Problems, etc
4. Classify machine learning algorithms for sovling Artificial Intelligence problems or other related problems.
5. Decide the individual specialization from the recent trends in computer science of their interest.

**** 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 Science & Internet of Things (IoT) >	In Class	Introduction, Data Science project lifecycle, Statistics, Data Preparation, Model Building, Machine learning models, Performance measurement of a model, Communicating results, Python for Data Science, Introduction to IoT, IoT Technologies and Architectures: Devices and Gateways, Local and wide area networking, Data management, Applications of Internet of Things.	10	1		
	****Assignment Topics**	Opportunities and Challenges in the Internet of Things				
Module 2: < Computer Vision & Machine Learning >	In Class	Fundamentals of vision: Image Formation and Representation – Intensity and Range Images– Camera models – Camera Parameters – Light and color – Image noise – Image filtering – Image smoothing-Sharpening, Image features: point and line detection – Hough Transform – Edge detection – corner detection – Harris Detecter – Textures – Principal component analysis – feature descriptors	11	2,3		

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		– SIFT and SURF, High level vision: Geometric methods – Model based vision – Obtaining hypothesis by pose consistency – pose clustering using invariants – verification, Linear discriminant based classifiers and tree classifiers, Learning-Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.				
	****Assignment Topics**	Learning by gradient descent.				
Module 3: < Artificial Intelligence >	In Class	Overview of Artificial intelligence, Problems and techniques, Problem solving agents, searching for solutions; various uniform search strategies, Introduction to Heuristic search strategies, Hidden Markov models, Learning Bayesian networks.	6	3,4		
	****Assignment Topics**	Fuzzy sets & fuzzy logics.				
Module 4: < Block Chain Coding >	in class	Introduction: trustless system, Why blockchain, Decentralized transactions. History: How and when blockchain/bitcoin started, Milestones on the development of bit coin: creation, exchanges. Overview of blockchain technology: What is blockchain, Transactions: Recording transactions, Digital signature, Verifying and confirming transactions; Blocks, Hashes, Consensus: Distributed consensus, Byzantine generals problem, Proof of work; Verify and confirm blocks. Blockchain applications : Government, Identity management, Auto executing contracts, Three signature escrow.	6	3		
	****Assignment Topics**	Triple entry accounting, Elections and voting.				
Module 5: < Augmented Reality>	in class	Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. What is Augmented Reality? History of Augmented Reality. Augmented and Mixed Reality, Mixed Reality. Mixed Reality continuum, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.	7	5		
	****Assignment Topics**	wireless displays in educational augmented reality applications.				

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Text Books:

1. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media Publication

2. Bernd Jahne and Horst HauBecker, Computer vision and Applications, Academic Press, 2000

3. David A. Forsyth & Jean Ponce, Computer vision-A modern Approach, Prentice Hall, 2002

4. Introductory techniques for 3D computer vision, Prentice Hall, 1998

5. Arvind Narayanan, Joseph Bonneau, Edward Felten, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Kindle Edition.

6. Andreas M. Antonopoulo,"Mastering Bitcoin: Programming the Open Blockchain",2nd Edition, Kindle Edition.

Reference Books:

1. Andries P. Engelbrecht , "Computational Intelligence: An Introduction", Wiley 2nd Edition, 2007
2. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000
3. Leandro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new Computational Intelligence Approach", Springer-Verlag, Germany 2002.

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Sub Code: CS302A3 **Credit: 4(L-3, T-1, 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 tha can be used in many disciplines. Design Thinking applies the methodologies of design to challenges in busines 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 connections with the business community.
4. Develop communication skills necessary to facilitate high performance team formation and maintenance and 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		

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	**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					

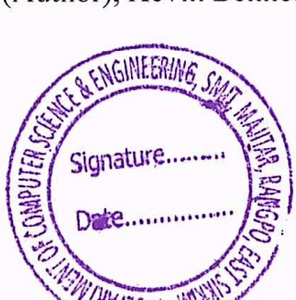
Text Books:

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).





ub Code: CS303A3

Credit: 4(L-3, T-1, P-0)

SPEECH AND NATURAL LANGUAGE PROCESSING

Questions to be set: 05 (All Compulsory)

Course Objectives: Natural language generation systems convert information from computer database intoreadable human language. Natural language understanding systems convert samples of human language intomore formal representations that are easier for computer programs to manipulate

Pre-requisites: computer languages (such as C++, Java or LISP)

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

1. Define the concepts used for describing and analyzing language.
2. Explain semantics related to the language.
3. Construct language models for understanding pragmatics of the language.
4. Illustrate modeling concepts using programming languages like Python.
5. Evaluate basic language modeling techniques using some standard data set.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Linguistics resources	in class	Models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK.	8	1,2		
	****Assignment Topics**	Human languages, Introduction to corpus,				
Module 2: Expressions and Automata and Speech	In Class	Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF, Part of Speech tagging-Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.	8	1,2		

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	**Assignment Topics	Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models,				
Module 3: Parsing and Semantics	in class	WordNet, Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches.	8	3		
	**Assignment Topics	Parsing- Unification, probabilistic parsing, TreeBank, Meaning representation, semantic analysis, lexical semantics				
Module 4: Discourse	in class	Algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP- Spell-checking, Summarization	8	3,4		
	**Assignment Topics	Reference resolution, constraints on co-reference,				
Module 5: Information Retrieval	in class	Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.	8	4,5		
	**Assignment Topics					

Text books:

1. Daniel Jurafsky and James H Martin. Speech and Language Processing, 2e, Pearson Education, 2009

Reference Books:

1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninian perspective, PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval, OUP, 2008.

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Sub Code: CS304A3 **Credit: 4(L-3, T-1, P-0)**

REMOTE SENSING

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, aeria photographic techniques, photogrammetric, multispectral, hyper-spectral, and thermal imaging, and RADAI and LIDAR image analysis will be introduced. The newest technology in the field will also be discussed. Th subject will be synthesized by developing an overall application of the discipline, not just knowledge inon 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 supplemen classroom discussion and reading assignments. At the end of the semester students should have a goo 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 systemdevelopment.
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 agiven 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 Acquisition >	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 scanners and thermal scanners – geometric characteristics of scanner imagery – calibration of	7	2,3		
	****Assignment Topics**					

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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 remote sensing: >	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.

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Sub Code: CS305A3 **Credit: 4(L-3, T-1, P-0)**

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.				

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Module 4: < Computational intelligence >	in class	Swarm intelligence, Evolutionary computation.	5	4		
	**Assignment Topics	Artificial immune system, Ant algorithm.				
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.				

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

andro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new ComputationalIntelligence Approach", ringer-Verlag, Germany 2002.

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Sub Code: CS306A3 **Credit: 4(L-3, T-1, 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.

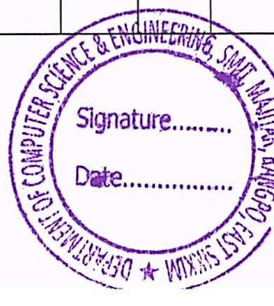
Course Outcomes (CO): On completion of the course, it is expected to endow the students with skills to:

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 usecases", CRC Press.





Sub Code: CS307A3 **Credit: 4(L-3, T-1, P-0)**

DATA ANALYTICS

Questions to be set: 05 (All Compulsory)

Course Objective: Data Analytics is the science of analyzing data in order to come up with some decision-making useful knowledge. The course presents wide range of data analytics techniques and tools for extraction of knowledge.
Pre-requisites: Database Systems.

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

1. Apply data analytics techniques and tools to produce knowledge from a given dataset.
2. Analyze and apply statistical and probabilistic approach for the development of a model using large dataset.
3. Create and evaluate the model using suitable machine learning algorithms.
4. Formulate statistical hypothesis testing and inference for the model development.
5. Explain the dataset using different data representation tools.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Data Analytics Lifecycle and methodology	in class	Introduction to data analytics (DA), data preparation, and data cleaning, Big Data Overview, What is data sciences, The rising and importance of data sciences, Understanding Business Data, Data Preparation,Data, Modelling, Data Evaluation, Communicating results	8	1,2		
	****Assignment Topics**	**Big data analytics in industry**, **Deployment of Data**.				
Module 2: Statistical Analysis	in class	Basic statistical concepts. Mean, standard deviation, Distributions, Covariance, correlation, analysis of variance, Statistical tests, confidence and hypothesis testing, Tools such as R.	6	4		
	****Assignment Topics**	Rank statistics and percentiles				
Module 3: Probabilistic Analysis	in class	Dependence and Independence, Conditional Probability, Bayes's Theorem, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.	6	5		
	****Assignment Topics**	Random Variables				
Module 4: Data Analytics: Theory &	in class	Data features, Classification, Supervised and unsupervised learning, Supervised learning - Linear/Logistic regression, Decision trees, Naïve Bayes, Unsupervised learning - K-means clustering, Association rules, Clustering	10	1,3		

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Methods and Hypothesis and Inference		algorithms, Statistical Hypothesis Testing, Example: Flipping a Coin, Confidence Intervals, Example: Running an A/B Test				
	****Assignment Topics**	Knowledge discovery, Anomaly detection, P-hacking, Bayesian Inference.				
Module 5: Tools for Data Analytics and Data Representation and Analysis	in class	Globally distributed data stores, Tools for big data, Introduction to Hadoop, HDFS, MapReduce, , HBase, Hive, Pig, NoSQL. Log Data Analysis – HDFS scenario: Write once & Read often, , Fraud Detection, Risk Modeling, Social Sentiment Analysis, Image Classification,.	10	2,5		
	****Assignment Topics**	YARN, Sqoop, Zookeeper, Flume, Data Warehouse, Graph Analysis				

Text Books:

1. Daniel T. Larose & Chantal D. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", Wiley 2nd Edition.
2. Ron Klimberg and B. D. McCullough, "Fundamentals of Predictive Analytics with JMP" SAS Institute Publishers, 2013.

Reference Books:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" Wiley Publications.
2. Joel Grus, "Data Science from Scratch First Principles with Python", O'Reilly Media, 2015.





Sub Code: CS308A3 **Credit: 4(L-3, T-1, P-0)**

BIG DATA

Questions to be set: 05 (All Compulsory)

Course Objectives: This course presents a detailed study of various aspects of Big Data and it Industrial applications. The course covers technologies associated with Big Data with a comprehensive approach in dealing with it, including real time data analysis.

Pre-requisites: Computer Network, Basics of Algorithms, Data Base Management Systems

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

1. Develop competence in statistics and mathematical modelling to solve big data problems.
2. Apply research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
3. Solve problems associated with batch learning and online learning, and the big data characteristics suchas high dimensionality, dynamically growing data and in particular scalability issues.
4. Create, Select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations for solving big data problems.
5. Recognize ethical dilemmas between Transparency, Identity and Power.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: **Introduction to Big Data,** Big data approaches in companies	In Class	What is big data? 4 V's of Big Data (Volume, Velocity, Variety, Value) explained. Google, Amazon and Facebook - Big data Analytics vs. Classical Statistical Analysis - Techniques and Challenges. Introduction to Big Business around Big data and its scopes: 2011 McKinsey's report, IDC Report on Big Data, Cuckier's Talk.	6	1,2		
	****Assignment Topics**					
Module 2: Introduction to Distributed Computing, **Big Data technologies**	In Class	Map Reduce - Explaining Map and Reduce steps, write pseudo-codes on some well-known problems in Map-Reduce like Word frequency Algorithm, Distributed Sorting, Count of URL Access. Eventually Consistent Transaction explained, CAP Theorem explained. Eventual Consistency continued, CAP Theorem. Amazon's Dynamo DB and Key-Value store. Storage and Big Table of Google.	10	2,4		
	****Assignment Topics**					
Module 3:	In	Introduction to ML, Overview of Item based	7	3,4		

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Machine Learning Techniques in Big Data, **Cloud Computing**	Class	Collaborative Filters, Amazon's Recommendation System. Understanding the issues in Collaborative Filtering. Recommendation System - convergence, Recommendation System of Youtube Introduction to cloud computing - How various components fit together, Simplified Search Engine Architecture. Search Engines: Introduction to Page Ranking algorithm: Explanations and Google Page Ranking algorithm				
	****Assignment Topics**					
Module 4: **Introduction to Hadoop core architecture**	in class	Apache. Load balancing in Hapdoop: Implementation .In depth discussion on Hadoop and HIVE: How HIVE and Hadoop work together	6	1,3		
	****Assignment Topics**					
Module 5: Introduction to Data Mining and ARM, **The Future of Big Data and Criticism over Big Data**	in class	Basic concepts and related technologies. APriori Algorithm in ARM: Fast Algorithms for Mining Association Rules - Paper by Agrawal and Srikant. Bridging the gap: ML Techniques and ARM - How we can take Machine learning and Data mining technologies closer to build integrated solution for Big Data, Machine Learning and Data Mining in the Cloud. Next Generation techniques for Big Data: Quantum Computing, Topological Data Analysis, Application of TDA in Big Data. Concluding note - The three paradoxes of Big Data namely Transparency, Identity and Power, Big Security on Big Data - The HP business White paper	10	3,5		
	****Assignment Topics**					

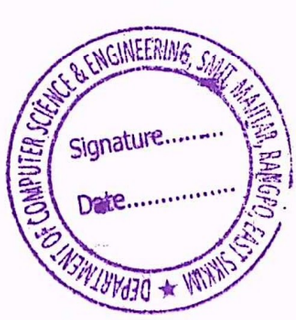
Text Books:

1. Big Data: A Revolution That Will Transform How We Live, Work, and Think.Viktor Mayer- Schönberger, Kenneth Cukier,Houghton Mifflin Harcourt.
2. Big Data Now: Current Perspectives from O'Reilly Radar,O'Reilly Radar Team, O'Reilly

References

1. S. Burckhardt, D. Leijen, M. F˙hndrich and M. Sagiv.Eventually Consistent Transactions.
2. S. Gilbert and N. A. Lynch. Perspectives on the CAP Theorem.\





Sub Code: CS309A3 **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 it is expected to endow the students with skills 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 engineering problems.
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: < Introduction & 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. Fuzzy Membership 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:	in class	Fuzzy Logic: Fuzzy Logic Basics, Fuzzy Truth as Fuzzy Membership, Fuzzy Truth and Linguistic Variables, Fuzzy Rules, Fuzzy Quantifiers,	9	2		

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< Fuzzy Logic & Propositional Logic >		Generalized Modus Ponens, Fuzzy Inference, Generalized Modus Tollens Propositional Logic: Propositions, Propositional logic 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 & Rough Sets >	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 Terms of 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 and Applications", Prentice Hall.

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Reference Books:

1. Simon Haykin, "Neural Networks – A Comprehensive Foundation", Prentice Hall.
2. Jerry M. Mendel, "Uncertain Rule-Based Fuzzy Logic Systems: Introduction and New Directions", 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).

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Sub Code: CS310A3 **Credit: 4(L-3, T-1, P-0)**

COMPUTER VISION

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. It also introduces graphics processing to general purpose parallel computing. Study high-definition 3D graphics, programmable graphic processor unit, multithreaded processor, multi core processor with tremendous computational horsepower and very high memory bandwidth.

Pre-requisites: Programming concepts, object-oriented concept

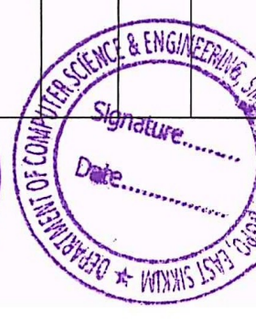
Course Outcomes (CO): On completion of the course it is expected to endow the studentswith skills to:

1. Identify fundamental principles of Image Processing underlying Computer Vision based implementations.
2. Discuss known principles of human visual system, Understand Image formation process and Its representation including its geometry
3. Identify features, extract them, and model them for real-time computer vision applications.
4. Recommend appropriate techniques for implementing clustering, classification, and dimension reduction as per the needs of the applications.
5. Design of a computer vision system for a specific problem

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Fundamental Concepts	In Class	Introduction to Computer Graphics, Fundamentals of Image Processing	6	1		
	****Assignment Topics**					
Module 2: Geometry	In Class	2-D Projecture Geometry, Homography, Camera Geometry, Stereo Geometry	8	2		
	****Assignment Topics**					
Module 3: Feature Modelling	In Class	Feature Detection, Line, Circle, Ellipse, Colour, Intensity, Feature Matching	8	3		
	****Assignment Topics**					
Module 4: Computer Vision Technique	in class	Colour Processing, Range Image Processing, Clustering and Classification	8	4		





	**Assignment Topics					
Module 5: Hands-on Computer Vision	in class	Dimensionality and Sparse representation Tools and Application	12	5		
	**Assignment Topics					

Text books:

1. Donald Hearn & M. Pauline Baker, "Computer Graphics", PHI.
2. NVIDIA CUDA™ Programming Guide Version 2.3.1
3. NVIDIA CUDA C Programming Guide PG-02829-001_v7.0
4. Donald Hearn & M. Pauline Baker, "ComputerGraphics with OpenGL", PHI.

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.

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Sub Code: CS311A3 **Credit: 4(L-3, T-1, P-0)**

CRYPTOGRAPHY AND NETWORK SECURITY

Questions to be set: 05 (All Compulsory)

Course Objectives: This course provides an overview of computer security principles ranging from cryptography tonetwork security. The course will help to learn the principles and practices of computer security in various computing environments. The goal of the course is to provide students with the necessary foundations to apply cryptograph analysis techniques in new and emerging fields.

Pre-requisites: Computer Networks and Number theory.

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

1. Define mathematical modelling of a Security services to address modern security issues andchallenges.
2. Demonstrate and an ability to formulate a solution plan and methodology for security ininformation systems using Cryptography.
3. Analyze diverse set of alternative design solutions to meet the basic requirements and goals of asecurity system.
4. Recognize technical issues for existing security principles and network applications consistentwith their level of knowledge and understanding.
5. Develop solutions for existing security principles and network applications.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction	in class	Introduction: Attacks, Services and mechanisms, Security attacks, Security services	6	1,2		
	****Assignment Topics**					
Module 2: Cryptography I	in class	A model of internetwork conventional encryption model, Classical encryption technique, Simplified DES, Block cipher principles, The Data Encryption Standard, The strength of DES, Differential and linear cryptanalysis algorithms, Triple DES, Confidentiality using conventional encryption, Random number generation.	8	2,3		
	****Assignment Topics**	Steganography, International data encryption algorithms, Blowfish, Placement of encryption function, Traffic confidentiality, Key distribution.				
Module 3: Cryptography II	In Class	Public key cryptography: Principles of Public key cryptography, The RSA algorithm, Key management, Hellman key exchange, Number theory: Prime and relatively prime numbers, Modular arithmetic, Fermat's and Euler's theorems, Message authentication and Hash functions, Authentication requirements, Authentication functions, Message authentication codes, MD5 message digest algorithm.	9	2,3		
	****Assignment Topics**	Testing for primality, Digital signatures, Digital signature standard.				



Module 4: Network Security- I	in class	Authentication applications, Kerberos, Electronic mail security, Pretty good privacy, IP security, IP security overview, IP security architecture, Authentication header, Encapsulation security.	9	4,5		
	****Assignment Topics**	X.509 directory authentication service, S/MIME, Payload, Combining security associations, Key management.				
Module 5: Network Security – II	in class	Web security, Web security requirements, Secure socket and transport layer security, Intruders, Intruders, Firewalls, Firewall design principles.	9	4,5		
	****Assignment Topics**	Secure electronic transaction, Viruses, and related threats, Trusted systems.				

Text Books:

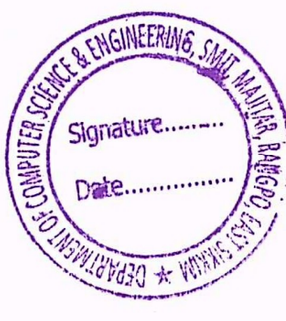
1. William Stallings, "Cryptography and Network Security", Pearson, 6th Edition.
2. Behrouz A Frouzan, "Cryptography and Network Security", Tata McGraw Hill, 2nd Edition.

Reference Books:

1. Richard E. Smith, "Internet Cryptography", Pearson, 1st Edition.
2. D. Chapman and E. Zwicky, "Bulding Internet Firewalls", O'Reilly, 2nd Edition.
3. Derek Atkins et al., "Internet Security, Professional Reference", Techmedia, 2nd Edition.

AtulKahate, "Cryptography and Network Security", McGraw Hill, 2nd Edition





Sub Code: CS312A3 **Credit: 4(L-3, T-1, P-0)**

COMPUTATIONAL NUMBER THEORY

Questions to be set: 05 (All Compulsory)

Course Objectives: To give students a detailed description of the main modern algorithms in computational number theory. To implement all the algorithms and methods introduced in the course on acomputer using a computer algebra system

Pre-requisites: Knowledge of discrete mathematical structures (groups, rings, fields), algorithms (design and analysis techniques), and probability.

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

1. Explain the different concepts in divisibility and modular arithmetic.
2. Develop various algorithms for polynomials
3. Acquire a fundamental understanding of computational models related to elliptic curves and Integer factoring algorithms.
4. Analyze the various methods to compute discrete logarithms.
5. Analyze the various methods to compute integer factoring algorithms.

** **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 for integer arithmetic &Representation of finite fields >	in class	Montgomery arithmetic, congruence, Chinese remainder theorem, Hensel lifting, orders and primitive roots, quadratic residues, integer and modular square roots, prime number theorem, continued fractions and rational approximations. Prime and extension fields, representation of extension fields, polynomial basis, primitive elements, normal basis, optimal normal basis, irreducible polynomials.	12	1		
	**Assignment Topics	Divisibility, gcd, modular arithmetic, modular exponentiation.		1		
Module 2: < Algorithms for polynomials >	in class	Root-finding and factorization, Lenstra-Lenstra-Lovasz algorithm.	8	5		
	**Assignment Topics	Polynomials over finite fields		5		
Module 3: <Elliptic curves >	in class	The elliptic curve group, elliptic curves over finite fields, Schoof's point counting algorithm. Primality testing algorithms: Fermat test, Miller-Rabin test, Solovay-Strassen test.	6	3		
	**Assignment Topics	AKS test.		3		
Module 4:	in class	Trial division, Pollard rho method, p-1 method, CFRAC method, quadratic sieve method.	6	4		

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<Integer factoring algorithms >	**Assignment Topics	Elliptic curve method.		4		
Module 5: <Computing discrete logarithms over finite fields >	in class	Baby-step-giant-step method, Pollard rhomethod, Pohlig-Hellman method, index calculus methods, linear sieve method, Coppersmith's algorithm.	8	2,5		
	**Assignment Topics	Applications: Algebraic coding theory, cryptography.		2		

Text Books:

1. V. Shoup, A computational introduction to number theory and algebra, Cambridge University Press.
2. M. Mignotte, Mathematics for computer algebra, Springer-Verlag.
3. Niven, H. S. Zuckerman and H. L. Montgomery, An introduction to the theory of numbers, John Wiley.

Reference Books:

1. J. von zur Gathen and J. Gerhard, Modern computer algebra, Cambridge University Press.
2. R. Lidl and H. Niederreiter, Introduction to finite fields and their applications, Cambridge University Press.
3. J. Menezes, editor, Applications of finite fields, Kluwer Academic Publishers.

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Sub Code: CS313A3 **Credit: 4(L-3, T-1, P-0)**

FAULT TOLERANT COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: The purpose of the course is to solve and understand dependability problems; the need to design computer systems which are reliable, available and safe. Dependability concerns are integral partsof engineering design. The term dependability encompasses the concepts of reliability, availability, safety, security, maintainability testability. Implementation of Fault Tolerance Designs through Redundancy is oneway to improve the dependability parameters of the system.

Pre-requisites: Basic computer architecture

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

1. Manipulate different concepts in fault tolerant computing.
2. Correlate the basic knowledge of fault tolerant computing with real time situations.
3. Decide on the applicability of such tools during safety critical cases.
4. Select an appropriate tool for testability, controllability and observability.
5. Select an appropriate algorithm for resilience and self- checking

** **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	Background of testing, fault tolerant computing and dependable computing, Dependability Attributes, Review of fundamental dependability and security theory, basic Concepts of Reliability, Faults in Digital Circuits, The calculation of reliability, MTTF, MTBF, MTTR, Availability, Multi-state systems	8	1		
	**Assignment Topics	Decision Diagrams				
Module 2: < Fault Tolerant Design of Digital Systems>	in class	Introduction to Fault Tolerant Design of Digital Systems: Fault Tolerance, Static redundancy, Dynamic redundancy, Fault tolerant design of Memory systems, Practical Fault Tolerant Systems: FTMP, ESS, COMTRAC	12	1,2		
	**Assignment Topics					
Module 3: < Self-checking>	in class	Self-checking and fail-safe logic, Replication and voting. Redundant Disk Arrays, Degradation Allowance, management	8	2,3		
	**Assignment Topics					
Module 4:	in class	Resilient Algorithms, Software Redundancy	4	4,5		

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< Resilience>	**Assignment Topics	Case study of Software Redundancy				
Module 5: < Design for Testability>	in class	Testability, Controllability and Observability, Design of testable Combinational Logic Circuits, Testable design of Sequential Circuits, The scan path technique, Designing testability into logic boards	8	5		
	**Assignment Topics	Case studies of fault tolerant multiprocessor and distributed system				

Text Books:

1. Fault Tolerant and Fault Testable Hardware Design, Parag K. Lala, PHI, 1985

Reference:

1. Fault Tolerant Computing Theory and Techniques-Volume I, D.K. Pradhan, PHI, 1986
2. Testing of Digital Systems, Niraj Jha and Sandeep Gupta, Cambridge University Press, 2003

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Sub Code: CS315A3 **Credit: 4(L-3, T-1, P-0)**

ADVANCED ALGORITHMS

Questions to be set: 05 (All Compulsory)

Course Objectives: Algorithm design and analysis is a fundamental and important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms and explores a variety of applications.

Pre-requisites: Design and Analysis of Algorithms and Probability& Statistics.

Course Outcomes (CO): On successful completion of this course, students will be able to:
1. Formulate and solve recurrence relations for asymptotic analysis.
2. Compute order statistics for algorithms.
3. Solve computational problems using advance algorithmic paradigms
4. Compute space and time complexities using amortised analysis.
5. Identify problem hardness classes.

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 1: Overview	In Class	Time complexity, Asymptotic Analysis, Solving Recurrence, Divide & Conquer, Quick Sort, Heap Sort	8	1		
	****Assignment Topics**					
Module 2: < Advance Sorting >	In Class	Linear Time Sorting-order statistics, Binary Search Tree Sort, Hash Function, Red Black Trees	9	2		
	****Assignment Topics**					
Module 3: Problem Solving Strategies	In Class	Dynamic Programming, Bellman Ford, Johnson algorithm, String-Matching algorithm	7	3		
	****Assignment Topics**					
Module 4: < Problem Analysis >	in class	Amortized Analysis, Disjoint set data structure.	7	3,4		
	****Assignment Topics**					

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Module 5: < Theory of NP-Hard and NP-Complete Problems >	in class	Network flow, P, NP-Hard and NP-Complete complexity		4,5		
	**Assignment Topics					

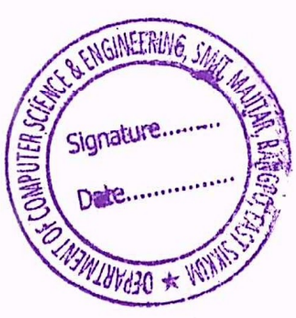
Text Books:

1. Introduction to Algorithms : T.H. Cormen, C.E.Leiserson and R.L. Rivest
2. Fundamentals of Algorithmics : G.Brassard and P.Bratley

Reference Books:

2. Approximation Algorithms: Vijay V.Vazirani
3. Randomized Algorithms: R. Motwani and P.Raghavan
4. Reference book: Algorithmics :The spirit of computing: D.Harel





Sub Code: CS316A3 **Credit: 4(L-3, T-1, P-0)**

ARTIFICIAL NEURAL NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objective: The objective of this paper is to give the students an in-depth understanding of Artificial Neural Networks (ANN). Different models of ANN with their functionalities, architecture and algorithms are covered. The learner is exposed to ANN concepts from ground up, gradually moving to theoretical and mathematical proofs with applications.

Prerequisites: Linear algebra, Multivariate calculus, Basic notions of statistics.

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

1. Visualize sufficient understanding of mathematical and engineering fundamentals in the perspective of Artificial neural network theory.
2. Name Artificial Neural network suitable for a complex problem.
3. Estimate the importance of tolerance of imprecision and uncertainty for design of robust and low-cost intelligent machines.
4. Identify technical issues of a problem and solve the problems using various Artificial neural network.
5. Design real-life application using various neural network algorithm.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Basic Concepts	in class	What is a Neural Network, Biological Neuron, Artificial Neuron, Human Brain, Feedback and Feedforward, Network Architectures, Knowledge Representation, Learning Process, Learning Task, Uses of Neural Networks, Perceptron, Perceptron Convergence Theorem, Rosenblatt Model, McCulloch Pitts Model, Pattern based Computation, Classification, Association, Linear Regression - Pattern Classification, AND, OR, XOR Problem, Activation Functions, Identity, Step, Sigmoid, Hyperbolic Tangent.	7	1		
	****Assignment Topics**					
Module 2: Pattern Classifiers	in class	Hebb Nets: Architecture, Algorithm, Perceptron: Architecture, Algorithm, Application, Perceptron Convergence Theorem – Revisit, ADALINE, Architecture, Algorithm, Application, Derivations, MADALINE, Architecture, Algorithm.	9	2		
	****Assignment Topics**					
Module 3:	In	Training Algorithms: Hebb Rule for Association, Delta Rule, Hetero-associative Networks:	8	3		

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Pattern Associators	Class	Architecture, Algorithm,Auto-associative Networks: Architecture, Algorithm, Training, Application, Elimination of Self-connection, Recognition of Noisy Patterns, Storage, Iterative Auto associative Net: Recurrent Linear Auto associator, Brain-State-in-a-Box, Auto associator with Threshold Function, Hopfield Networks, Bidirectional Associative Memory: Architecture, Algorithm, Application, Analysis.				
	****Assignment Topics**					
Module 4: Competitive Neural Networks	in class	MAXNET: Training, Application, Kohonen's Self Organizing Map: Architecture, Algorithm, Application, Learning Vector Quantization: Architecture, Algorithm, Application, Adaptive Resonance Theory: Stability-Plasticity, Basic Architecture, Basic Operation, ART1: Architecture, Algorithm, Application, ART2: Architecture, Algorithm, Application.	9	3,4		
	****Assignment Topics**					
Module 5: Backpropagation	in class	Multi-layered Feedforward Networks, Architecture, Generalized Delta Rule, Algorithm: Parameters Choice, Applications	7	4,5		
	****Assignment Topics**					

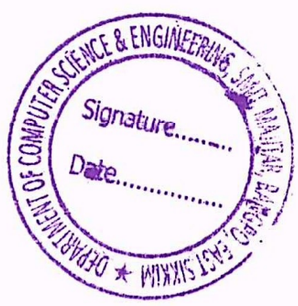
Text Books:

1. Fundamentals of Neural Networks – Architectures, Algorithms and Applications – Laurene Fausett, Pearson
2. Introduction to Soft Computing, Neuro-Fuzzy and Genetic Algorithms – Samir Roy, Udit Chakraborty, Pearson

Reference Books:

1. Neural Networks and Learning Machines – Simon Haykin, Pearson
2. Neuro-Fuzzy & Soft Computing – J.-S. R. Jang, C. -T. Sun, E. MizutaniPearson





Sub Code: CS317A3 **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 applicatio
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 Phi programming.

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**	**<u>High performance clusters</u>**				
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		

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	**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-Hill Higher Education.
2. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar,"Introduction to Parallel Computing", Pearson Education India.
3. V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers – Architecture and Programming", Prentice-Hall of India, 2003.

Reference Books:

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

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Sub Code: CS318A3 **Credit:4(L-3, T-1, P-0)**

PARALLEL AND DISTRIBUTED ALGORITHMS

Questions to be set: 05 (All Compulsory)

Course Objectives: To provide you with an introduction and overview to the computational aspects of paralle and distributed computing. To introduce several important parallel computing models that capture the essence of existing and proposed types of synchronous and asynchronous parallel computers. To study typical models for distributed computing. To study a few typical algorithms for each model, selected from various basic areas such as sorting, selection, graphs, matrices, numerical problems, and computational geometry. To provide an important skill for those who may work with large applications since these usuallymust be implemented on a parallel or distributed system, due to their memory space and speed requirements

Pre-requisites: Multiprocessor systems, Design and Analysis of Algorithms, Parallel Computing.

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

1. Discuss about in-depth discourse on how to think about algorithms in a parallelized manner.
2. Select algorithms suitable for conventional, single-processor computers are not appropriate for parallel architectures.
3. Compare inherent parallel algorithms with their counterparts.
4. Justify the choice of parallel algorithms to accomplish a task.
5. Illustrate the process of synchronization.

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

Module	Topics to be Covered	Topics	Hrs	CO	PO	PSO
Module 1: <The Idea of Parallelism & PRAM Algorithms >	in class	A Parallelised version of the Sieve of Eratosthenes, PRAM Model of Parallel Computation, Pointer Jumping and Divide & Conquer: Useful Techniques for Parallelization. Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging Two Sorted Lists, Graph Coloring, Reducing the Number of Processors and Brent's Theorem	12	1,2		
	****Assignment Topics**					
Module 2: <Dichotomoy of Parallel Computing Platforms>	in class	Cost of Communication, Programmer's view of modern multi-core processors, The role of compilers and writing efficient serial programs, Parallel Programming Languages: Shared Memory Parallel Programming using OpenMP, Parallel Complexity: The P-Complete Class	8	3		
	****Assignment Topics**					
Module 3: <Scheduling>	in class	Mapping and Scheduling, Elementary Parallel Algorithms, Matrix Multiplication, Writing efficient openMP programs, Sorting	6	3,4		





	**Assignment Topics					
Module 4: <Dictionary Operations >	in class	Parallel Search, Graph Algorithms, Safety, liveness, termination, logical time and event ordering	6	3,4		
	**Assignment Topics					
Module 5: <Algorithms and Synchronization>	in class	Global state and snapshot algorithms, Mutual exclusion and Clock Synchronization, Distributed Graph algorithms, Distributed Memory Parallel Programming: Cover MPI programming basics with simple programs and most useful directives; Demonstrate Parallel Monte Carlo	8	5		
	**Assignment Topics					

Text Books:

1. Michael J Quinn, Parallel Computing, TMH 2. Joseph Jaja, An Introduction to Parallel Algorithms, Addison Wesley.

Reference Books:

1. Mukesh Singhal and Niranjan G. Shivaratri, Advanced Concepts in Operating Systems, TMH

2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, Pearson

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Sub Code: CS319A3 **Credit:4 (L-3, T-1, P-0)**

INTERNET, TECHNOLOGY AND SOCIETY

Questions to be set: 05 (All Compulsory)

Course Objectives: The primary objective of this course is to develop an understanding of the impact createdb technology and internet on the modern society. It also emphasizes on the ways to cope-up with the negativ impacts.

Pre-requisites: NIL

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

1. Describe while identifying the impact of technology and internet on the modern society
2. Interpret software freedom principles and free/open-source licensing system
3. Identify ethical issues related to surveillance system, digital divide and identify data privacy concerns
4. Prioritize privacy concerns by applying free & open-source software solutions
5. Recognize the impact of engineering and industrial practices on social contexts.

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PS
Module 1: <Introduction, Information & Society>	in class	Introduction, History of Internet, Perspectives on the relations between technology, internet and society,The impact of technology and internet on society, Technological determinism, social determinism. Theories of Information Society, The Geography of internet and the digital divide, Issues affecting digital divide, Digital Inequality, Access to Knowledge, Technology Accessibility, Net neutrality, Uses and Gratification Theory, Cultural Cognition Theory.	9	1,3		
	**Assignment Topics					
Module 2: <Technology, Economy & Society>	in class	Attention Economy, Pros and cons of attention economy, Case Study: Social media, e-commerce and messaging systems, Growing up digital, Digital childhood and adolescence, Trust, credibility & reputation in social systems, Social isolation, Automation in workplace, Technology & income inequality.	7	1,5		
	**Assignment Topics					
Module 3: < Privacy and Surveillance>	in class	Data Privacy, Data Breach, Privacy, work and family, Case Study: Facebook Analytica, The fundamental right to privacy, Privacy and Data Protection in India, Surveillance, Mass Surveillance, Case Study: PRISM, Software as a service and its privacy implications, Security - Encryption, Signing & Web Security,	8	1,3		

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		Phishing in social media, Identifying fraudulent entities.				
	****Assignment Topics**					
Module 4: < Software Freedom & Licenses>	in class	Code is Law, The regulation of code, Software ethics, Proprietary software, Digital Restrictions Management, Free Software Movement, Free/Libre software vs Open source software, Four essential software freedom, Secure Boot vs. Restricted Boot, Free JavaScript, GNU OS, Free BIOS Campaign. Intellectual Property Rights, Software Patents, Copyright vs. Copyleft, Creative Commons, EULA, Free and Open source licenses, GNU Licenses.	8	2,3		
	****Assignment Topics**					
Module 5: < Protecting our privacy and freedom & Conclusion>	in class	Free/libre OS, Free/libre software alternatives, Protecting privacy on internet, Protecting privacy on mobile phone, Email self defence, Free Android, Freedom Campaigns. The future of internet and technology: cultural and technical perspective.	8	2,4		
	****Assignment Topics**					

Text Books:

1. Anabel Quan-Haase, "Technology and Society: Social Networks, Work, and Inequality", Oxford University Press.
2. Lawrence Lessig, "Code version 2.0", Basic Books.

Reference Books:

1. The Center for Internet & Society: https://cis-india.org/
2. Free Software Foundation: https://www.fsf.org/

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Sub Code: CS320A3 **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 layeredhigh-level representations of data in a way that maximizes performance on a given task.

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

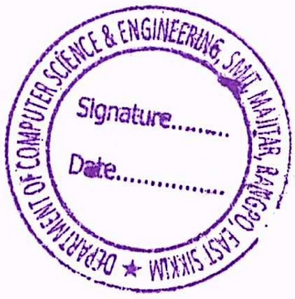
Course Outcomes: Upon successful completion of the course, the students are expected to be able to:

1. Describe deep learning techniques and computing environment that are suitable for the applications under 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 of knowledge and understanding.
4. Develop a set of alternative design solutions to problems for which standard algorithmic solutions do not exist.
5. Apply Deep Learning techniques to solve real-life problems which directly or indirectly benefits to the society.

**** 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, unsupervised features, 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:

2. Ian Goodfellow, Yoshua Bengio, Aaron Courville. "Deep Learning".
3. Duda, R.O., Hart, P.E., and Stork, D.G. "Pattern Classification". Wiley-Interscience. 2nd Edition, 2001.
4. 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.

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Sub Code: CS321A3 **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 students with 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**					

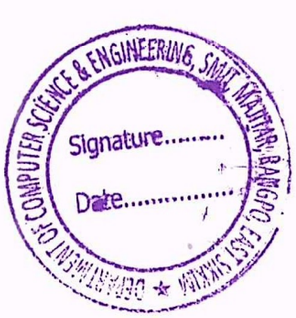
Text Books:

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

Reference Books:

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





Sub Code: CS322A3 **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 inone 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:

6. Define the concepts and recognize the characteristics of a real-time system.
7. Identify and implement important software engineering principles for real-time systemdevelopment.
8. Produce an architectural design of a real-time system.
9. Evaluate the real-time systems in appropriate terminology and the real-time characteristics of agiven system to assist in deciding which software or kernel is appropriate for a problem.
10. 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 Acquisition >	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 scanners and thermal scanners – geometric characteristics of scanner imagery – calibration of	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 remote sensing: >	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:

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

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Sub Code: CS323A3

Credit: 4(L-3, T-1, P-0)

ETHICAL HACKING

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 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		

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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		

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		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 Penetration Testing Made Easy", Syngress Media, Second Revised Edition, 2013.

Reference Books:

2. Michael T. Simpson, Kent Backman, James E. Corley, "Hands On Ethical Hacking and Network Defense", Cengage Learning, 2012.

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Sub Code: CS324A3 **Credit: 4(L-3, T-1, P-0)**

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-hoc wireless 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 of wireless ad-hoc/sensor networks.
3. Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks.
4. Explain the challenges in designing routing and transport protocols for wireless Ad- hoc/sensor networks.
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		

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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				

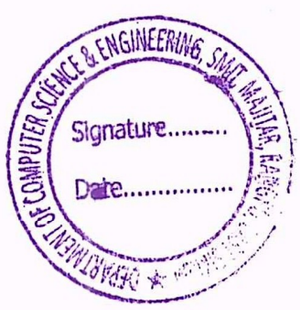
Text Books:

1. C. Siva Ram Murthy, B.S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols",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 Technologyand Protocols",Springer.





Sub Code: CS325A3 **Credit: 4(L-3, T-1, P-0)**

MOBILE COMPUTING

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 and latest 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 with skills to:

1. Examine fundamentals of wireless communications.
2. Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless 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 and current 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 GPRS applications, limitations.	8	2		
	****Assignment Topics**					
Module 3:	In	CDMA, EDGE, UMTS, UTRAN, OFDM, HSPA,	7			

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< Cellular Technology >	Class	LTE, Wi-Max, mobile satellite communication.				
	**Assignment Topics					
Module 4: < Data Dissemination and Data Synchronization in 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., New Delhi, 2005.

Reference Books:

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

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Sub Code: CS326A3 **Credit: 4(L-3, T-1, P-0)**

DISTRIBUTED DATABASE SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course envisages the principles of distributed database systems including design and architecture, security, integrity, query processing and optimization, transaction management,concurrency control, and fault tolerance. Fundamental issues in distributed database systems that aremotivated by the computer networking and distribution of processors and databases will also be addressed.

Pre-requisites: Database Management System, Computer Network and Distributed Systems.

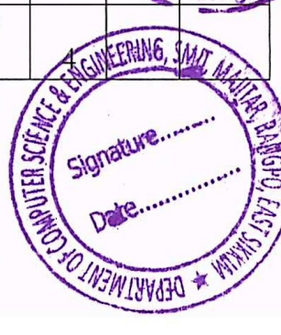
Course Outcomes: On completion of the course it is expected to endow the students with skills to

1. Describe the various range of data models, database architectures and features supported by different database management systems.
2. Compare the procedural and non-procedural languages and use them where appropriate to process data.
3. Evaluate various types of client-side interfaces to databases using selected modern tools appropriate for the task.
4. Discuss issues underpinning distributed database administration, security and performance.
5. Define and manipulate distributed database data using Structured Query Language(SQL).

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Distributed Database Architecture	in class	Distributed data processing, what is Distributed Database System (DDBS), resembling setups which are not DDBS, examples of DDBS's, Promises of DDBs, DBMS Standardization, DDBS reference model, Architectural Model – Client Server Architecture and its variants, Multi-database model (MDBMs) Architecture.	7	1		
	****Assignment Topics**	**Case studies such as airline/railway reservation system, banking sector, e-commerce etc.**				
Module 2: Distributed Database Design	in class	Design Strategies, Distribution Design Issues, Fragmentation – Primary Horizontal fragmentation (PHF) Derived Horizontal Fragmentation (DHF), Vertical Fragmentation, Mixed/Hybrid Fragmentation,	8	2		
	****Assignment Topics**	**Acces Frequencies and patterns, Replication and Allocation – concepts and strategies.**				
Module 3: Overview of Query Processing and Transaction Management	in class	Query processing Problem, Objectives, Distributed query processing operators, Characterization of Query Processor, and Layers of Query Processing.	8	5		
	****Assignment Topics**	**Complexities of Relation Algebra Operators, Definition of Transaction, Properties, Types (Flat Tx's, Nested Tx's, and Workflows), Architectures.**				
Module 4:	in class	Serializability Theory, Taxonomy, Locking Based Algorithm, Timestamp Based Algorithm,	9	4		





Distributed Concurrency Control and Distributed DBMS Reliability		Optimistic Concurrency Control algorithm, Reliability Concepts, Failures and Fault Tolerance Concepts, Failures in DDBMs, Local reliability Protocol, Distributed Reliability Protocols.				
	****Assignment Topics**	**Deadlock Management**, , **Dealing with site failures, Network Partitioning.**				
Module 5: Object Database Management Systems and Current Issues	in class	Object Distribution Design, Object Management Push-Based technology, Mobile Databases	8	3		
	****Assignment Topics**	**Fundamental Object Concepts**, , **soft computing applications in distributed database system design.**				

Text Books:

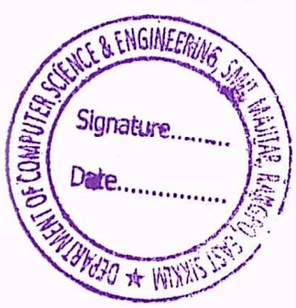
1. M. Tamer Oezsu, Patrick Valduriez "Principles of Distributed Database Systems", Prentice Hall
2. Bell and J. Grimson, "Distributed Database Systems", Addison-Wesley.

Reference Books:

1. Coulouris, Dollimore and Kindberg, "Distributed Systems: Concepts and Designs",Addisson-Wesley
2. Ceri, Pellagati, "Distributed Database Systems", McGraw Hill
3. M. Stonebraker, "Readings in Database Systems", San Mateo, California: MorganKaufmann.

y, "Distributed Database Systems", Pearson.





Sub Code: CS327A3 **Credit: 4(L-3, T-1, P-0)**

COMPUTATIONAL GEOMETRY

Questions to be set: 05 (All Compulsory)

Course Objectives: Detailed knowledge of the fundamental problems within computation geometry and general techniques for solving problems within computational geometry and practical experience with implementation issues involved in converting computation geometry algorithms into running programs

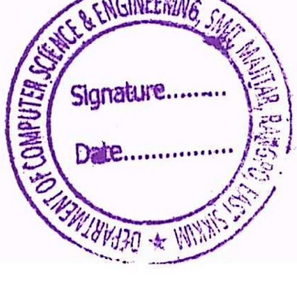
Pre-requisites: Advanced Algorithms, a basic course in probability, Experience doing mathematicalproofs.

Course Outcomes(CO): On successful completion of this course, students will be able to:
1. Describe the divide-and-conquer paradigm and the scenario when it should be employed.
2. Construct algorithms related to computational geometry.
3. Analyze various algorithms based on certain underlying parameters.
4. Evaluate various computational geometry problems
5. Apply computational geometry in solving real world 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: <Introduction>	in class	Algorithmic Background, Data Structures, Geometric Preliminaries, Models of Computation. Geometry Searching, Point-Location Problems, Range-Searching Problems	12	1		
	****Assignment Topics**					
Module 2: <Convex Hulls>	in class	Preliminaries, Problem Statement and Lower Bounds, Convex Hull Algorithms in the Plane, Graham's Scan, Jarvis's March, QUICKHULL techniques, Dynamic Convex Hull, Convex Hull in 3D	12	2		
	****Assignment Topics**					
Module 3: <Proximity Problem >	in class	A Collection of Problems, A Computational Prototype: The Closest- Pair Problem: A Divide-and-Conquer Approach, The Voronoi Diagram, Proximity Problems Solved by the Voronoi Diagram	7	2,3		
	****Assignment Topics**	Element Uniqueness, Lower Bounds				
Module 4: < Triangulation >	in class	Planar Triangulations, Greedy Triangulations, Partitioning a Polygon into Monotone Pieces, Triangulating a Monotone Polygon, Delaunay Triangulation	7	3,4		





	**Assignment Topics					
Module 5: < Intersections>	in class	Application Areas, Planar Applications: Intersection of Convex Polygons, Star-shaped Polygons; Intersection of Line Segments, 3D Applications: Intersection of 3D Convex Polyhedra; Intersection of Half-spaces	6	5		
	**Assignment Topics					

Textbooks:

1. Computational Geometry: An Introduction, F. P. Preparata and M.I. Shamos, Springer-Verlag, 1985.

2. Computational Geometry: Algorithms and Applications, M. de Berg, M. van Kreveld, M. Overmars, O. Schwarzkopf, Springer-Verlag, Revised Second Edition, 2000.

Reference Books:

1. **Joseph O'Rourke, Computational Geometry in C, Cambridge University Press, 2nd Edition,1998**

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Sub Code: CS328A3 **Credit: 4(L-3, T-1, P-0)**

ADVANCED COMPUTER NETWORKS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course emphasizes on several computer network concepts, applications and protocolsin 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 Technique and Data Communication.

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

1. Understand and discover the engineering fundamentals involved in Computer Network and other related frame work
2. Identify the complex engineering problem relating computer network relating to host Identification data delivery and routing.
3. Ability to formulate a solution plan and methodology for an engineering problem concerning Network Security
4. Ability to formulate and interpret a model based on the Computer Networks and its related framework.
5. Understand and explain basic responsibilities/concept of protocols in protocol present stack, DNS, SDN and Distributed System

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: < Network layer 6>	in class	IPv6 packets and addressing, Internet Control Message Protocol (ICMP), Internet Group Message Protocol (IGMP), Mapping Physical to Logical Address: Reverse Address Resolution Protocol (RARP) Bootstrap Protocol (BOOTP), Dynamic Host Configuration Protocol (DHCP)	9	1,5		
	****Assignment Topics**					
Module 2: < Software Defined Network>	in class	History and evolution of Software Defined Network, Control and data plane separation, Control Plane, Network Virtualization, Data Plane, Open Flow.	9	1,2		
	****Assignment Topics**					
Module 3: < Application>	in class	. Brief overview of protocols in Application Layer:Domain Name Systems, Hyper Text TransmissionProtocol, TELecomunications NETwork (TELNET),File Transfer Protocol, Dynamic Host ConfigurationProtocol. Email: Architecture and services	9	2,4		





	**Assignment Topics	Stream Control Transmission Protocol (SCTP)				
Module 4: < Network security 8>	in class	.Principles, Symmetric and Asymmetric Cryptography, Confidentiality, Authenticity, Integrity and Non-repudiation. Symmetric key algorithms: Data Encryption Standard (DES), Public key algo: Rivest Shamir and Adleman algorithm (RSA), Key Exchange Algorithm	8	1,5		
	**Assignment Topics	AES				
Module 5: < Fundamentals of Distributed Systems 8>	in class	Introduction and challenges of Distributed Systems, Systems models, Logical time and logical clocks, Global states, External Data Representation and Marshalling, Request-Reply protocols, Remote Procedure Call.	5	1,4		
	**Assignment Topics	Remote Method Invocation				

Text Books:

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

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

3. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design",Pearson

4. Pradeep K. Sinha, "Distributed Operating Systems", PHI.

Reference Books:

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

2. Alberto Leon-Garcia, Indra Widjaja, "Communication Networks – Fundamental Concepts and KeyArchitectures", Tata McGraw-Hill

3. Kurose Ross, "Computer Networks – A Top-Down Approach featuring the Internet", Pearson.

4. Thomas Nadeau and Ken Gray "SDN – Software Defined Networks"- O'Reilly Media

5. Patricia A Morreale and James M. Anderson, "Software Defined Networking: Design and Deployment"- CRC Press.

6. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced Concepts in Operating System", McGraw Hill.

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Sub Code: CS329A3 **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 withskills to:

1. Identify methods to solve ML problems.
2. Design pattern recognition program systems using approaches of these theories for solving various real-world problems.
3. Identify importance of tolerance of imprecision and uncertainty for design of robust and low-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		

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	**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 UniversityPress, 2003.

Reference Books:

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

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Sub Code: CS330A3 **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 networkingprotocols 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**					





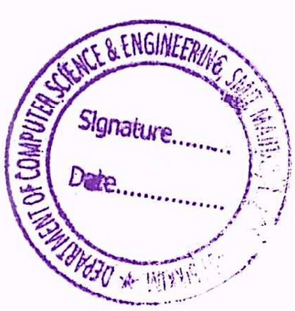
Text Books:

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





CS331A3 **Credit: 4(L-3, T-1, P-0)**

QUEUING THEORY AND MODELING

Questions to be set: 05 (All Compulsory)

Course Objectives: The course focusses on modeling and finding solution of different queuing models that appear many branches of engineering sciences. The course equips the students with sophisticated mathematical tools to analyze and model various problems in this area.

Pre-requisites: Linear Algebra, Probability, Stochastic Processes, Numerical Analysis

Course Outcomes: The students will be able to:

1. Analyze different continuous time models
2. Identify different distribution to apply to queueing theory
3. Solve different generalized models
4. Understand different networks, model them in queuing notations.
5. Tackle the error, obtain the bounds by numerical techniques and compare with analytical solutions.

Module	Topics	Hrs	COs	PO	PSO
Module 1:	Introduction to Queues and Queuing Theory, Stochastic Processes, Markov Processes and Markov Chains, Birth-Death Process. Basic Queueing Theory ((M/M/-/- Type Queues), M/M/1 Model: Steady state solution, M/M/1/N Queuing system, Queues with Bulk Arrivals.	8	1		
Module 2:	Queue with parallel Channels (M/M/c), Erlang Formula Steady state formula, Derivation and problems. M/M/c/K Queue.	8	2		
Module 3:	Equilibrium Analysis of the M/G/1 Queue, Analyzing the M/G/1 Queue using the Method of Supplementary Variables, M/G/1 with Vacations, M/[x]/G/1 Queue, Priority Operation of the M/G/1 Queue.	8	3		
Module 4:	Classification and Basic Concepts: Open Jackson Networks and closed Jackson Networks Type Queues, Jackson's Theorem, Analysis of closed Queueing Networks using Convolution and Mean Value Algorithms, Norton's Theorem for Closed Queueing Networks.	8	4		
Module 5:	Numerical Techniques, Bounds, Approximation, Discrete event Simulation.	8	5		

Text Books:

1. Donald Gross, James M. Thompson, John F. Shortle and Carl W. Harris, Fundamentals of Queueing Theory, Wiley 2008.
2. Medhi, Stochastic Models in Queuing Theory, Elsevier 2/e, 2003.

Reference Text:

1. Sanjay K. Bose, An Introduction to Queueing Systems, Springer 2002
2. U N Bhat, An Introduction to Queuing Theory, modeling and analysis, 2nd Ed, Birkhauser, 2015

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Sub Code: CS332A3 **Credit: 4(L-3, T-1, P-0)**

QUANTUM COMPUTING

Questions to be set: 05 (All Compulsory)

Course Objectives: Analyze the behavior of basic quantum algorithms

- Implement simple quantum algorithms and information channels in the quantum circuit model
- Simulate a simple quantum error-correcting code
- Prove basic facts about quantum information channel

Pre-requisites: Familiarity with linear algebra including concepts such as vector space, inner products,matrices, eigenvalues and eigenvectors will be assumed

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

1. Describe the fundamentals of quantum information processing.
2. Illustrate the fundamentals of quantum computation, quantum cryptography, and quantum information theory.
3. Device the quantum circuit model consisting of qubits, unitary operators, measurement, entanglement
4. Represent various implementations of Quantum computers.
5. Represent various applications of Quantum computers 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: < Quantum Cryptography>	in class	Introduction, Cryptography,introduction to quantum cryptography. BB84, B92 protocols. Introduction to security proofs for these protocols.	8	1		
	****Assignment Topics**	classical cryptography				
Module 2: < Quantum Algorithm >	in class	Introduction to quantum algorithms. Deutsch-Jozsa algorithm, Grover's quantum search algorithm, Simon's algorithm. Shor's quantum factorization algorithm	8	2		
	****Assignment Topics**					
Module 3: < Error Correction>	in class	Errors and correction for errors. Simple examples of error correcting codes in classical computation. Linear codes. Quantum error correction and simple examples.	8	3		
	****Assignment Topics**	Shor code.				
Module 4: < Quantum Entanglement>	in class	Quantum correlations, Bell's inequalities, EPR paradox. Theory of quantum entanglement. Entanglement of pure bipartite states. Entanglement	8	4		

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		of mixed states. Peres partial transpose criterion. NPT and PPT states, bound entanglement, entanglement witnesses.				
	****Assignment Topics**					
Module 5: <Implementations>	in class	Different implementations of quantum computers. NMR and ensemble quantum computing, Ion trap implementations. Optical implementations	8	5		
	****Assignment Topics**					

Text books:

1. **Quantum Computation and Quantum Information, M.A. Nielsen and I.L.Chuang, CambridgeUniversity Press 2000.**

Reference Books:

1. P. Kaye, R. Laflamme, and M. Mosca. An Introduction to Quantum Computing. Oxford, 2007.
2. M. A. Nielsen and I. L. Chuang. Quantum Computation and Quantum Information. Cambridge UniversityPress, 2000

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Sub Code: CS333A3 **Credit: 4(L-3, T-1, P-0)**

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, Response, Scanning, Security policy, Threat Management.	10	1		
	****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		

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		Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation				
	**Assignment Topics					
Module 3: Cryptography and Network Security	in class	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 of International 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-time	5	4,5		
	**Assignment Topics					

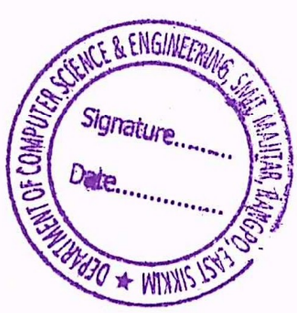
Text Books:

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: CS334A3 **Credit: 4(L-3, T-1, P-0)**

FUTURE INTERNET ARCHITECTURE

Questions to be set: 05 (All Compulsory)

Course Objectives: This course is an advanced networking course focusing on present and future Internet architecture and protocols. This course will introduce students to the basic design principles on which today's networks are based. In addition, this course will cover recent proposals to improve network performance, functionality and scalability.

Pre-requisites: Some background in computer networking

Course Outcomes(CO): On successful completion of this course, students will be able to:
1. Describe the basic concepts of networking.
2. Construct algorithms related to different backbone networks and Software Defined Networking (SDN)
3. Analyze various algorithms based on data centre networks and data centre virtualization
4. Evaluate various problems based on overlay networks
5. Evaluate various problems based on virtualization.

**** 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 of Computer Network Concepts & Modern Transport Protocols in the Internet >	in class	Device level connectivity, network protocol stack, OSI/ISO reference Model, basic TCP/IP protocol principles. Basics of TCP and its limitations SPDY and QUIC, Multipath TCP (MPTCP).	8	1		
	****Assignment Topics**					
Module 2: < Software Defined Networking (SDN)>	in class	History and Evolution of Software Defined Networking, Management issues in present network architecture Network Virtualization and evolution of SDN, SDN architecture - data plane vs control plane Examples of SDN controllers - OpenFlow architecture, SDN Programming	6	1,2		
	****Assignment Topics**					
Module 3: < Virtualization>	in class	Data Centre Networks, Data Center Virtualization, Hyperconvergence Architecture, Virtual Network managenemt and QoS, Replica Management and Geo-load balancing	5	3,5		
	****Assignment Topics**			3,5		

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Module 4: < Content Delivery Network (CDN)& Named Data Networking (NDN)>	in class	Web Caching, Proxy caches, Limitations of web caching, Content Distribution Network: Server Selection Policy, Server Selection Mechanism, and Case Study: How Akamai Works. Introduction, Challenges of Traditional Internet, Information Centric Network, Content-Centric Networks, Named Data Network: Content, Naming, Interest, Interest Forwarding, Data Retrieval, Security, Applications and challenges of NDN.	10	3,5		
	****Assignment Topics**					
Module 5: <Overlay Network>	in class	Introduction of overlay networks, Distributed Hash Tables (DHTs), Application of DHTs.	5	5		
	****Assignment Topics**					

Text Books:

1. Thomas D. Nadeau, Ken Gray "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", - O'Reilly Media

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

References:

1. Kurose Ross, "Computer Networks – A Top-Down Approach featuring the Internet", Pearson.

2. Patricia A Morreale and James M. Anderson"Software Defined Networking: Design and Deployment"-CRC Press.

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Sub Code: CS335A3 **Credit: 4(L-3, T-1, P-0)**

DISTRIBUTED SYSTEMS

Questions to be set: 05 (All Compulsory)

Course Objectives: This course is designed to present the concepts of heterogeneous multi-computer systems and distributed operating systems. Communication in a client/server model using RPC, Message oriented communications, remote object invocation, and distributed processes and software agents are discussed. Other distributed systems concepts such as clock synchronization, data consistency and replication, fault tolerance, security and distributed component and file systems are also covered.

Pre-requisites: Database Management Systems, Computer Networks – I, ComputerNetworks - II

Course Outcomes: Upon completion of the course it is expected to endow the students with skills to:

1. Observe the complexities of distributed system development.
2. Develop a strategy to overcome important issues including time, inter-process communication, and state management in distributed computing.
3. Construct systems in a constrained distributed environment by integrating several modules and validate the detailed design.
4. Illustrate the ability to apply the knowledge in analyzing and designing distributed systems.
5. Summarize the middleware technologies that support distributed applications such as RPC, RMI and object-based middleware.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Fundamentals and Time and global states	in class	Introduction to Distributed Systems, Evolution and applications of DCS, Challenges and examples of distributed systems, Distributed systems models: Architectural models and fundamental models. Logical time and event ordering, Global state and snapshot algorithms, clock synchronization.	10	1,3		
	****Assignment Topics**					
Module 2: Coordination and agreement	in class	Introduction, distributed mutual exclusion, distributed shared memory: General architecture, elections. Flat and nested distributed transactions, Atomic commit protocol, Distributed deadlocks and recovery.	6	2		
	****Assignment Topics**	Concurrency control in distributed transaction				
Module 3: Distributed transactions and Fault	in class	Flat and nested distributed transactions, Atomic commit protocol, Distributed deadlocks and recovery, Fault tolerance and recovery: Fault models, Fault tolerant services, reliable communication, Resource	8	2,4		

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olerance and oad balancing		sharing and load balancing.				
	**Assignment Topics					
Module 4: nter-process ommunication nd Remote nvocation	in class	API for the Internet protocols, external data representation and marshalling, Multicast communication Request-reply protocols, Remote procedure call, Remote method invocation,	9	5		
	**Assignment Topics	Indirect Communication: Publish-subscribe systems, Case study: Java RMI, CORBA RMI				
Module 5: Security and Authentication nd Distributed files systems	in class	Overview of security techniques, Digital signatures, Kerberos, Features of DFS, File service architecture,	7	5		
	**Assignment Topics	Case study: Sun Network File System, Andrew File System, Google file systems (GFS).				

ext Books:

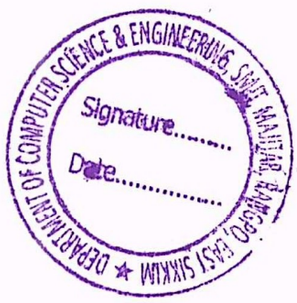
. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design",Pearson

. Andrew S. Tanenbaum, Maarten van Steen, "Distributed Systems: Principles andParadigms", Pearson

ference Books:

1. Pradeep K. Sinha, "Distributed Operating Systems", PHI.
2. Nancy A. Lynch, "Distributed Algorithms", Elsevier.
3. Kenneth P. Birman, "Reliable distributed systems: Technologies, Web services, and applications",Springer.
4. Paulo Veríssimo, Luis Rodrigues, "Distributed systems for system architects", Springer.





Sub Code: CS336A3 **Credit: 4(L-3, T-1, 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:

Demonstrate the knowledge and understanding of the basic ideas underlying optimization techniques.
Apply the mathematical approach to optimization problems relevant to engineering
Analyze the robustness of continuous linear optimization problems solutions using sensitivityanalysis.
Ability to understand and interpret the results and information provided by a particular method.
Compare the robustness of continuous linear optimization problems solutions using varioustechniques

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		

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	**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).

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Sub Code: CS337A3 **Credit: 4(L-3, T-1, P-0)**

ENGINEERING RESEARCH METHODOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: Objective: This course covers the various stages of research work in engineering sciences and highlights the importance, scope, functioning and procedures to be followed for successful research outcomes and its documentation and presentation. It also intends to give students the tools to conceptualize their theses in terms of research questions and design, methodology, data collection and qualitative as well as quantitative analysis.

Pre-requisites: NIL.

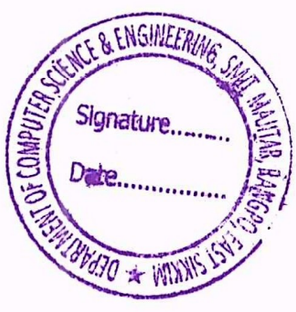
Course Outcomes: On successful completion of this course, students will be able to:

1. Apply appropriate procedure/algorithm, dataset and test cases and choose appropriate hardware/software tools to conduct the experiment.
2. Identify gaps in knowledge and a strategy to complete this gap enhancing knowledge.
3. Select discipline-specific tools, techniques and resources based on strengths and limitations of tools and techniques.
4. Create/develop comprehend technical literature and document project work to produce well formulated written document for supporting logical progression of ideas.
5. Analyze the experimental data and ethical issues.

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

Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
odule 1: Research ethodology and terature Survey >	in class	Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India,Benefits to the society in general. Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique Involved in Defining a Problem. Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet Literature Review.	7	1,2		
	****Assignment Topics**	**Need of Review, Guidelines for Review, Record of Research Review.**				
odule 2: Research Design d Statistical Data nalysis >	in class	Meaning of Research Design, Need of Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Developing a Research Plan, Design of	6	2,3		





		Experimental Set-up, Use of Standards and Codes Sample Design and Sampling. Role of Statistics for Data Analysis. Functions of Statistics, Estimates of Population. Parameters. Parametric V/s Non Parametric methods. Descriptive Statistics, Points of Central tendency, Measures of Variability, Measures of relationship. Inferential Statistics- Estimation, Hypothesis Testing. Use of Statistical software. Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.				
	****Assignment Topics**	**Exploration of the data. Description and Analysis of Data. Different Research Designs, Basic principles of Experimental Designs.**				
Module 3: < Research Report Writing >	in class	Format of the Research report. Style of writing report.	7	3		
	****Assignment Topics**	**Reference Books / Bibliography / Webliography, Technical paper writing /Journal report writing.**				
Module 4: < Research Proposal preparation>	in class	Writing a Research Proposal and Research Report, Writing a Research Grant Proposal.	10	4		
	****Assignment Topics**					
Module 5: < Grammar and Editing >	in class	MS Style Guides & Proof Reading, Introduction of Latex style and documentation, MLA referencing style, contextual correctness of technical writing, Achieving clarity in technical communication.	10	5		
	****Assignment Topics**	**English Grammar, Punctuation and Mechanics,**				

Text Books:

1. Barrett, Terry. Why is that Art? Oxford University Press, 2007. ISBN: 0195167422
2. Barrett, Terry. Criticizing Art, 2d ed. McGraw Hill, 2001. ISBN: 7115034X
3. Barrett, Terry. Interpreting Art. McGraw-Hill, 2002. ISBN: 0767416481
4. Farris-Dufrene, Phoebe. Voices of Color: Art and Society in the Americas. Humanities Press, 1997. ISBN:039103992X

Reference Books:

1. Kelly, Michael, ed. Encyclopedia of Aesthetics. Oxford University Press, 1998. ISBN: 0195113071
2. Kieran, Matthew. Contemporary Debates in Aesthetics. Blackwell Publishing, 2005. ISBN: 1405102403

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Sub Code: CS338A3 **Credit: 4(L-3, T-1, P-0)**

HUMAN-COMPUTER INTERACTION

Questions to be set: 05 (All Compulsory)

Course Objectives: The course explores the design of computer interfaces that are based on theabilities, limitations and goals of the users. The students would be introduced to the underlying principles of useable interface design through a review of theories and current research in HCI.

Pre-requisites: Data Structures.

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

1. Describe and apply core theories, models, and methodologies from the field of HCI.
2. Analyze one after another the main features of interactive systems, and explain how to gauge the usability of digital environments, tools, and interfaces.
3. Name the various tools and techniques for interface analysis, design, and evaluation.
4. Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.
5. Apply theories and concepts associated with effective work design to real-world application

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Vision	in class	Definition, Concerns of HCI, Goals of HCI, History, Introduction to basic issues and process of designing usable interfaces. as they relate to HCI, will be discussed. Light models, Camera Geometry, Colour Perception, Perceptual Processes of Pattern Recognition, Feature Extraction, Shape Analysis, and Object Tracking.	7	1		
	****Assignment Topics**	**Basic capabilities of the visual system, Visual anatomy**				
Module 2: Cognitive Processes, Motor Control and Command Language	in class	decision making and the implications they have on HCI design. Space Time and Temporal Methods, Effect of Response Time and Feedback on performance Fitt's Law, Interaction with Computer through motor activities like mouse movement, keyboard press etc, Study of CLI. Command organization, names, abbreviations and use of symbols.	8	2		
	****Assignment Topics**	**Limitations in memory , Basics of bio-mechanics of the human body.**				
Module 3:	in class	Semantic Organization, sequence, types of menus, selection alternatives, response time and screen design, Screen layout design, sequencing information, perceptual organization, error	9	3,4		

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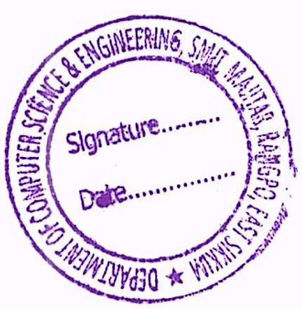
Menus, **Forms and** Graphical user Interface		correction and aesthetics, Direct manipulation, visual languages, methods of direct manipulation, visual display design and virtual reality.				
	****Assignment Topics**	**Case-Studies (Algorithms and Parallelization Approaches), Matrix –Matrix-multiplication.**				
Module 4: Interaction Devices, Natural Language	in class	pointing devices, specialized controls, speech recognition and displays, Appropriateness of HCI using Natural Languages. Issues in Natural Language interaction.	8	4		
	****Assignment Topics**	**Design of interaction devices like keyboard, Natural language interaction.**				
Module 5: MPI Design Process and Evaluation	in class	Process and methodologies of designing user interfaces. User-centered design, user input, task analysis, design tools, Methodologies of evaluating user interface design.	8	5		
	****Assignment Topics**					

Text Books:

1. **Alan Dix, Janet E. Finlay Gregory, D. Abowd, Russell Beale, Human Computer Interaction, Pearson.**

Reference Books:

2. Don Norman, The Design of Everyday Things, Basic Books.
3. Steve Krug, Don't Make Me Think-A Common Sense Approach to Web Usability, New Riders, Berkeley, California.
4. ACM Sigchi Curriculla for Human Computer Interaction, Chapter 2.





Sub Code: CS339A3 **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 knowledge in 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 variety of novel input devices.
2. Describe a knowledge of the research literature in Augmented Reality for both compositing and interactive 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 and interactive 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		

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		Interfaces.				
	****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 collaborativework · Distributed graphics · Sample Application Areas.	9	4		
	****Assignment Topics**					
Module 5: Mobile AR & Developing Applications with ARToolKit	in class	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, undations of Effective Design, Morgan Kaufmann, 2009.

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Sub Code: CS340A3 **Credit: 4(L-3, T-1, P-0)**

BLOCK CHAIN

Questions to be set: 05 (All Compulsory)

Course Objectives: The syllabus is aimed at giving a basic understanding of cryptocurrency, its importance and 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 chain technology.
3. Discoverthe 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 identify security 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 Cryptocurrency Technologies: A Comprehensive Introduction", Kindle Edition.
2. Andreas M. Antonopoulo,"Mastering Bitcoin: Programming the Open Blockchain",2nd Edition, 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

ps://www.evry.com/globalassets/insight/bank2020/bank-2020---block chain-powering-the-internet-of-v
itepaper.pdf

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Sub Code: CS341A3 **Credit: 4(L-3, T-1, P-0)**

AGILE METHODOLOGY

Questions to be set: 05 (All Compulsory)

Course Objectives: The main objectives of this course are to help one to understand the meaning of agile, its importance and when it is best suited in software industry. Software industry is going crazy on agile methods. It is rapidly becoming the choice for software development where requirements are unpredictable or is expected to change over time.

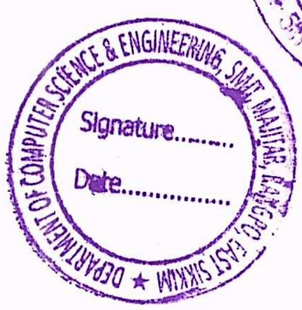
Pre-requisites: Basic familiarity with software, software life cycles, agile

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

1. Explain the philosophy and historical context of agile methods.
2. Enumerate the common agile practices and principles based on the contemporary scientific discourse.
3. Analyze the strengths and weaknesses of an agile approach within a particular development context.
4. Modify selected agile practices and principles based on own experience from project.
5. Employ the latest tools in agile methodology.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Overview of Software Engineering methodology and Introduction to Agile methodology	in class	Software life cycle, Life Cycle Models: Classical waterfall model, Emergence of software engineering, Notable changes in software development practice, Computer system engineering, Software project management. Introducing agile – Origin of methodologies, The agile framework – history, principles, values, and methodologies of agile PM and the Agile Manifesto, Agile versus traditional method comparisons and process tailoring Agile lifecycle – Value-driven delivery (part 1 assessing value)	8	1,2		
	****Assignment Topics**					
Module 2: Agile development methods	in class	Scrum – Introduction and key principles, Agile lifecycle – Value-driven delivery (part 2 planning, delivering, confirming, tracking, and reporting value), Scrum – sprints, requirements, product backlog, Scrum roles – Product Owner, ScrumMaster, Team, Project Manager, Agile requirements, The Scrum Experience (hands-on exercise)	8	2,3		
	****Assignment Topics**					
Module 3:	in class	Managing the Agile approach Monitoring progress Targeting and motivating the team Managing business involvement Escalating issues,	8	4,5		



People and their roles and Introduction to Devops		Empowerment Team Size. Skills Availability Motivation, Introduction to DevOps, Agile vs Devops, Benefits for using DevOps, Combining DevOps with agile, understanding devOps and its evolution				
	****Assignment Topics**					
Module 4: DevOps tools	in class	GIT, JENKINS, SELENIUM, DOCKER, UPPET, CHEF, ANSIBLE, NAGIOS, ELKSTACKSPLUNK	8	5		
	****Assignment Topics**					
Module 5: DevOps Engineers roles and responsibilities	in class	DevOps Roles, DevOps Engineers, the skills & responsibilities of a DevOps Engineer, VMWare.	8	5		
	****Assignment Topics**					

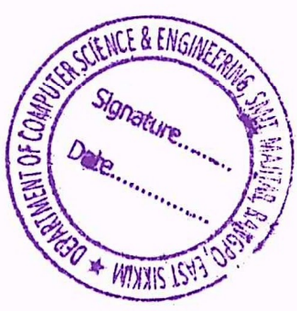
Text Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI
2. Marcus Ries, "Agile project management", Kindle edition

Reference Books:

1. Martin, Robert C. Agile software development: principles, patterns, and practices.Prentice Hall,2002.
2. Shore, James. The Art of Agile Development: Pragmatic guide to agile softwaredevelopment. "O'Reilly Media, Inc.", 2007.
3. Kim, Gene, et al. "The DevOps Handbook: How to Create World-Class Agility."Reliability, andSecurity in Technology Organizations (2016).
4. Schwaber, Ken, and Mike Beedle. Agile software development with Scrum.





Sub Code: CS342A3 **Credit: 4(L-3, T-1, P-0)**

OBJECT ORIENTED ANALYSIS AND DESIGN

Questions to be set: 05 (All Compulsory)

Objective: This course delves into the processes of both object-oriented analysis and object-oriented design using UML as the notation language to provide a common, standard notation for recording both analysis models and design artifacts. Facets of the Unified Process approach to designing and building asoftware system are also covered.

Pre-requisites: Object oriented Design concepts, Design & Analysis of Algorithms and software engineering.

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

1. Identify objectoriented design techniques suitable for a complex problem
2. Demonstrate an ability to formulate a solution plan and methodology for an engineering problem using object-oriented analysis and design using UML.
3. Determination of the formula and interpretation of a model for project management.
4. Investigate a problem to identify technical issues and solve the problems using various object-oriented design tools and techniques.
5. Design real-life application using modern UML tools, techniques and resources.

**** 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 & Modelling concepts>	In Class	Challenges in Software Engineering, Complexity of Software, Structure and Attributes of a Complex System, Evolution of Object Models - Programming Languages and Paradigms , Foundations of the Object Model - OOA, OOD and OOP, Development and OO Modeling History. Elements of Object Model-Abstraction and Encapsulation, Modularity and Hierarchy, Typing, Concurrency and Persistence, Nature of an object: State, Behavior and Identity, Relationships among objects, Three models- Class Model, State model and Interaction model. Overview of UML	6	1,2		
	****Assignment Topics**	**<u>About Object Orientated Technology, Modeling design Technique,</u>**				
Module 2: <Class and State Modelling>	In Class	Nature of a class: Interface and Implementation, Relationships among classes, Object and class concepts, link and association, Advanced class modeling- aggregation, Abstract class metadata, constraints. How to build quality Classes and Objects. Event, state, Transition and conditions, state diagram, state diagram behavior, concurrency, Relation of Class and State models.	10	2,3		

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	**Assignment Topics	**Generalization and Inheritance,**				
Module 3: < Interaction Modeling and Analysis & Design>	in class	Notations, Relationships and Examples - Use case Models, sequence models, activity models. Development stages, Domain Analysis-Domain class model, domain state model, domain interaction model, Iterating and analysis. Application Interaction model, Application class model, Application state Model, Adding operation.	8	4		
	**Assignment Topics	**Development Life cycle**				
Module 4: < System Design >	in class	Estimating Performance, breaking system into subsystems, identifying concurrency, allocation of subsystems, management of data storage, Handling Global resources, choosinga software control strategy, Handling boundary condition, common Architectural style	8	4,5		
	**Assignment Topics	**Making a reuse plan**				
Module 5: <Class design >	in class	Designing algorithms, recursing downward, refactoring, design optimization,	8	4,5		
	**Assignment Topics	**Overview of class design, Adjustment of Inheritance, Reification of Behavior.**				

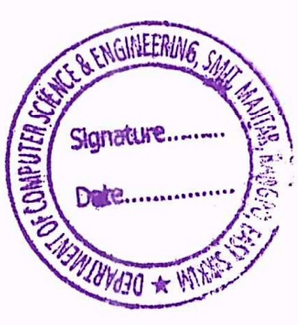
Text Books:

1. Michael R Blaha, James R Rumbaugh, "Object-Oriented Modeling and Design with UML", Pearson.
2. Ali Bahrami, "Object Oriented Systems using the United Modeling Language", McGraw Hill.

Reference Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language", PearsonEducation.
2. Grady Booch, "Object Oriented Analysis and Design", Pearson Education.
3. Graig Larman, "Applying UML and Patterns", Addison Wesley.
4. Perdita Stevens, Rob Pooley, "Using UML Software Engineering with Objects a ndComponents",Pearson.





Sub Code: CS343A3 **Credit: 4(L-3, T-1, P-0)**

SOFTWARE QUALITY MANAGEMENT

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: Software engineering.

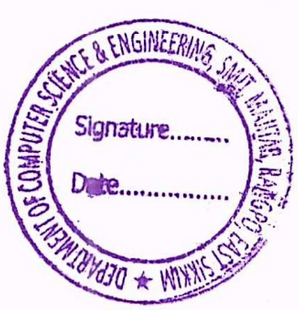
Course Outcomes (CO): On successful completion of this course, students will be able to:

1. Explain the requirements of ISO 9000 Certification and other process evaluation models
2. Discuss the role of software quality measures, quality assurance and quality control in improving the software development process.
3. Prepare a software quality plan for a software project - to include sections on change management, configuration management, defect elimination, validation, verification and measurement.
4. Apply the techniques learned to improve the quality of their own software development.
5. Employ the latest software quality tools.

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

Module	Topics to be Covered	Topics	Hrs	CO	PO	PSO
Module 1: < Fundamentals of Software Quality Engineering>	In Class	Concepts Software Quality, Hierarchical models of Boehm and McCall Quality measurement, Metrics measurement and analysis, Gilb's approach, GQM Model, Quality tasks, SQA plan, teams characteristics, implementation, documentation, reviews and audits, tools for Quality, concepts of Quality improvement, concepts of process maturity, improving process maturity	7	1		
	****Assignment Topics**	Ishikawa's basic tools, CASE tools				
Module 2: < Software Quality Measurements>	In Class	Selecting quality goals and measures, principles of measurement, measures and metrics of Quality Function Deployment, goal/question/measure paradigm for quality characteristics tree, The FURPS model And FURPS+ model, Gilb Approach.	5	3		
	****Assignment Topics**	Quality Prompts				
Module 3: < Software Quality Management System>	In Class	Elements Of A Quality Engineering Program, quality control, assurance and engineering reliability, maintainability, verifiability, testability, safety and supportability, historical perspective elements of QMS, Human Factors, time management in QMS.	8	4		





	****Assignment Topics**	Software Quality Assurance – ISO9000 Series– A Generic Quality Management Standard Tools For Quality.				
Module 4: < Principles and practices in Software Quality Management System>	in class	Process, product, project, people in software development and management spectrum, principle and critical practices in QMS and capability maturity models, six sigma, zero defects and statistical quality control.	10	2		
	****Assignment Topics**	ISO 9001				
Module 5: < Measures and Metrics in Process and Project domains>	in class	Key measures for software engineers, defects, productivity and quality, measuring and improving the development process, assigning measures to process elements and events, Isikawa Diagrams, metrics for software quality, integrating metrics within software engineering process.	10	5		
	****Assignment Topics**	metrics for small organizations				

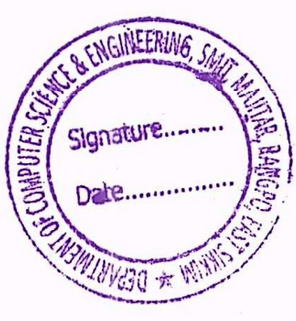
Text Books:

1. Brian Hambling, "Managing Software Quality", Tata McGraw Hill.
2. Alcon Gillies, "Software Quality: Theory and Management", International Thomson, Computer Press.

Reference Books:

1. Juran. J.M.Frank, M.Gyrna, "Quality Planning and Analysis (from product development through use)",Tata McGraw Hill.
2. Stephen H.Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley.
3. Roger S. Pressman, "Software Engineering - A Practitioner's Approach", Fifth Edition, McGraw Hill.
4. Humphrey Watts, "Managing the Software Process", Addison Wesley.





Credit: 4(L-3, T-1, P-0)

INDUSTRY VERSION 4.0

estions to be set: 05 (All Compulsory)

urse Objective: The objective of this paper is to give the students a basic understanding of the technologies tributing to Industry 4.0.

erequisites: There are no prerequisites for this course.

urse Outcomes: On completion of the course it is expected to endow the students with skills to:

1. List out the technological pillars of Industry 4.0.
2. Identify factors influencing computer networks.
3. Discover principles underlying solutions using cloud and big data.
4. Connect blocks to build high level Cyberphysical systems.
5. Analyze end to end solutions to problems using key components driving Industry 4.0.

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

MODULE	MODE	TOPICS	HRS	CO	PO	PSO
1	Contact	Brief History of Industrial Revolution - Industrial Revolution Timeline; Salient Features of each Industrial Revolution; Key aspects of Industry v4.	02	1	1	
2	Contact	Introduction to Computer Networks; Types of networks – LAN, WAN, Internet; Advantages of internet; Internet as a influencer in Industry; Major Issues handled while implementing Internet – Addressing, Name resolution, Data Transfer, Path Planning and Routing, Switching and Data Traffic Control, Data Storage.	10	2	5	
3	Contact	Introduction to Cloud; Major Advantages leading to wide acceptance of Cloud -Data Backup and Restoration, Collaboration, Accessibility, Low Maintenance, Mobility, Use and Pay Services, Unlimited Storage, Security; Cloud Types – Public Clouds, Private Clouds, Hybrid Clouds, Multiclouds.	09	3	5	
	Assign ment	Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS).	02	3	5	
4	Contact	Big Data – Definition, Volume, Velocity, Variety; Internet of Things (IoT) – Sensors, Actuators, Example of IoT; Cyberphysical Systems-Definition	08	3&4	5	
	Assign ment	Example - IoT in Smart Cities (Sample)	02	5	5	
5	Contact	Machine Learning – Definition, Some examples of ML algorithms and their uses; Stitching all components together.	07	5	5	



Credit: 4(L-3, T-1, P-0)

PROGRAMMING WITH 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 algorithmsand 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		

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<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.

A. S. Tanenbaum, Y. Langsam, M.J. Augenstein, "Data Structures using C", Pearson.

3. M. A. Weiss, "Data Structure and Algorithm Analysis in C", Pearson



Credit: 4(L-3, T-1, P-0)

PYTHON

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.

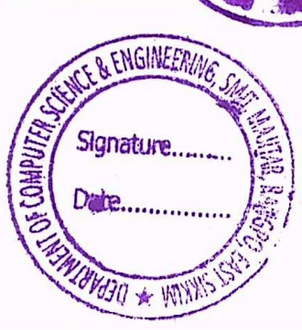
Course Outcomes (CO): On successful completion of this course, students will be able to:

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.

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Sub Code: CS310A2/ CS310A8 **Credit: 4(L-3, T-1, P-0)**

PROMPT ENGINEERING

estions to be set: 05 (All Compulsory)

urse Objective: The objective of this paper is to give the students a working knowledge on Prompt Engineering that uld enable them to explore further in this field.

erequisites: There are no prerequisites for this course.

urse Outcomes: On completion of the course, it is expected to endow the students with skills to:

1. Create prompts to guide the user towards a desired outcome.
2. Design prompts for interactive software development
3. Generate code and data using Large Language Models.
4. Analyse Large Language Models.
5. Evaluate Large Language Models based on their properties.

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

ODULE	MODE	TOPICS	HRS	CO	PO	PSO
1	Contact	Introduction to Prompt Engineering: What are prompts? Why prompts are required? Basics of prompting. Some prompt examples.	02	1	1	
2	Contact	Large Language Models: Introduction to Artificial Neural Networks. Word Embedding. Context Embedding. Working principle of LLMs. Some LLM examples.	09	2 & 4	2	
	Assignment	Some LLM examples	02	2 & 4	5	
3	Contact	Prompt Engineering Techniques: Zero-shot prompting, Few-shot prompting, Chain of thought prompting, Knowledge prompting, Tree –of-thoughts	09	4 & 5	5	
	Assignment	Prompt Examples	02	4 & 5	5	
4	Contact	Prompt Engineering Applications [8 Lectures] Generating Code, Generating Data, Retrieval-augmented Generation	07	3	5	
	Assignment	Code and Data Generation Examples	02	3	5	
5	Contact	Some Models and Risks ChatGPT, LLaMA, GPT4, Prompt Injection, Prompt Leaking, Jailbreaking, Prompt Bias	07	5	5	

xt Book:

- AI Prompt Engineering: The Engineer's Handbook, 1st Edition, Timothy Krimmel, ISBN-13: 979885135951 4
- Quick Start Guide to Large Language Models:
- Strategies and Best Practices for Using ChatGPT and Other LLMs, 1st Edition, Sinan Ozdemir, Addison-Wesl Professional, ISBN: 9780138199197
- Hands-On Large Language Models, 1st Edition, Jay Alammar, Maarten Grootendorst, O'Reilly Media, Inc. ISB 9781098150969

ference Material:

- https://github.com/dair-ai/Prompt-Engineering-Guide

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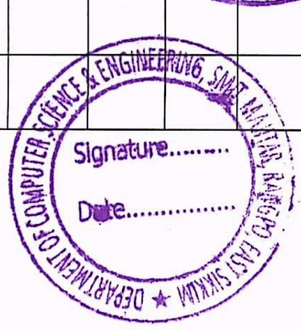
		– SIFT and SURF, High level vision: Geometric methods – Model based vision – Obtaining hypothesis by pose consistency – pose clustering using invariants – verification, Linear discriminant based classifiers and tree classifiers, Learning-Supervised and Unsupervised learning, adaptive Learning, Reinforcement learning, Linear classification, Loss minimization, Stochastic gradient descent, K-Means Algorithm, The perceptron. Multilayer perceptron and the back propagation algorithm, Deep learning, Auto-encoders, CNNs, RNNs, Introduction to Natural Language Processing.				
	****Assignment Topics**	Learning by gradient descent.				
Module 3: < Artificial Intelligence >	In Class	Overview of Artificial intelligence, Problems and techniques, Problem solving agents, searching for solutions; various uniform search strategies, Introduction to Heuristic search strategies, Hidden Markov models, Learning Bayesian networks.	6	3,4		
	****Assignment Topics**	Fuzzy sets & fuzzy logics.				
Module 4: < Block Chain Coding >	in class	Introduction: trustless system, Why blockchain, Decentralized transactions. History: How and when blockchain/bitcoin started, Milestones on the development of bit coin: creation, exchanges. Overview of blockchain technology: What is blockchain, Transactions: Recording transactions, Digital signature, Verifying and confirming transactions; Blocks, Hashes, Consensus: Distributed consensus, Byzantine generals problem, Proof of work; Verify and confirm blocks. Blockchain applications : Government, Identity management, Auto executing contracts, Three signature escrow.	6	3		
	****Assignment Topics**	Triple entry accounting, Elections and voting.				
Module 5: < Augmented Reality>	in class	Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. What is Augmented Reality? History of Augmented Reality. Augmented and Mixed Reality, Mixed Reality. Mixed Reality continuum, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.	7	5		
	****Assignment Topics**	wireless displays in educational augmented reality applications.				





Text Books:

i. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media Publication

ii. Bernd Jahne and Horst HauBecker, Computer vision and Applications, Academic Press, 2000

iii. David A. Forsyth & Jean Ponce, Computer vision-A modern Approach, Prentice Hall, 2002

iv. Introductory techniques for 3D computer vision, Prentice Hall, 1998

v. Arvind Narayanan, Joseph Bonneau, Edward Felten, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Kindle Edition.

vi. Andreas M. Antonopoulo, "Mastering Bitcoin: Programming the Open Blockchain",2nd Edition, Kindle Edition.

Reference Books:

1. Andries P. Engelbrecht , "Computational Intelligence: An Introduction", Wiley 2nd Edition, 2007
2. Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000
3. Leandro N. de Castro and Jonathan Timmis, "Artificial Immune system: A new Computational Intelligence Approach", Springer-Verlag, Germany 2002.



Credit:4 (L-3, T-1, P-0)

INTERNET TECHNOLOGY AND SOCIETY

Questions to be set: 05 (All Compulsory)

Course Objectives: The primary objective of this course is to develop an understanding of the impact createdby technology and internet on the modern society. It also emphasizes on the ways to cope-up with the negative impacts.

Pre-requisites: NIL

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

6. Describe while identifying the impact of technology and internet on the modern society
7. Interpret software freedom principles and free/open-source licensing system
8. Identify ethical issues related to surveillance system, digital divide and identify data privacy concerns
9. Prioritize privacy concerns by applying free & open-source software solutions
10. Recognize the impact of engineering and industrial practices on social contexts.

**** 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, Information & Society>	in class	Introduction, History of Internet, Perspectives on the relations between technology, internet and society,The impact of technology and internet on society, Technological determinism, social determinism. Theories of Information Society, The Geography of internet and the digital divide, Issues affecting digital divide, Digital Inequality, Access to Knowledge, Technology Accessibility, Net neutrality, Uses and Gratification Theory, Cultural Cognition Theory.	9	1,3		
	****Assignment Topics**					
Module 2: <Technology, Economy & Society>	in class	Attention Economy, Pros and cons of attention economy, Case Study: Social media, e-commerce and messaging systems, Growing up digital, Digital childhood and adolescence, Trust, credibility & reputation in social systems, Social isolation, Automation in workplace, Technology & income inequality.	7	1,5		
	****Assignment Topics**					
Module 3: < Privacy and Surveillance>	in class	Data Privacy, Data Breach, Privacy, work and family, Case Study: Facebook Analytica, The fundamental right to privacy, Privacy and Data Protection in India, Surveillance, Mass Surveillance, Case Study: PRISM, Software as a service and its privacy implications, Security - Encryption, Signing & Web Security,	8	1,3		



		Phishing in social media, Identifying fraudulent entities.				
	****Assignment Topics**					
Module 4: < Software Freedom & Licenses>	in class	Code is Law, The regulation of code, Software ethics, Proprietary software, Digital Restrictions Management, Free Software Movement, Free/Libre software vs Open source software, Four essential software freedom, Secure Boot vs. Restricted Boot, Free JavaScript, GNU OS, Free BIOS Campaign. Intellectual Property Rights, Software Patents, Copyright vs. Copyleft, Creative Commons, EULA, Free and Open source licenses, GNU Licenses.	8	2,3		
	****Assignment Topics**					
Module 5: < Protecting our privacy and freedom & Conclusion>	in class	Free/libre OS, Free/libre software alternatives, Protecting privacy on internet, Protecting privacy on mobile phone, Email self defence, Free Android, Freedom Campaigns. The future of internet and technology: cultural and technical perspective.	8	2,4		
	****Assignment Topics**					

Text Books:

i. Anabel Quan-Haase, "Technology and Society: Social Networks, Work, and Inequality", Oxford University Press.

ii. Lawrence Lessig, "Code version 2.0", Basic Books.

Reference Books:

1. The Center for Internet & Society: https://cis-india.org/
2. Free Software Foundation: https://www.fsf.org/

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Credit: 4(L-3, T-1, P-0)

FUTURE INTERNET ARCHITECTURE

Questions to be set: 05 (All Compulsory)

Course Objectives: This course is an advanced networking course focusing on present and future Internet architecture and protocols. This course will introduce students to the basic design principles on which today's networks are based. In addition, this course will cover recent proposals to improve network performance, functionality and scalability.

Pre-requisites: Some background in computer networking

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

1. Describe the basic concepts of networking.
2. Construct algorithms related to different backbone networks and Software Defined Networking (SDN)
3. Analyze various algorithms based on data centre networks and data centre virtualization
4. Evaluate various problems based on overlay networks
5. Evaluate various problems based on virtualization.

**** 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 of Computer Network Concepts & Modern Transport Protocols in the Internet >	in class	Device level connectivity, network protocol stack, OSI/ISO reference Model, basic TCP/IP protocol principles. Basics of TCP and its limitations SPDY and QUIC, Multipath TCP (MPTCP).	8	1		
	****Assignment Topics**					
Module 2: < Software Defined Networking (SDN)>	in class	History and Evolution of Software Defined Networking, Management issues in present network architecture Network Virtualization and evolution of SDN, SDN architecture - data plane vs control plane Examples of SDN controllers - OpenFlow architecture, SDN Programming	6	1,2		
	****Assignment Topics**					
Module 3: < Virtualization>	in class	Data Centre Networks, Data Center Virtualization, Hyperconvergence Architecture, Virtual Network managenemt and QoS, Replica Management and Geo-load balancing	5	3,5		
	****Assignment Topics**			3,5		

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Credit: 4(L-3, T-1, P-0)

FUTURE INTERNET ARCHITECTURE

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3. Analyze various algorithms based on data centre networks and data centre virtualization
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5. Evaluate various problems based on virtualization.

**** 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 of Computer Network Concepts & Modern Transport Protocols in the Internet >	in class	Device level connectivity, network protocol stack, OSI/ISO reference Model, basic TCP/IP protocol principles. Basics of TCP and its limitations SPDY and QUIC, Multipath TCP (MPTCP).	8	1		
	****Assignment Topics**					
Module 2: < Software Defined Networking (SDN)>	in class	History and Evolution of Software Defined Networking, Management issues in present network architecture Network Virtualization and evolution of SDN, SDN architecture - data plane vs control plane Examples of SDN controllers - OpenFlow architecture, SDN Programming	6	1,2		
	****Assignment Topics**					
Module 3: < Virtualization>	in class	Data Centre Networks, Data Center Virtualization, Hyperconvergence Architecture, Virtual Network managenemt and QoS, Replica Management and Geo-load balancing	5	3,5		
	****Assignment Topics**			3,5		

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Module 4: < Content Delivery Network (CDN)& Named Data Networking (NDN)>	in class	Web Caching, Proxy caches, Limitations of web caching, Content Distribution Network: Server Selection Policy, Server Selection Mechanism, and Case Study: How Akamai Works. Introduction, Challenges of Traditional Internet, Information Centric Network, Content-Centric Networks, Named Data Network: Content, Naming, Interest, Interest Forwarding, Data Retrieval, Security, Applications and challenges of NDN.	10	3,5		
	**Assignment Topics					
Module 5: <Overlay Network>	in class	Introduction of overlay networks, Distributed Hash Tables (DHTs), Application of DHTs.	5	5		
	**Assignment Topics					

Text Books:

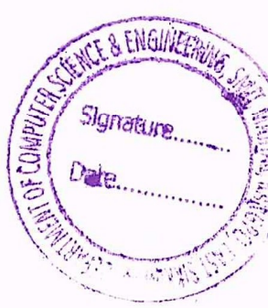
3. Thomas D. Nadeau, Ken Gray "SDN: Software Defined Networks: An Authoritative Review of Network Programmability Technologies", - O'Reilly Media

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

References:

1. Kurose Ross, "Computer Networks – A Top-Down Approach featuring the Internet", Pearson.
2. Patricia A Morreale and James M. Anderson"Software Defined Networking: Design andDeployment"-CRC Pre





Credit: 4(L-3, T-1, P-0)

HUMAN-COMPUTER INTERACTION

Questions to be set: 05 (All Compulsory)

Course Objectives: The course explores the design of computer interfaces that are based on the abilities, limitations and goals of the users. The students would be introduced to the underlying principles of useable interface design through a review of theories and current research in HCI.
Pre-requisites: Data Structures.

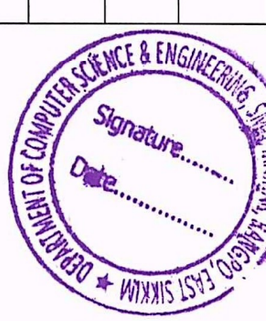
Course Outcomes: On completion of the course, it is expected to endow the students with skillsto:

6. Describe and apply core theories, models, and methodologies from the field of HCI.
7. Analyze one after another the main features of interactive systems, and explain how to gauge the usability of digital environments, tools, and interfaces.
8. Name the various tools and techniques for interface analysis, design, and evaluation.
9. Identify the impact of usable interfaces in the acceptance and performance utilization of information systems.
10. Apply theories and concepts associated with effective work design to real-world application

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Vision	in class	Definition, Concerns of HCI, Goals of HCI, History, Introduction to basic issues and process of designing usable interfaces. as they relate to HCI, will be discussed. Light models, Camera Geometry, Colour Perception, Perceptual Processes of Pattern Recognition, Feature Extraction, Shape Analysis, and Object Tracking.	7	1		
	****Assignment Topics**	**Basic capabilities of the visual system, Visual anatomy**				
Module 2: Cognitive Processes, Motor Control and Command Language	in class	decision making and the implications they have on HCI design. Space Time and Temporal Methods, Effect of Response Time and Feedback on performance Fitt's Law, Interaction with Computer through motor activities like mouse movement, keyboard press etc, Study of CLI. Command organization, names, abbreviations and use of symbols.	8	2		
	****Assignment Topics**	**Limitations in memory , Basics of bio-mechanics of the human body.**				
Module 3:	in class	Semantic Organization, sequence, types of menus, selection alternatives, response time and screen design, Screen layout design, sequencing information, perceptual organization, error	9	3,4		





Menus, **Forms and** Graphical user Interface		correction and aesthetics, Direct manipulation, visual languages, methods of direct manipulation, visual display design and virtual reality.				
	****Assignment Topics**	**Case-Studies (Algorithms and Parallelization Approaches), Matrix –Matrix-multiplication.**				
Module 4: Interaction Devices, Natural Language	in class	pointing devices, specialized controls, speech recognition and displays, Appropriateness of HCI using Natural Languages. Issues in Natural Language interaction.	8	4		
	****Assignment Topics**	**Design of interaction devices like keyboard, Natural language interaction.**				
Module 5: MPI Design Process and Evaluation	in class	Process and methodologies of designing user interfaces. User-centered design, user input, task analysis, design tools, Methodologies of evaluating user interface design.	8	5		
	****Assignment Topics**					

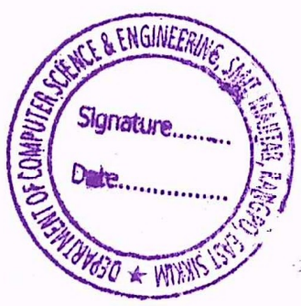
Text Books:

1. **Alan Dix, Janet E. Finlay Gregory, D. Abowd, Russell Beale, Human Computer Interaction, Pearson.**

Reference Books:

1. Don Norman, The Design of Everyday Things, Basic Books.
2. Steve Krug, Don't Make Me Think-A Common Sense Approach to Web Usability, New Riders, Berkeley, California.
3. ACM Sigchi Curriculla for Human Computer Interaction, Chapter 2.





Credit: 4 (L-3, T-1, P-0)

INTELLECTUAL PROPERTY RIGHTS

Questions to be set: 05 (All Compulsory)

Course Objectives: To introduce the role and importance of Intellectual property rights in the field of information technology. To understand the concepts of patents, trademarks and copyrights. To introducethe procedure for obtaining patents, trademarks and copyright.

Pre-requisites: NIL

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

1. Identify regulations, legislation and standards for Intellectual Property Rights
2. Describe the impact of Intellectual Property Rights on engineering and industrial practices vis a vissocial, environmental and economic context.
3. Apply principles of Intellectual Property Rights to sustainable design and development.
4. Analyze ethical lapses and recognize ethical dilemmas.
5. Distinguish professional issues which arise in the intellectual property law context

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: < troduction Intellectual Property Rights>	in class	Intellectual Property, Introduction to IPR, History of IPR, Overview & Importance, Role of IPR in Research & Development, Legislations Covering IPRs in India, Different forms of IPR – Patents, Copyright, Trademark, Industrial Designs, Layout Designs of Integrated Circuits, Geographical Indications, Some important examples of IPR	8	1		
	****Assignment Topics**	Trade Secrets, Plant Varieties				
Module 2: Ethics, Values, and Reason >	in class	Values and Engineering, Ethics in Popular Culture and in Reality, One Model of Ethics, Moral and Amoral Agents, Ethical Conventionalism and Ethical Relativism, Ethical Conventionalism and Ethical Relativism	8	2,3		
	****Assignment Topics**					
Module 3: Copyright Patents & Trademarks>	in class	Introduction: Meaning of copyright, Characteristics of copyrights, Indian Copyright Law. Main features of Copyright Act 1957, Amendments to Copyright Act, Requirements of copyrights, Copyright are protection in form and not in idea, Authorship and ownership of copyright. Rights conferred by copyright, Term of copyright, Related rights, Distinction between related rights and copyright. Introduction, Patent – A form of property, The Patent Law in India, Patent Document, Protectable Subject matter: Patent and kind of inventions protected by a patent , Inventions which are not patentable under the actMeaning of Trademark, the	8	2,3		

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		Functions of a Trademark, Essentials of a Trademark,				
		Trademark Law in India, Domain name and how does it relate to trademarks? Registration of Trademark				
	**Assignment Topics	Rights Conferred to Patentee , Rights conferred by registration of Trademark				
Module 4: < IPR in the field of Information Technology & Computer Ethics >	in class	Introduction, Information Technology Act - 2000, Offences and corresponding penalties – Section 65 to 71, Section 66A and restriction of free speech, National Cyber Security Policy – 2013, Some notable cases. Definition of Ethics, Computer and Information Ethics, The Ten Commandments of computer ethics, Hacking, Plagiarism.	9	4,5		
	**Assignment Topics	Ethical hacking				
Module 5: < Open-Source Software>	in class	Introduction to Free and Open Source Software (FOSS), Open Source vs. Closed Source, Free Software, Free Software vs. Open Source software, Copyright vs. Copyleft, Licenses: GNU General Public License (GPL), MIT License, BSD License, Mozilla Public License, Apache License. Creative Commons, Public Domain, Forking Open Source projects	7	4,5		
	**Assignment Topics	Violation of copyrights and remedies, Using Open-Sore projects in industry, Open Source Government, Open-Source Hardware, Open source media				

xt Books:

1. Dr. B. L. Wadhera, Law Relating to Intellectual Property, Universal Law Publishing Co. Ltd.
2. P. Narayanan; Law of Copyright and Industrial Designs; Eastern Law House, Delhi
3. Ethics in Engineering practice and Research (2nd Edition) by Caroline Whitbeck Cambridge

Reference Books:

1. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; MacmillanIndia Ltd. 2006.
2. National Cyber Security Policy, 2013. 3. Information Technology Act – 2000

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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:

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

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Credit: 4(L-3, T-1, P-0)

INFORMATION RETRIEVAL

Questions to be set: 05 (All Compulsory)

Course Objectives:

- Learn the information retrieval models.
- Be familiar with Web Search Engine.
- Be exposed to Link Analysis.
- Understand Hadoop and Map Reduce.
- Learn document text mining techniques.

Pre-requisites: Data Mining, Artificial Intelligence

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

6. Define information retrieval models.
7. Develop Web Search Engine.
8. Analyze the different tools, techniques and algorithms with an experiment.
9. Experiment with Hadoop and Map Reduce.
10. 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.				

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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.





Credit: 4(L-3, T-1, P-0)

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 goodoverview 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 techniquesused 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:

6. Distinguish the concepts of data warehousing and data mining

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

8. Explain the knowledge discovery process.

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

10. 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				

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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:

i. Ian H. Witten, Eibe Frank, "Data Mining Practical Machine Learning Tools and Techniqueswith JavaImplementations", Morgan Kaufmann Publishers.

ii. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TataMcGrawHill.

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

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





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 it is expected to endow the students with skills 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 engineering problems.
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: < Introduction & 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. Fuzzy Membership 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:	in class	Fuzzy Logic: Fuzzy Logic Basics, Fuzzy Truth as Fuzzy Membership, Fuzzy Truth and Linguistic Variables, Fuzzy Rules, Fuzzy Quantifiers,	9	2		

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< Fuzzy Logic & Propositional Logic >		Generalized Modus Ponens, Fuzzy Inference, Generalized Modus Tollens Propositional Logic: Propositions, Propositional logic 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 & Rough Sets >	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 Terms of 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 and Applications", Prentice Hall.

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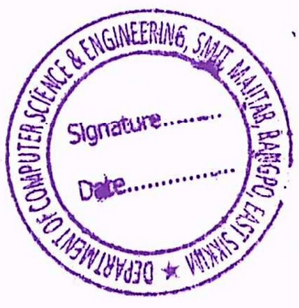
Reference Books:

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





Credit: 4(L-3, T-1, P-0)

DATA ANALYTICS

Questions to be set: 05 (All Compulsory)

Course Objective: Data Analytics is the science of analyzing data in order to come up with some decision-making useful knowledge. The course presents wide range of data analytics techniques and tools for extraction of knowledge.
Pre-requisites: Database Systems.

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

6. Apply data analytics techniques and tools to produce knowledge from a given dataset.
7. Analyze and apply statistical and probabilistic approach for the development of a model using large dataset.
8. Create and evaluate the model using suitable machine learning algorithms.
9. Formulate statistical hypothesis testing and inference for the model development.
10. Explain the dataset using different data representation tools.

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

Module	Mode	Topics	Hrs	CO	PO	PSO
Module 1: Introduction and Data Analytics Lifecycle and methodology	in class	Introduction to data analytics (DA), data preparation, and data cleaning, Big Data Overview, What is data sciences, The rising and importance of data sciences, Understanding Business Data, Data Preparation,Data, Modelling, Data Evaluation, Communicating results	8	1,2		
	****Assignment Topics**	**Big data analytics in industry**, **Deployment of Data**.				
Module 2: Statistical Analysis	in class	Basic statistical concepts. Mean, standard deviation, Distributions, Covariance, correlation, analysis of variance, Statistical tests, confidence and hypothesis testing, Tools such as R.	6	4		
	****Assignment Topics**	Rank statistics and percentiles				
Module 3: Probabilistic Analysis	in class	Dependence and Independence, Conditional Probability, Bayes's Theorem, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.	6	5		
	****Assignment Topics**	Random Variables				
Module 4: Data Analytics: Theory &	in class	Data features, Classification, Supervised and unsupervised learning, Supervised learning - Linear/Logistic regression, Decision trees, Naïve Bayes, Unsupervised learning - K-means clustering, Association rules, Clustering	10	1,3		

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Methods and Hypothesis and Inference		algorithms, Statistical Hypothesis Testing, Example: Flipping a Coin, Confidence Intervals, Example: Running an A/B Test				
	****Assignment Topics**	Knowledge discovery, Anomaly detection, P-hacking, Bayesian Inference.				
Module 5: Tools for Data Analytics and Data Representation and Analysis	in class	Globally distributed data stores, Tools for big data, Introduction to Hadoop, HDFS, MapReduce, , HBase, Hive, Pig, NoSQL. Log Data Analysis – HDFS scenario: Write once & Read often, , Fraud Detection, Risk Modeling, Social Sentiment Analysis, Image Classification,.	10	2,5		
	****Assignment Topics**	YARN, Sqoop, Zookeeper, Flume, Data Warehouse, Graph Analysis				

Text Books:

1. Daniel T. Larose & Chantal D. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", Wiley 2nd Edition.
2. Ron Klimberg and B. D. McCullough, "Fundamentals of Predictive Analytics with JMP" SAS Institute Publishers, 2013.

Reference Books:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" Wiley Publications.
2. Joel Grus, "Data Science from Scratch First Principles with Python", O'Reilly Media, 2015.

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Credit: 4(L-3, T-1, P-0)

DIGITAL IMAGE PROCESSING

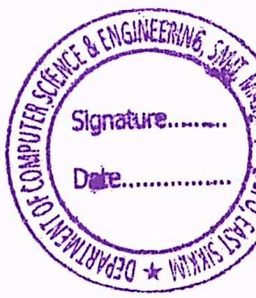
Questions to be set: 05 (All Compulsory)
Course Objectives: The objective of this course is to provide the students a general understanding of the fundamentals of digital image processing. It also introduces analytical toolswhich are currently used in digital image processing. By the end of the course 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: <Digital Image Fundamentals>	in class	Basic concepts of digital images and digitization process, Fundamental steps and elements of digital image processing, Image representation: pixels, color models Relationships between pixels, Linear and Nonlinear operations, Image zooming and shrinking operation.	7	1		
	****Assignment Topics**	**Elements of Visual Perception**				
Module 2: < Image Enhancement and Restoration >	in class	Enhancement by Point Processing: point processing techniques, arithmetic operations, Histogram Processing: equalization and Specification, and Mask processing. Spatial domain filtering: convolution, smoothing, sharpening. Frequency domain filtering: low-pass, high-pass filters. Image restoration: noise removal, restoration techniques	9	2, 3		
	****Assignment Topics**	Case Studies with Examples				
Module 3: < Image	in class	Thresholding methods, Edge detection algorithms: Point, Line Edge, Region-based segmentation techniques, K-means segmentation, Color image processing. Fundamentals image compression and Image Compression Models: Lossy and Lossless	9	4		





Segmentation and Compression >						
	**Assignment Topics	**Error Free Compression, Lossy Compression**.				
Module 4: < Morphological Processing, Image Representation, Description & Recognition >	in class	Image morphology fundamentals. Basic morphological operation: erosion and dilation. Advanced morphological operation: open, close and hit-or-miss transformation, thinning, skeletonization, boundary extraction, region filling. Various Representation and description Schemes, Different types of Boundary and Regional Descriptors. Classical object recognition techniques.	9	5		
	**Assignment Topics	**Case study on Boundary and Regional Descriptors and object recognition strategy**				
Module 5: < Deep Learning for Image Processing Applications >	in class	Basics of neural networks, Convolutional layers and operations Pooling layers, activation functions, Convolutional Neural Networks (CNN) architectures for image classification, CNN for Object Detection: R-CNN and YOLO models.	6	4		
	**Assignment Topics	**Case Studies with Examples**				

Text Books:

. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education Publications.
. RajjanShinghal, "Pattern Recognition", Oxford Publications.

Reference Books:

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

01A3

Credit: 4(L-3, T-1, P-0)

INDIAN MUSIC SYSTEM

SIKKIM MANIPAL UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING, SMIT, MAJITAR, RANGPO, EAST SIKKIM
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Questions to be set: 05 (All Compulsory)

Objectives: emphasizes that sharpening the perception of the arts through creating cultural and artistic responsiveness and consciousness in the student will generate an understanding of the arts in India, which will give students "the ability to appreciate the richness and variety of artistic traditions as well as make them liberal, creative thinkers and good citizens of the nation".

Pre-requisites: Brief Knowledge about various instruments and vocals.

Learning outcomes: On completion of the course it is expected to endow the students with skills of

i. To be able to identify, in an oral fashion, the main melodic, rhythmic and formal characteristics of Indian classical music.
i. To identify the principal instruments of Indian classical music.
i. To identify the names of some major composers and performers of Indian classical music.

Introoduction [6 Hrs]

Sangeet, Swara, Saptak, Laya, Rãga, Varna, Rãga ki Jati-Audav – Shadav – Sampuran
Nãd – Nãd ki Jati – Tarta, Tivrata, Gun, Ãroha, Avroha, Pakad
Basic knowledge of the following instruments: Tãnpura/Sitar, Tabla/Harmonium

Biographies & contributions [6 Hrs]

Amir Khusro, Swami Haridas, Tansen, Maseet Khan, Raza Khan, Faiyaz Khan, Ameer Khan

Study of prescribed Rãgas & Tãlas [7 Hrs]

Rãga – Alhaiya Bilawal, Kafi, Bhairav Tãla – Teentãl, Dadra
Rãga –
1.Alhaiya Bilaval
2.Kafi
3.Bhairav

Vocal Music [6 Hrs]

a.Five Alankars in all the Rãgas.
b.Swarmallika in all the Rãgas
c.Lakshangeet or Drut Khyãl in all Rãgas.

Instrumental Music [6 Hrs]

a.Five Alankars in all the Rãgas.
b.Razakhanigat in all the Rãgas
c.Basic technique of Jhala Playing.

Vocal & Instrumental [7 Hrs]

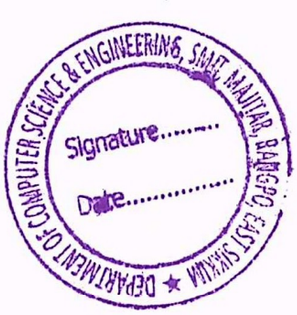
Ability to recite the following Thekas with Tãli & Khãli Teentãla, Dadra
Vocal - Playing of Tanpura is compulsory
Basic knowledge of Playing Harmonium

Text Books:

1.Bhatkhande Sangeet Shastra- V. N. Bhatkhande
2.Sangeet Visharad- Basant
3.Kramik Pustak Mallika- Part II V. N. Bhatkhande

Reference Books:

1.Raag Vigyan – V. N. Patwardhan
2.Sangeet Bodh – Sharad Chandra Pranjpayee
3.Hamare Sangeet Ratna- Laxmi Narayan Garg





4.Tantri Naad Part-I – Pt. Lal Mani Mishra
5.Kramik Pustak Mallika, Part-III –V. N. Bhatkhande
6.Ragini Trivedi - Ragvibodha Mishrabani, Vol. I & II

02A3

Credit: 4(L-3, T-1, P-0)

HISTORY OF SCIENCE

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Tadong, Gangtok
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING, SMIT, MAJITAR, RANGPO, EAST SIKKIM
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Questions to be set: 05 (All Compulsory)

Objectives:

i. Explain the reaction of Renaissance society to the heliocentric solar system.
ii. Describe the scientific innovations of Isaac Newton
iii. Explain how the personality of scientists can influence their discoveries.
iv. Describe how scientists can negatively interact with each other.
v. Describe the impact of the Industrial Revolution on science and society.
vi. Explain the difference between the Industrial and Scientific Revolution.
vii. Explain the philosophy of Classic Greek Science
viii. Explain the philosophy of the Industrial Revolution.
ix. Describe the influence of religion and politics on early science.
x. Describe the forces which brought about the Scientific Revolution.
xi. Describe the forces which brought about the Industrial Revolution.
xii. Compare and contrast beliefs associated with early and Renaissance science.
xiii. Explain how the benefits and risks of future science can be compared.
xiv. Discuss how past predictions about the future can be used to explain difficulties in successfully predicting future science.
xv. Identify how methods of scientific study have changed.

Pre-requisites: NIL

Learning outcomes: On completion of the course it is expected to endow the students with skills of

i. Define science and the scientific method.
ii. Explain the difference between a scientific hypothesis and a theory.
iii. Describe the possible future of science.
iv. Explain the difficulties involved in predicting the future of science.
v. Describe possibilities for prioritizing societal decisions about science based on present needs and future consequences.
vi. Explain some of the effects of technology on modern society.
vii. Compare modern and past examples of science.

Prehistory to the Renaissance [10 Hrs]

Introduction to the History of Science, Early Science I: The Roots of Science, Early Science II: Greece, Early Science III: Arabia, Early Science IV: The Dark Ages, The Dawn of the Renaissance

Copernicus to Darwin [10 Hrs]

The Scientific Revolution, Great Scientists I: Moving the Earth, Great Scientists II: Apples, Optics, and Orbits, Science During the Industrial Revolution, Great Scientists III: The Origin of Life, Anticipating the Twentieth Century

Einstein to the Twenty-First Century [10 Hrs]

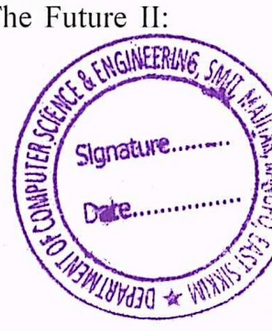
Great Scientists IV: The Theory of Relativity, Great Scientists V: Genes and Genetics, Great Scientists VI: Secrets of the Atom, Great Scientists VII: Medical Pioneers, Great Scientists VIII: The Information Age, Science at the end of the 20th Century

Unit 4: Perspectives on Past, Present, and Future Science [10 Hrs]

Politics and Philosophy of Early Science, Politics and Philosophy of Renaissance Science, Politics and Philosophy of Modern Science, The Future I: Responsibilities for the Future?, The Future II: Dreams and Nightmares

Text Books:





1. Frederick Gregory, History of Science 1700-1900 CDs - The Teaching Company (The Great Courses)
2. Joy Hakim, The Story of Science: Aristotle Leads the Way

Reference Books:

1. Joy Hakim,The Story of Science: Einstein Adds a New Dimension
2. Adam Rutherford A Brief History of Everyone Who Ever Lived: the Human Story Retold Through Our Genes

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CS403A3 **Credit: 4(L-3, T-1, P-0)**

INTRODUCTION TO ART AND AESTHETICS

Questions to be set: 05 (All Compulsory)

Objectives:
demonstrate coherent and detailed knowledge of central historical and contemporary issues in aesthetics and the philosophy of art;
deploy capacities for critical explication and presentation of arguments;
demonstrate a conceptual understanding which enables the development and sustaining of an argument;
describe and comment on particular aspects of recent research and/or scholarship;
appreciate the uncertainty, ambiguity and limitations of knowledge in the discipline;
make appropriate use of scholarly reviews and primary sources.

Pre-requisites: NIL

Learning outcomes: On completion of the course it is expected to endow the students with skills of
acquaint with a range of questions in the philosophy of art and aesthetics;
understanding of the history of aesthetics, and the contemporary state of the subject;
facilitate the application of philosophical thought on aesthetics to students' own engagements with art and the aesthetic;
to build on and develop their core philosophical skills.

The cosmological perspective and the theory of mimesis [7 Hrs]
Introduction: Aesthetics -- Philosophy of Art or Philosophy of Beauty?, The meaning of the beautiful, The ancient quarrel between philosophy and art, Art and nature Mimesis, meaning, and metaphor: truth in art?, The destiny of the cosmological perspective: the Renaissance

The turn to the subject and the theory of taste [6 Hrs]
Aesthetic judgment, Art, genius, and aesthetic ideas

Art, Metaphysics, and History (Romanticism) [6 Hrs]
The priority of art over nature and the demand for philosophical reflection, Beauty as truth: the essence of appearance, History and the end of art: toward art's autonomy

The Autonomy of Art: Phenomenological Approaches [10 Hrs]
Ontological phenomenology: thing and work, Ontological phenomenology: work and truth, Midterm recess, Ontological phenomenology: truth and art, Hermeneutic phenomenology: presentation, representation, and play, Hermeneutic phenomenology: structure, event, and the increase in being, Hermeneutic phenomenology: interpretation and reintergration, Existential phenomenology: embodiment and vision (the flesh of the world), Existential phenomenology: brute meaning and the enigma of depth

The Autonomy of Art: Analytic Perspectives [10 Hrs]
Evaluative approaches to art: aesthetic experience and aesthetic attitude, Evaluative approaches to art: taste, discrimination, and aesthetic concepts , Classificatory approaches to art: the institutional theory , Works and things, Aesthetics and the metaphysics of representation, Interpretation, identification, representation Thanksgiving Recess, Metaphor, expression, and life transfigured, After the end of art?

Text Books:

. Barrett, Terry. Why is that Art? Oxford University Press, 2007. ISBN: 0195167422
. Barrett, Terry. Criticizing Art, 2d ed. McGraw Hill, 2001. ISBN: 7115034X
. Barrett, Terry. Interpreting Art. McGraw-Hill, 2002. ISBN: 0767416481
. Beardsley, Monroe. Aesthetics from Classical Greece to the Present: A Short History. MacMillan, 1966.
. Bosanquet. Bernard. A History of Aesthetic. Cosimo Classics, 2005. ISBN: 1596053240
. Eaton, Marcia. Basic Issues in Aesthetics. Waveland Press, 1999. ISBN: 157766034X
. Farris-Dufrene, Phoebe. Voices of Color: Art and Society in the Americas. Humanities Press, 1997. ISBN: 039103992X

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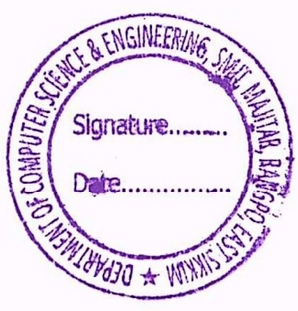
Reference Books:

1. Kelly, Michael, ed. Encyclopedia of Aesthetics. Oxford University Press, 1998. ISBN: 0195113071
2. Kieran, Matthew. Contemporary Debates in Aesthetics. Blackwell Publishing, 2005. ISBN: 1405102403
3. Kivy, Peter, ed. Blackwell Guide to Aesthetics. Blackwell Publishing, 2005. ISBN: 063122131X
4. Levinson, Jerrold. Oxford Handbook of Aesthetics. Oxford University Press, 2005. ISBN: 0199279454
5. Sheppard, Anne. Aesthetics: An Introduction to Philosophy of Art. Oxford University Press, 1987. ISBN: 0192891642
6. Stewart, Marilyn G. Thinking through Aesthetics. Davis Publishing, 1997. ISBN: 0871923629





CS404A3 **Credit: 4(L-3, T-1, P-0)**

ECONOMIC POLICIES IN INDIA

Questions to be set: 05 (All Compulsory)

Objectives:
The objective of this Paper is to sharpen the analytical faculty of the student, by highlighting an integrated approach to the functioning aspects of the Indian economy, keeping in view the scope for alternative approaches. Such an analysis is essential because the Indian economy is a unique amalgam of alternative competing and often conflicting theories and a proper understanding of its working is imperative if the student is to comprehend the ramifications that underlie most of the observed phenomena in the Indian economic set-up. The emphasis of the paper is on overall social, political and economic environment influencing policy decisions.

Pre-requisites: NIL.

Learning outcomes: On completion of the course it is expected to endow the students with skills of
.Exploring the subject matter of Economics
.Supply and Demand: How Markets Work, Markets and Welfare
.Firm Structure

Economic Development and its Determinants [4 Hrs]
Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.

Planning in India [4 Hrs]
Objectives and strategy of planning; Failures and achievements of Plans; Developing grass-root organizations for development – Panchayats, NGOs and pressure groups.

Demographic Features, Poverty and Inequality [4 Hrs]
Broad demographic features of Indian population; rural-urban migration; Urbanization and civic amenities; Poverty and Inequality.

Resource Base and Infrastructure [4 Hrs]
Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development.

The Agricultural Sector [4 Hrs]
Institutional Structure – land reforms in India; Technological change in agriculture – pricing of agricultural inputs and output; industry; Agricultural finance policy; Agricultural Marketing and Warehousing; Issues Terms of trade between agriculture and in food security – policies for sustainable agriculture.
Industrial policy [5 Hrs]
Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labour market reforms; approaches for employment generation.

Public Finances [5 Hrs]
Fiscal federalism – Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India.

Money, Banking and Prices [5 Hrs]
Analysis of price behaviour in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money and capital markets; Working of SEBI in India.

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Economic Reforms [5 Hrs]

Rationale of internal and external reforms; Globalization of Indian economy; WTO and its impact on the different sectors of the economy; Need for and issues in good governance; Issues in competition and safety nets in Indian economy.

Text Books:

1. Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development (Essays in honour of Manmohan
2. Singh), Oxford University Press, New Delhi.
3. Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.

Reference Books:

1. Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press,
2. Amritsar.
3. Brahmananda, P. R. and V. R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State
4. Perspectives, Book well, Delhi.
5. Chakravarty, S. (1987), Development Planning : The Indian Experience, Oxford University Press, New Delhi.
6. Dantwala, M. L. (1996), Dilemmas of Growth : The Indian Experience, Sage Publications, New Delhi.

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b Code: CS224A3 **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

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	****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:	in class	Security Auditing	

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Security Auditing, Legal and Ethical Aspects		Architecture, Security Audit Trail, Implementing the Logging Function, Audit Trail Analysis. Cybercrime and Computer Crime.	
	****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.

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ject Code: CS225A3 **Credit: 4 (L-3, T-1, P-0)**

E-COMMERCE

stions to be set: 05 (All Compulsory)

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

requisites: Nil

rse 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: roduction to 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: Commerce frastructure and E-mmerce arketing oncepts	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		

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Module	Topics to be covered	Topics	Hrs	CO	PO	PSO
Module 3: ommerce urity	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: -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 ssues 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		

Books:

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

rence Books:

Digital Money: The New Era of Internet Commerce, Daniel Lynch and Lundquist,1996, John Wiley
Web Commerce Technology Handbook, Daniel Minoli & Emma Minoli, 1998,McGraw Hill
Frontiers of Electronics Commerce, Kalakota Whinston Stone, 1996, Addison Wesley
Developing E-Commerce Sites: An Integrated Approach, Vivek Sharma & Rajiv Sharma, 2000, Pearson Education
E-Business and E-commerce Management, Dave Chaffey, 2009, Pearson Education

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26A3

Credit: 4 (L-3, T-1, P-0)

DIGITAL SIGNAL PROCESSING

stions to be set: 05 (All Compulsory)

rse Objectives:

To Analyze signals and systems in time and frequency domain.
To attain a good analytical ability in digital filter design.
To investigate the applications of digital signal processing.

requisites: Calculus

rse Outcomes (CO):

n 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 DTFT, DFT etc.
3: Understand Z-transform, the discrete analogue of Laplace Transform.
4: Explain the fundamentals of IIR and FIR filters.
5: Understand the fundamental concepts of adaptive filters and real-world applications of signal processing.

odule	**Topics**	**Hrs**	**CO**
odule 1: gnals and ystems	Continuous-Time and Discrete-Time Signals, Nyquist Sampling Theorem, LTI Systems and its properties, Generation of Signals and basic operations using MATLAB/OCTAVE	**8**	**1**
odule 2: equency nalysis	Discrete Time Fourier Transform (DTFT), Properties of DTFT, Discrete Fourier Transform (DFT), Properties of DFT, Frequency analysis of signals and systems using MATLAB/OCTAVE	8	2
odule 3:	Z-Transform, ROC, Poles & Zeros, Properties of Z-Transform	8	3
odule 4: ndamentals of R & FIR Filters	Introduction to Analog IIR Filters; Design of Butterworth IIR LPF Filters. Windowing, Design of FIR filter using Window, Filter structures	8	4
odule 5: daptive Filters d DSP pplications	Basics of Adaptive filters; Wiener Filters and LMS Filter, Real-world applications of digital signal processing	8	5

Books:

lan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab (1996).*Signals and Systems* (2nd ed.). PHI

ohn G Proakis, Dimitris Manolakis (2007). *Digital Signal Processing* (4th ed.). Pearson

K.Mitra (2013). *Digital Signal Processing: A Computer - Based Approach* (4th edition). McGraw Hill Education.

rence Books:

.S. Thyagarajan (2019). *Introduction to Digital Signal Processing Using MATLAB with Application to Digital ommunications* (1st Edition)Springer

inay K. Ingle and John G. Proakis (2011). Digital Signal Processing Using MATLAB (3rd Edition). CL Engineering.

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27A3

Credit: 4 (L-3, T-1, P-0)

MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING

stions to be set: 05 (All Compulsory)

rse Objective: The Mathematical Foundations for Machine Learning course aims to equip students with the ntial mathematical tools necessary for understanding and excelling in the field of machine learning. Throughout the se, participants will delve into key topics that form the backbone of machine learning mathematics. These topics ıde: Linear Algebra and Analytic Geometry, Matrix Decompositions, Vector Calculus, Probability and Distributions Optimization.

requisites: NIL.

rse Outcomes (CO): ***Upon successful completion of the course, students should be able to***

)1: Understand the fundamentals of linear algebra, a crucial mathematical concept in machine learning.

)2: Apply matrix decomposition techniques, such as Cholesky, Eigen, and singular value decomposition, to machine learning issues.

)3: Use the vector calculus concepts such as partial derivatives, Jacobian, Hessian in Taylor series and relevant problems.

)4: Apply probability and distribution principles to real-world issues.

)5: Apply appropriate convex optimization techniques to a particular machine learning problem.

Module	Topics	Hrs.	CO
dule 1: ear Algebra and lytic Geometry	*Linear Algebra:* Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces *Analytic Geometry:* Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations	10	1
dule 2: trix ompositions	Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition	8	2
dule 3: tor Calculus	Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series	8	3
dule 4: bability and tributions	Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform	9	4
dule 5: tinuous imization	Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization	8	5

t Books:

S.Boyd and L. Vandenberghe. Introduction to Applied Linear Algebra - Vectors, Matrices, and Least Squares. ambridge University Press, 2019

M. P. Deisenroth, A. A. Faisal and Cheng Soon Ong. Mathematics for Machine Learning. Cambridge versity Press, 2019

eference Books:

J. A. Gubner, Probability and Random Processes for Electrical and Computer Engineers, Cambridge University s, 2006.

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21A3

Credit: 4 (L-3, T-1, P-0)

SPEECH PROCESSING

stions to be set: 05 (All Compulsory)

rse Objectives: To enrich the knowledge of the students with a sound understanding of various techniques of speech essing. It begins with the human speech production mechanism and then goes on to the fundamental parameters of ch such as pitch frequency, formants, spectral features like log spectrum, 3-D spectrogram, cepstral features, MFCC, ar prediction coefficients, transform-domain parameters, etc. It deals with applications like speech coding, speech ancement, speaker and language recognition, speech recognition, text to speech synthesis, and the overview of state-ne-art techniques like DNN for speech processing

requisites: Signal Processing (Recommended, but not necessary), Probability and Random Process.

rse Outcomes (CO):

n successful completion of the course, students should be able to

1: Explain the speech production and perception process.
2: Analyze speech signals in time and frequency domain.
3: Describe statistical modeling techniques for speech signal.
4: Apply channel compensation and classification techniques to speech processing applications.
5: Implement simple algorithms for processing speech signals.

lodule	**Topics**
lodule 1: peech Signal: Production, erception, and Acoustic-honetic characterization	Process of Speech production and Perceptions in Human Beings, Speech-Production Process, Representing Speech in the Time and Frequency domains, Place and Manner of Articulation, Windowing, Pre-emphasis filter, STFT, Spectrogram. Concept of filter bank, Auditory perception: psycho acoustics
lodule 2: peech Analysis	Prosodic features:-Energy contour, Pitch contour, and Syllable duration, Voiced /Unvoiced detection using Energy and Zero crossing Rate, AMDF and Pitch. Acoustic features:- LPC- Basic Principles of linear predictive analysis, Auto correlation method, Solution of LPC equations using Durbin's Recursive algorithm, Cepstral analysis of Speech, MFCC, Shifted Delta Cepstral. Perceptual Linear Prediction (PLP) Speech distortion measures – mathematical and perceptual considerations; Spectral–Distortion Measures: Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Liftering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.
lodule 3: atistical Modeling	K-means clustering and Vector quantization, Gaussian mixture Modeling, Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues
lodule 4: hannel Compensation echniques and Classifiers	*Overview of Compensation Techniques:* Linear Discriminant Analysis (LDA), Within-class covariance normalization (WCCN), Nuisance Attribute Projection (NAP) *Overview of Classifiers:* Cosine distance scoring, Support vector machine, Gaussian PLDA, Logistic regression, Deep Neural network (DNN)

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Module 5: Application of speech processing	Speech Coding, Speech Enhancement, Speaker and Language recognition, Automatic Speech Recognition, Text to Speech Synthesis

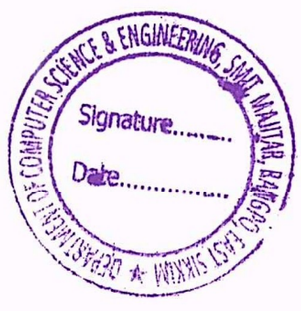
Text Books:

Thomas F, Quatieri (2008). Discrete-Time Speech Signal Processing.(Prentice Hall Pearson Education,2004.
Douglas O'Shaughnessy, Speech communication: human and machine, Addison-Wesley Pub.Co.,1987
L.R. Rabiner and B. H. Juang, Fundamentals of Speech Recognition, Prentice Hall,1993.

Reference Books:

Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., Singapore, 2004
L.R.Rabiner and R.W.Schaffer – Digital Processing of Speech signals – Prentice Hall -1979
J.R. Deller, J.H.L. Hansen and J.G. Proakis, Discrete Time Processing of Speech Signals, John Wiley, IEEE Press, 2000.





22A3 **Credit: 4 (L-3, T-1, P-0)**

Analog Electronics Circuits

estions to be set: 05 (All Compulsory)

rse Objectives: To enrich the knowledge of the students with a sound understanding of analog electronic circuit, will help them in the further course of their studies. It starts with basic circuit components and circuit concepts and , gradually moves to practical building blocks of analog electronic systems. In this course, a serious attempt has n made to make a balance between theory and practice so that the discussed circuits can be constructed in an ergraduate level laboratory class and their measured performance can be easily compared with the analytically licted performance. It helps to build confidence on theory.

-requisites: Basic Electronics

rse Outcomes (CO): ***On successful completion of the course, students should be able to***

1: Understand the fundamental operations and characteristics of diodes, bipolar junction transistors (BJTs), and al-oxide-semiconductor field-effect transistors (MOSFETs)

2: Analyze simple non-linear circuits and develop a fundamental understanding of small signal models.

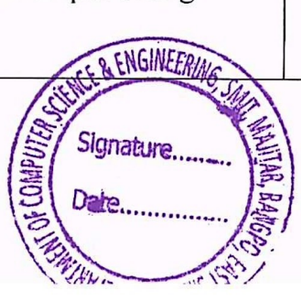
3: Describe the working principles of BJT and MOSFET amplifiers, and gain an understanding of high-frequency els.

4: Explain Multi transistor Amplifiers, Differential Amplifier and Current mirror.

5: Understand the concepts of Feedback system, and Oscillator.

lodule	**Topics**
lodule 1: eview of iode, BJT nd IOSFET	Revisiting: Simple diode circuit and its analysis, BJT - operation and characteristic equations. MOSFET - operation and characteristic equations
lodule 2: nalysis of mple non-ıear circuits	Analysis of simple non-linear circuits (containing one transistor) and introducing the notion of signal amplification. Input-output transfer characteristic of a non-linear circuit. Linearization of input-output transfer characteristic of a non-linear circuit and introducing the notion of small signal equivalent circuit. Small signal models of transistors.
lodule 3: mplifiers	Amplifier models (equivalent circuits): voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Cascading of multiple amplifiers. Common emitter (CE) amplifier – biasing, operation, analysis numerical examples and design guidelines. Common source (CS) amplifier – biasing, operation, analysis, Numerical examples and design guidelines. Frequency response of CE and CS amplifiers. Frequency response of CE and CS amplifiers considering High frequency models of BJT and MOSFET. Limitations of CE/CS amplifiers and hence the need of buffers. Common Collector (CC) and Common Drain (CD) amplifiers– biasing, operation, analysis and design. Common Base (CB) and Common Gate (CG) amplifier – biasing, operation, analysis and design.
lodule 4: ulti ansistor mplifiers, ifferential mplifier	Multi transistor Amplifiers (operation and analysis): CE-CC; CS-CD; CC-CC; Darlington pair; Cascode amplifiers (CS-CB and CS-CG); Amplifier with active load Single-ended signaling vs. differential signaling, Differential amplifier: Basic structure and principle of operation, analysis for differential mode gain, common mode gain, ICMR and output swing





nd Current irror	Current mirror- operation and analysis, Use of current mirror as bias circuit in amplifiers such as in CE/CS, CC/CD, CB/CG and Differential amplifier. Use of current mirror as signal mirror.
Iodule 5: eedback ystem, and Oscillator	Feedback system: Basic feedback theory; Four different feedback configurations and their characteristics. Effects of feedback on frequency response of an amplifier. Application of feedback in practical circuits. Oscillation in feedback system and oscillation criterion, Stability analysis of a feedback system, Two-stage differential amplifier and its stability analysis in feedback configuration. Oscillator: Phase-shift and LC based sinusoidal oscillators. Comparator. Square wave generator (Optional) : Power efficiency of an amplifier, Different modes of operation of amplifiers and their power efficiency: Class A, Class B, Class AB and Class C

ks and References

Millman and C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, McGraw Hill, 1985.
aul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition
rse
Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
.S. Sedra and K.C. Smith, Microelectronic Circuits,
undamentals of Microelectronics by Behzad Razhavi, Wiley 2013
Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988

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Code: CS223A3 **Credit: 4 (L-3, T-1, P-0)**

MICROCONTROLLER

stions to be set: 05 (All Compulsory)

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

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

Understand different types of microcontrollers, their pin configurations, and internal architectures.
Understand the 8051 microcontroller's architecture, I/O operations, special function registers, and addressing modes.
Apply various instruction sets of 8051 microcontrollers for developing programs.
Apply knowledge of interrupts, timers, and serial communications within the 8051 microcontroller system.
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
odule 1: **roduction**	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.				
odule 2: **eneral itecture, ports and al function sters, and dressing es of 8051 ocontroller**	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

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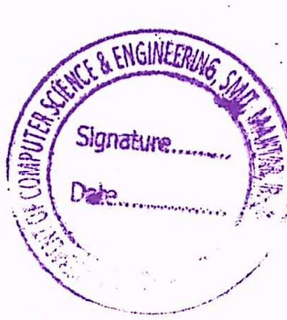
Module 3: **Instruction set of 8051 Microcontroller**	In class	**Data transfer instructions:** forms of MOV instructions, 8/16 bit data load. **Arithmetic instructions:** – ADD – SUBB – INC – DEC instructions. **Program branching instructions:** – unconditional jumps – conditional branching. **Subroutines 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				





53A3 **Credit: 3 (L-3, T-0, P-0)**

ARM Controller

Questions to be set: 05 (All Compulsory)

Course Objectives: Collect knowledge of architecture of ARM 7processor, LPC2148 and assembly programming of ARM. Learn to design, construct, program, verify, analyze and troubleshoot ARM assembly and C language programs and supporting hardware.

Pre-requisites: Knowledge of Digital electronics, Microcontroller Architecture and Programming

Course Outcomes (CO):

Upon successful completion of the course, students should be able to

CO 1: Understand the features of embedded systems, architecture of ARM7 and applications.

CO 2: Analyse and understand the instruction set and development tools of ARM

CO 3:Analyse and understand the THUMB state and achieving competency in assembly programming of ARM.

CO 4: Understand the exception, interrupts and interrupt handling schemes

CO 5: Understand the architectural features of LPC2148 microcontrollers and hardware and interfacing peripheral devices to LPC2148.

lodule	**Topics**	**Hr**
lodule 1: RM Embedded ystems and ARM rocessor ındamentals	The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software- applications. ARM core data flow model, Registers, CPSR-Processor modes, Banked registers. Pipeline- Characteristics.	8
lodule 2: RM Instruction Set	Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction.	7
lodule 3: troduction to HUMB and ARM rogramming	Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb,ARM Thumb Interworking. General Structure of ARM assembly module, Assemblerdirectives- AREA, ENTRY, END, SPACE, DCD, DCB, DCW, DCI, DCQ, EQU, EXPORT,ALIGN, CODE16, CODE32, DATA. Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan.	7
lodule 4: xception and terrupt handling hemes	Exception handling- ARM processor exceptions and modes, vector table, exception priorities,link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQexceptions with example- code for enabling and disabling IRQ and FIQ exceptions,Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design.	7
lodule 5: PC 2148 – ARM PUPeripherals	LPC 2148 - Salient features, block diagram, memory mapping. Functional features of Interrupt controller, RTC, USB, I2C, SPI controllers, watch dog timers, Pin Connect Block- Features, Register description with example. GPIO-Features, Applications, Pin description, Register description with examples PLL-Features, block diagram, PLL frequency Calculation- procedure for determining PLL settings, examples for PLL ConfigurationTimers-Features, applications, Architecture of timer module, register description, Simple C programs for application using -GPIO, PLL, Timer	7

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t Books:

Andrew Sloss, Dominic Symes, Chris Wright (2004).*ARM System Developer's Guide: Designing and Optimizing System Software*. Morgan Kaufmann

William Hohl, Christopher Hinds. *ARM Assembly Language* (2nd ed.), CRC Press.

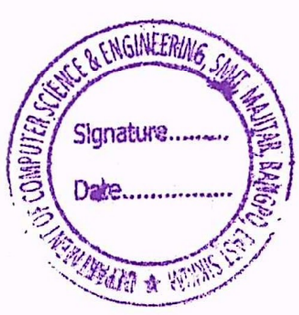
erence Books:

teve Furber (2009), ARM System-on-chip Architecture (2nd ed.). Pearson Education.

A P Godse (2020). ARM Controller: ARM Fundamentals, LPC2148 CPU and Peripherals. Amazon Digital ervices LLC - KDP Print US

ames K. Peckol (2008). Embedded Systems: A Contemporary Design Tool. Wiley.





Sub Code: CS350A3 Credit: 4(L-3, T-1, P-0)

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 Topics	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 Topics	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 Topics	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	In class Topics	Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The	6	4		

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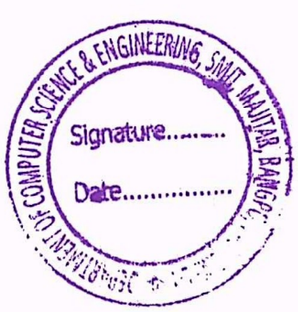
Optimization and Firefly Algorithm		Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.				
	Assignment Topics	Application of Particle Swarm Optimization		4		
Module 5: **Application in Image Processing**	**In class Topics**	Bio-Inspired 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





Sub Code: CS351A3 **Credit: 4(L-3, T-1, P-0)**

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		

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		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 echniques and Clock ynchronization Programming anguages 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.

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CS352A3 **Credit: 4 (L-3, T-1, P-0)**

DEVOPS ENGINEERING

estions to be set: 05 (All Compulsory)

urse Objectives: In this comprehensive course, participants will delve into the principles of DevOps, Agile thodologies, and Scrum practices. They'll gain a solid understanding of Git version control and its purpose in naging software development. Additionally, learners will explore Flask, a lightweight web framework, to build STful APIs and web services. The course also covers containerization concepts using Docker, along with bernetes and OpenShift for orchestrating containerized applications. Lastly, students will acquire essential owledge about monitoring tools and best practices for maintaining application health.

e-requisites: Familiarity with languages like Python, and Java can be beneficial.

urse Outcomes (CO):

on successful completion of the course, students should be able to

- 1: Understand the principles of DevOps, Agile methodologies, and Scrum practices.
- 2: Explain the purpose of Git version control.
- 3: Explore Flask, a lightweight web framework, for building RESTful APIs and web services
- 4: Understand containerization concepts, Docker for creating and managing containers, and Kubernetes and OpenShift for orchestrating containerized applications.
- 5: Understand monitoring tools and practices for maintaining application health.

Module	Topics	Hrs	CO
Module 1: ntroduction to DevOps, Agile Development and Scrum,	Overview of DevOps, Thinking DevOps, Working DevOps, Measuring DevOps, Case studies. Introduction to Agile and Scrum, Agile planning, Daily workflow for executing a sprint plan, Create an Agile Plan with Zenhub	8	1
Module 2: Git and GitHub	Git and GitHub Fundamentals, Git Commands and Managing GitHub Projects, Working with Github from your windows Desktop	8	2
Module 3: Developing AI Applications with Python and Flask	Developing AI Applications with Python and Flask: Basic difference between web applications and APIs. Application development lifecycle, from gathering requirements to maintaining the project, Web App Deployment using Flask, Embeddable Watson AI libraries, AI-based apps, Build a Text-based Sentiment Analysis tool.	8	3
Module 4: ntroduction to Containers w/ Docker, Kubernetes & OpenShift	**Introduction to Containers w/ Docker, Kubernetes & OpenShift:** Containers and Containerization, Kubernetes basics, Mangaing Applications with Kubernetes , Kubernetes ecosystem: OpenShift, Istio **Application Development using Microservices and Serverless:** Introduction to microservices, WebAPI Essentials: RestAPI and GraphQL, Serverless Overview, Create and Deploy using Serverless,	8	4
Module 5: CI/CD and Monitoring	**Continuous Integration (CI) and Continuous Delivery (CD):** Continuous Integration, Continuous Delivery, DevOps and GitOps with Openshift **Monitoring and Observability for Development and DevOps**: Introduction to Monitoring for Applications, Monitoring Systems and Techniques, Methodologies and Tools in Logging, Observability and Concepts. **DevOps Capstone Project**: Create and Execute Sprint Plans, develop a RESTful service using Test Driven Development, Add continuous	8	5

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	Integration (CI) and Security to a Repository, Deploy your Application to Kubernetes, Build an Automated CD DevOps Pipeline,		

xt Books:

oakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN10: 1788392574

Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952

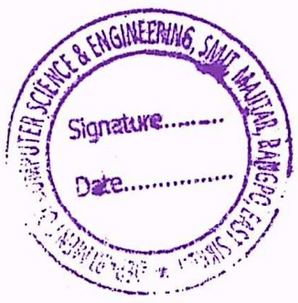
eference Book:

Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10.

Resources:

ps://www.coursera.org/professional-certificates/devops-and-software-engineering





Sub Code: CS334A3 **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**					

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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:

a) Pattern Recognition: Statistical, Structural and Neural networks, Robert Schalkoff, 2005, John Wiley Sons Inc.

b) Pattern Classification, Richard O.Duda, Peter E. Hart & David G. Strok, John Wiley & Sons, Inc.

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Sub Code: CS345A3 **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

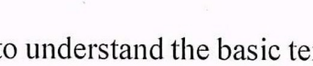
Pre-requisites: Web Technology and Web Services

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**					

t 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

ference 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

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Sub Code: CS346A3 **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.				

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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.				

xt Book

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

ference Book(S)

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.
Talcott, Carolyn. "Cyber-physical systems and events." *Software-Intensive Systems and New Computing Paradigms*. Springer, Berlin, Heidelberg, 2008. 101-115.

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S347A3

Credit: 4 (L-3, T-1, P-0)

REINFORCEMENT LEARNING

uestions to be set: 05 (All Compulsory)

ourse Objectives: The course deals with probabilistic models for problems of dynamic decision making under ncertainty. Stochastic dynamic programming is a general framework for modelling such problems. The course eals with building first the model based dynamic programming techniques and subsequently the model free, data iven algorithms, and deals with the theoretical foundations of these.

re-requisites: Probability and Statistics or an equivalent probability course

ourse Outcomes (CO):

pon successful completion of the course, students should be able to

O 1: Knowledge Creation on Reinforcement Learning

O 2: Understand Tabular methods and Q-networks

O 3: Apply different policy optimization technique

O 4: Analysis different tools and modeling techniques for problems of dynamic decision making under ncertainty

O 5: They will know the algorithms they can apply when faced with such problems and the convergence and curacy guarantees that

ch algorithms would provide.

Module	Topics	Hrs	CO
Module 1: Foundations	Introduction and Basics of RL 2. Defining RL Framework and Markov Decision Process 3. Polices, Value Functions and Bellman Equations 4. Exploration vs. Exploitation 5. Code Standards and Libraries used in RL (Python/Keras/Tensorflow)	8	1
Module 2: Tabular methods and Q-networks	Planning through the use of Dynamic Programming and Monte Carlo 7. Temporal-Difference learning methods (TD(0), SARSA, Q-Learning) 8. Deep Q-networks (DQN, DDQN, Dueling DQN, Prioritised Experience Replay) 2	8	2
Module 3: Policy optimization	Introduction to policy-based methods 10. Vanilla Policy Gradient 11. REINFORCE algorithm and stochastic policy search 12. Actor-critic methods (A2C, A3C) 13. Advanced policy gradient (PPO, TRPO, DDPG)	8	3
Module 4: Model based RL	Model-based RL approach	8	4
Module 5: Recent Advances and Applications	Meta-learning 16. Multi-Agent Reinforcement Learning 17. Partially Observable Markov Decision Process 18. Ethics in RL 19. Applying RL for real-world problems	8	5

ext Books:

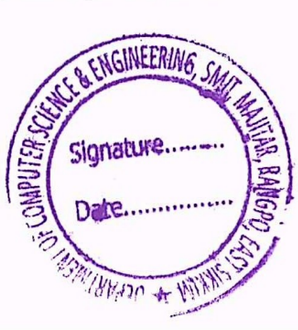
Richard S. Sutton,Francis Bach,(2019). Reinforcement Learning – An Introduction (Adaptive Computation and Machine Learning series) (Second Edition). MIT Press.

Lei, Chen (2021). Deep reinforcement learning. Springer

Wiering, Marco, Martijn Van Otterlo (2012). Reinforcement learning Adaptation, learning, and optimization. Springer.

eference Books:





Russell, Stuart J., and Peter Norvig(2016) Artificial intelligence: a modern approach. Pearson Education Limited.

Goodfellow, Ian, Yoshua Bengio,Aaron Courville (2016). Deep learning. MIT press.





S348A3

Credit: 4 (L-3, T-1, P-0)

GENERATIVE AI AND PROMPT ENGINEERING

uestions to be set: 05 (All Compulsory)

ourse Objectives: The objectives of Generative AI and Prompt Engineering course equips students with the ills to create and manage AI-generated content. It covers the core principles of generative AI, prompt gineering tactics, and the deployment of AI solutions.

re-requisites: Programming Knowledge Required preferably in Python

ourse Outcomes (CO):

pon successful completion of the course, students should be able to

O 1: Understand Classical ML and AI.

O 2: Explain the Generative AI Applications and Prompt Engineering.

O 3: Apply Generative Text and Speech Models.

O 4: Explain Generative AI models.

O 5: Understand LLMOps and cloud computing Tools.

Module	Topics	Hrs	CO
Module 1: Overview of Classical ML and AI	The AI/ML Process and Workflow How to solve a problem using data and algorithms? Data Types and State-of-the-Art Models Tabular Data - Gradient Boosted Models Image Data - Convolutional Neural Networks Sequential and Time Series Data - Recurrent Neural Networks Text and Speech Data - Transformers Generative AI- GPT class of Models for Text, Diffusion for Images/Video Difference between Gen AI and other types of AI, advantages, and disadvantages of Gen AI technologies	8	1
Module 2: Generative AI Applications and Prompt Engineering	Exercises to identify GenAI Use Cases in Diverse Domains LLM Guardrails Responsible AI in Generative Applications Low Code No Code ML/AI Platforms Basic Prompting to Build AI Applications	8	2
Module 3: Generative Text and Speech Models	Tokenization Fundamentals and Byte Pair Encoding How does the GPT class of models Generate Text? Training GPT Models Speech Models Interacting with Trained Models	8	3
Module 4: Generative AI models	Stable Diffusion Fundamentals Image and Video Generation Tools for Generating Images	8	4
Module 5: LLMOps with Low Code, No Code Platforms	LLMOps – Tools, Platforms (incl, but not limited to LangChain, OpenAI API) AWS Sage Maker, Kendra Cloud Computing Tools - AWS ML Tools, Google Cloud, IBM Watson	8	5

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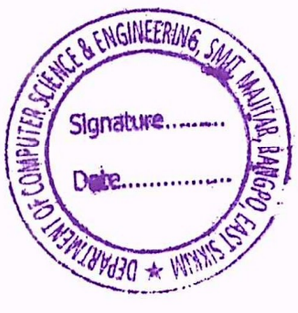
ext Books:

James Phoenix and Mike Taylor, Prompt Engineering for Generative AI, O'Reilly Media.
Altaf Rehmani, Generative AI for everyone,Bluerose Publishers Pvt. Ltd.,February 2024





CS349A3 **Credit: 4 (L-3, T-1, P-0)**

MERN Stack Development

uestions to be set: 05 (All Compulsory)

ourse Objectives: : The MERN stack, which stands for MongoDB, Express.js, React, and Node.js, is a werful technology stack used for building efficient and scalable web applications.

re-requisites: Basic Programming Concepts.

ourse Outcomes (CO):

pon successful completion of the course, students should be able to

O 1: Apply HTML, JavaScript, and CSS to create web pages and interactive user interfaces.

O 2: Gain proficiency in using NoSQL databases, understanding their principles, and implementing data orage and retrieval

O 3: Develop server-side applications using Node.js, including handling requests, managing modules, and ilding APIs

O 4: Use Express.js, a popular Node.js framework, for building robust and scalable web applications

O 5: Apply React.js, a JavaScript library for building dynamic and responsive user interfaces

Module	Topics	Hrs	CO
Module 1: Introduction to Web Development with HTML, CSS, JavaScript	**Introduction to Fullstack**: Fullstack Web Development, Introduction to Project Management in Web Development, Command Prompt (CMD), Introduction to GitHub **UI Design**: Introduction, Characteristics and Principles of UI Design, Introduction to Figma, UI Designing using Figma Introduction to Application Development, HTML Overview, CSS and HTML5, JavaScript programming for web applications	8	1
Module 2: MongoDB	DBMS using MongoDB: Introduction to Database, Concept of Data Modeling, Relational & Non-relational Databases, Introduction to MongoDB **Assignment:** Creating ERD & DB for E-Commerce Website	8	2
Module 3: NodeJS	Introduction to Node.js, Setting up Node.js, Callbacks and Events, Introduction to File System, Buffers & Streams, Concepts of Objects & Modules **Assignment:** Hosting Website using Node.js:	8	3
Module 4: ExpressJS	Introduction & Setup of Express.js, Concepts of RESTful API, HTTP Methods, Routing, Templating in Express.js, Database & Data Handling in Express.js, Authentication in Express.js **Assignment:** Creating Express APIs for E-Commerce Website	8	4
Module 5: ReactJS	Installation & Introduction to React.js, JSX & its Components, React's Props & State Management, Event Management in React, Concept of React Hooks, Routing in React, React Forms & Client-side Programming	8	5

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	Assignment: implementing a dynamic and interactive web application		

ext Books:

. Vasan Subramanian (2017). Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node. Apress901 Grayson Street Suite 204 Berkely, CAUnited States, ISBN:978-1-4842-2652-0

2. Greg Lim(2021). Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App, Independently Published

3. Nabendu Biswas (2023). Ultimate Full-Stack Web Development with MERN: Design, Build, Test, and Deploy Production-Grade Applications, Orange Education Pvt Ltd.

-Resources:

1. https://www.coursera.org/specializations/ibm-cloud-application-development-foundations#courses
2. MERN STACK: https://www.skillvertex.com/blog/mern-stack-course-syllabus/#module-2-ui-design

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ub Code: GN302A2 **Credit: 1 (L-1, T-0, P-0)**

QUANTITATIVE APTITUDE AND LOGICAL REASONING - II

uestions to be set: 05 (All Compulsory)

ourse Objective:

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

re-requisites: NIL

ourse Outcomes (CO): On successful completion of the course

CO	STATEMENT
CO1	Student will be able to solve variety of problems simple to complex in the space of quantitative domain.
CO2	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.
CO3	Students will be able to use shortcuts, tricks and techniques to solve the problems with high accuracy.
CO4	Students will be able to demonstrate essential skills pertaining to business communications.
CO5	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		

ext 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

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