B. Tech.
Computer Engineering

COURSE STRUCTURE/ COURSE CURRICULUM

Department of Computer Engineering
Jamia Millia Islamia

B. TECH. COMPUTER ENGINEERING
COURSE STRUCTURE

Codes for nature of courses

L : Lecture courses
P : Laboratory Based courses
S: Seminar

Category of Courses

PCC : Program Core courses

Weightage for Course Evaluation

L : Lecture T : Tutorial P : Practical CCA : Continuous Class Assessment MTE :Mid TermExam

B. TECH. COMPUTER ENGINEERING - I YEAR (Effective from July 2023)

I Year											
S.No.	**Course No.**	**Course Name**	**Type of Course**	**Credit**	**Periods /week**			**Examination Scheme (Distribution of Marks)**			
								Mid Semester Evaluation			**End Semester Evaluation**	**Total Marks**
					L	**T**	**P**	**CCA**	**MTE-1**	**MTE-2**		
THEORY			**I Semester**									
01	AST-101	Communication Skills	Theory (HSMC)	2	2	-	0	20			30	50
02	ASB-101	Engineering Physics I	Theory (BSC)	3	3	-	0	30			45	75
03	ASB-102	Engineering Chemistry	Theory (BSC)	3	3	-	0	30			45	75
04	ASB-103	Engineering Mathematics I	Theory (BSC)	3	3	-	0	30			45	75
05	EES-101	Basics of Electrical Engineering	Theory (ESC)	3	3	-	0	30			45	75
06	CSS-101	Fundamentals of Computing	Theory (ESC)	3	3	-	0	30			45	75
PRACTICAL (LAB.)												
I	ASL-101	Language Laboratory	Lab (HSMC)	1	0	-	2	15			10	25
II	ASL-102	Engineering Physics Laboratory I	Lab (BSC)	1	0	-	2	15			10	25
III	ASL-103	Engineering Chemistry Laboratory	Lab (BSC)	1	0	-	2	15			10	25

IV	MEL-104	Engineering Graphics & Design	Lab (BSC)	2	0	-	4	30	20	50
V	CSL-101	Design Thinking & Idea Lab	Lab (ESC)	1	0	-	2	15	10	25
		Total		**23**	**17**	**-**	**12**	**260**	**315**	**575**
THEORY II Semester										
01	ASB-201	Engineering Physics II	Theory (BSC)	3	3	-	0	30	45	75
02	ASB-202	Engineering Mathematics II	Theory (BSC)	3	3	-	0	30	45	75
03	ASB-203	Biology for Engineers	Theory (BSC)	3	3	-	0	30	45	75
04	ECS-201	Basics of Electronics & Communication Engg.	Theory (ESC)	3	3	-	0	30	45	75
05	MES-201	Basics of Mechanical Engineering	Theory (ESC)	3	3	-	0	30	45	75
06	CES-201	Basics of Civil Engineering	Theory (ESC)	3	3	-	0	30	45	75
07	ASM-201	Constitution of India	Theory (MC-1)	0	2	-	2	-	-	-
PRACTICAL (LAB.)										
I	ASL-201	Engineering Physics Laboratory II	Lab (BSC)	1	0	-	2	15	10	25
II	MEL-201	Workshop Practice	Lab (ESC)	2	0	-	4	30	20	50
III	MEL-202	Engineering Mechanics Laboratory	Lab (ESC)	1	0	-	2	15	10	25
		Total		**22**	**20**	**-**	**10**	**240**	**310**	**550**

Annexure-I

B. TECH. COMPUTER ENGINEERING

COURSE STRUCTURE

B. TECH. COMPUTER ENGINEERING -II YEAR (Effective from July 2024)

II Year											
S.No.	**Course No.**	**Course Name**	**Type of Course**	**Credit**	**Periods/ week**			**Examination Scheme (Distribution of Marks)**			
								Mid Semester Evaluation			End Semester Evaluation	Total Marks
					L	T	P	CCA	MTE -1	MTE -2		
THEORY			**Third Semester**									
01	ASM-301	Universal Human Values	**MC-II**	3	3	-	-	30			45	75
02	ASM-302	Essence of Indian Traditional Knowledge	**MC-III**	0	2	-	-	20			30	50 (non credit)
03	ASB-301	Engineering Mathematics III	**BSC**	3	3	-	-	30			45	75
04	CSC-301	Discrete Mathematics – PCC1	**PCC**	3	3	-	-	30			45	75
05	CSC-302	Data Structure- PCC2	**PCC**	3	3	-	-	30			45	75
06	CSC-303	Digital Logic Design - PCC3	**PCC**	3	3	-	-	30			45	75
07	CSC-304	System Software and Block-Chain Technology -PCC4	**PCC**	3	3	-	-	30			45	75
PRACTICAL (LAB.)												
I	CSL-301	C Programming Lab – PCL1	**PCC**	1	-	-	2	15			10	25
II	CSL-302	Data Structure Lab- PCL2	**PCC**	1	-	-	2	15			10	25
III	CSL-303	Digital Logic Design Lab– PCL3	**PCC**	1	-	-	2	15			10	25
IV	CSL-304	Linux Lab – PCL4	**PCC**	1	-	-		15			10	25
		Total		**22**	**18**	**-**	**6**	**240**			**310**	**550**
THEORY			**Fourth Semester**									
01	ASM-401	Environmental Science	**MC-III**	2	2	-	-	20			30	50
02	CSC-401	Computer Organization & Architecture- PCC5	**PCC**	3	3	-	-	30			45	75
03	CSC-402	Database Management System- PCC6	**PCC**	3	3	-	-	30			45	75
04	CSC-403	Operating System - PCC7	**PCC**	3	3	-	-	30			45	75

05	AST-401	Operations Research OEC-1	**HSMC (OEC I)**	3	**3**	-	**-**	30	45	75
06	AST-402	Economics OEC-2	**HSMC (OEC II)**	3	3	-	**-**	30	45	75
PRACTICAL (LAB.)										
I	CSL-401	Python Programming Lab – PCL5	**PCC**	1	-	-	2	15	10	25
II	CSL-402	DBMS Lab - PCL6	**PCC**	1	-	-	2	15	10	25
III	CSL-403	Operating System Lab – PCL7	**PCC**	1	-	-	2	15	10	25
IV	ASL-401	Numeric and Scientific Computing Lab.	**ESC**	2	-	-	4	30	20	50
		Total		**22**	**19**	**-**	**10**	**245**	**305**	**550**

B. TECH. COMPUTER ENGINEERING
COURSE STRUCTURE
B. TECH. COMPUTER ENGINEERING -III YEAR (Effective from July 2025)

S.No.	Course No.	Course Name	Type of Course	Credit	Periods/week			Examination Scheme (Distribution of Marks)				
								Mid Semester Evaluation			End Semester Evaluation	Total Marks
					L	T	P	CCA	MTE-1	MTE-2		
THEORY			**Fifth Semester**									
01	CSE-501	Introduction to Data Mining – PEC1	**PEC**	3	3	-	-	30			45	75
02	CSC-501	Object Oriented Programming – PCC8	**PCC**	3	3	-	-	30			45	75
03	CSC-502	Microprocessor – PCC9	**PCC**	3	3	-	-	30			45	75
04	CSC-503	Computer Networks - PCC10	**PCC**	3	3	-	-	30			45	75
05	CSC-504	Software Engg - PCC11	**PCC**	3	3	-	-	30			45	75
06	CSC-505	Automata Theory – PCC12	**PCC**	3	3	-	-	30			45	75
PRACTICAL (LAB.)												
I	CSL-501	OOPs Lab - PCL8	**PCC**	1	-	-	2	15			10	25
II	CSL-502	Microprocessor Lab - PCL9	**PCC**	1	-	-	2	15			10	25
III	CSL-503	Computer Network Lab - PCL10	**PCC**	1	-	-	2	15			10	25
IV	CSL-504	Software Engg. Lab - PCL11	**PCC**	1	-	-	2	15			10	25
		Total		**22**	**18**	**-**	**8**	**240**			**310**	**550**

THEORY								**Sixth Semester**		
01	CSC-601	Analysis and Design of Algorithms - PCC13	**PCC**	3	3	-	-	30	45	75
02	CSC-602	Compiler Design PCC14	**PCC**	3	3	-	-	30	45	75
03	CSC-603	Embedded Systems- PEC II	**PCC**	3	3	-	-	30	45	75
04	CSC-604	Artificial Intelligence – PCC15	**PCC**	3	3	-	-	30	45	75
05	CSE-601	Parallel & Distributed Computing PCC16	**PEC**	3	3	-	-	30	45	75
PRACTICAL (LAB/SEMINAR)										
I	CSL-601	Data Mining Lab - PCL12	**PCC**	1	-	-	2	15	10	25
II	CSL-602	Compiler Design Lab PCL13	**PCC**	1	-	-	2	15	10	25
III	CSL-603	Embedded Systems Lab - PCL14	**PCC**	1	-	-	2	15	10	25
IV	CSL-604	Artificial Intelligence Lab - PCL15	**PCC**	1	-	-	2	15	10	25
V	CSP-601	Seminar (Literature Review)	**PROJ**	1	-	-	2	15	10	25
		Total		**20**	**15**	**-**	**10**	**225**	**275**	**500**

B. TECH. COMPUTER ENGINEERING
COURSE STRUCTURE

B. TECH. COMPUTER ENGINEERING –IV YEAR (Effective from July 2026)

S.No.	**Course No.**	**Course Name**	**Type of Course**	**Credit**	**Periods/ week**			**Examination Scheme (Distribution of Marks)**				
								Mid Semester Evaluation			**End Sem. Evaluation**	**Total Marks**
					L	**T**	**P**	**CCA**	**MTE-1**	**MTE-2**		
THEORY				**Seventh Semester**								
01	CSE-70x	PECIII	**PEC**	3	3	-	-	30			45	75
02	CSE-70x	PECIV	**PEC**	3	3	-	-	30			45	75
03	CSE-70x	PECV	**PEC**	3	3	-	-	30			45	75
04	CSE-70x	PECVI	**PEC**	3	3	-	-	30			45	75
05	CSO-70x	OEC III	**OEC**	3	3	-	-	30			45	75
PRACTICAL (LAB./MINOR PROJECT)												
I	CSP-792	Summer Internship	**PROJ**	2	-	-	4	30			20	50
II	CSP-793	Minor Project	**PROJ**	3	-	-	6	45			30	75
		Total		**20**	**15**	**-**	**10**	**225**			**275**	**500**

THEORY			**Eighth Semester**							
01	CSO-80x	OEC IV	**OEC**	3	3	-	**-**	30	45	75
02	CSO-80x	OEC V	**OEC**	3	3	-	-	30	45	75
PRACTICAL (LAB./MAJOR PROJECT)										
06	CSP-891	Major Project	**PROJ**	6	-	-	12	90	60	150
		Total		**12**	**6**	**-**	**12**	**150**	**150**	**300**

List of Electives:

Electives in VIIth Semester	**Electives in VIIIth Semester**
CSE-701: Computer Vision and Image Processing CSE-702: Mobile Computing & IoT CSE-703: Cloud Computing CSE-704: Internet Protocol CSE-705: Soft Computing CSE-706: Social Network Analysis CSE-707: Artificial Neural Networks	CSO-801: Network Security CSO-802: Applications of Blockchain Technology CSO-803: Software Testing CSO-804: Big Data Analytics CSO-805: Advanced Graph Theory CSO-806: Applied Linear Algebra in AI and ML CSO-807: Generative AI

- **Total Credits from IIIrd to VIIIth Semester: 118**
- **Total Credits from Ist to VIIIth Semester: 163**
- **Total Marks from IIIrd to VIIIth Semester: 2950**

Honours/Specialization 1: Artificial Intelligence and Machine Learning

S. No.	Code	COURSE NAME	Semester	COURSE TYPE		Credit	L	T	P	HRS
1	CSH-411	Introduction Machine Learning	IV	Theory	PC	3	3	0	0	3
2	CSH-511	Data Analytics	V	Theory	PC	3	3	0	0	3
3	CSH-611	Deep Learning	VI	Theory	PC	3	3	0	0	3
4	CSH-711	Natural Language Processing	VII	Theory	PC	3	3	0	0	3
5	CSH-811	Special topics in Artificial Intelligence	VIII	Theory	PC	3	3	0	0	3
6	CSHL-411	Machine Learning Lab	IV	Lab	PC	1	0	0	2	2
7	CSHL-611	Deep Learning Lab	VI	Lab	PC	1	0	0	2	2
8	CSHL-711	NLP Lab	VII	Lab	PC	1	0	0	2	2
					Total	18	15	0	6	21

Honours/Specialization 2: Data Science

S. No.	Code	COURSE NAME	Semester	COURSE TYPE		Credit	L	T	P	HRS
1	CSH-411	Introduction Machine Learning	IV	Theory + Lab	PC	4	2	1	2	5
2	CSH-511	Data Analytics	V	Theory + Lab	PC	4	2	1	2	5
3	CSH-611	Deep Learning	VI	Theory + Lab	PC	4	2	1	2	5
4	CSH-711	Special topics in Artificial Intelligence	VII	Theory	PC	3	2	1	0	3
5	CSD-821	Data Visualization	VIII	Theory	PC	3	2	1	0	3
					Total	18	10	5	6	21

Honours/Specialization 3: Cyber Security

S. No.	Code	COURSE NAME	Semester	COURSE TYPE		Credit	L	T	P	HRS
1	CSD-431	Introduction to Cyber Security	IV	Theory + Lab	PC	4	2	1	2	5
2	CSD-531	Data Encryption	V	Theory + Lab	PC	4	2	1	2	5
3	CSD-631	Steganography & digital watermarking	VI	Theory + Lab	PC	4	2	1	2	5
4	CSD-731	Digital Forensic	VII	Theory	PC	3	2	1	0	3
5	CSD-831	Quantum Cryptography	VIII	Theory	PC	3	2	1	0	3
					Total	18	10	5	6	21

Minor Degree (Computer & A.I.) for other department students only

S. No.	Code	COURSE NAME	Semester	COURSE TYPE		Credit	L	T	P	HRS
1	CSM-401	Data Structures and Algorithms	IV	Theory	PC	3	3	0	0	3
2	CSM-501	Database Management System	V	Theory	PC	3	3	0	0	3
3	CSM-601	Computer Networks	VI	Theory	PC	3	3	0	0	3
4	CSM-602	Artificial Intelligence and Machine Learning	VI	Theory	PC	3	3	0	0	3
5	CSM-701	Data Mining and Analytics	VII	Theory	PC	3	3	0	0	3
6	CSML-401	Data Structures and Algorithms Lab	IV	Lab	PC	1	0	0	2	2
7	CSML-501	DBMS Lab	V	Lab	PC	1	0	0	2	2
8	CSML-701	Data Mining Lab	VII	Lab	PC	1	0	0	2	2
					Total	18	15	0	6	21

(CSS-101/201) FUNDAMENTALS OF COMPUTING

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

CO1 Students will be able to understand the basics of computer, generation and types of computer and Number system.

CO2 Student will be able to understand the concept of algorithms, flowchart and C programming basics.

CO3 Student will be able to implement loops and array in C programming.

CO4 Students will be able to apply the concepts of searching and sorting techniques in C programming.

CO5 Students will be able to describe different types of operating systems and its functions and they will understand basics of computer networking and internet.

UNIT 1: BASICS OF COMPUTERS (CO1)

Computer fundamentals, Bits and Bytes, CPU, Memory, Types of memory, Input and output devices, Operating system, application software, system software, generation of computer, classification of computer.

Number system: decimal number system, binary number system, octal number system, hexadecimal number system.

UNIT 2: INTRODUCTION TO C PROGRAMMING (CO2)

Introduction to Programming Language, Compiler, Interpreter, Algorithms, flow chart, C character set, C-tokens: constants, variable, keywords, Data types, operator and expressions.

Decision controls: if-else, if-else ladder, nested if-else, conditional operator, switch case.

UNIT 3: LOOP AND ARRAY (CO3)

For loop, while loop and do-while loop, continue and break statement, Function: inbuilt and user defined functions, call by value and call by reference, Array: Single dimensional array. 2D array, multidimensional array, Operations on array.

UNIT 4: SEARCHING AND SORTING (CO4)

Pointers, searching and sorting, Searching techniques: linear search, binary search, Sorting techniques: bubble sort, selection sort, Strings, library string functions.

UNIT 5: OPERATING SYSTEM & NETWORKING (CO5)

OS definition, role of OS in computer system, multi programming, time sharing OS, multitasking OS, multiprocessing OS, real time system OS, client server computing, distributed OS, functions of OS.

Computer Network, transmission media, network topologies, LAN, WAN, MAN, Internet, ISP, WWW, Email, URL, Web browsers, websites, intranet. Latest technologies in IT.

References / Text Books:

- Herbert Schildt C-The Complete Reference., Tata McGraw Hill Edition
- Ritchie, D. M., Kernighan, B. W., & Lesk, M. E. (1988). The C programming language. Englewood Cliffs: Prentice Hall.
- Kamthane, A. N. (2011). Programming in C, 2/e. Pearson Education India.

- Doja, M. N. (2005). Fundamentals of Computers and Information Technology
- Yashwant, K. Let us C. 8th edition, BPB publication.
- Balagurusamy, E. (2012). *Programming in ANSI C*. Tata McGraw-Hill Education.

CSC-301: DISCRETE MATHEMATICS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

- **CO1.** Understand the logical notation to define and reason about fundamental concepts such as sets, relations, and algebraic structures.
- **CO2.** Analyze problems in Computer Science using graphs and trees.
- **CO3.** Evaluate and prove the properties of recurrence relations and analyze their applications in Computer Science
- **CO4.** Design and synthesize proofs using induction hypotheses, combinatorics, inclusion-exclusion, propositions etc.
- **CO5.** Design the models and optimize the combinational problems using LPPs.

UNIT 1: ALGEBRAIC STRUCTURES CO-1

Review of Relations, Equivalence Relations, Partial Orders, Lattices, Characteristics Function. Algebraic Structure: Semi-Groups, Monoids, Groups, Permutation Groups, Cyclic Groups, Normal subgroups, Group Isomorphism, Rings, Fields, Integral Domain.

UNIT 2: GRAPH THEORY CO-2

Definition and properties of graphs, directed and undirected graphs, degree sequence, cycles, path, connectivity, adjacency matrix, incidence matrix. Complete graphs, Regular graphs, Bipartite graphs, Planar graphs. Graph Isomorphism. Euler circuit, Hamiltonian circuit. Coloring of graphs- Welch-Powell algorithm.

UNIT 3: RECURRENCE RELATIONS CO-3

Introduction, Generalized linear homogenous/non-homogenous recurrence relations, common recurrence relations. Solving recurrence relations: Iteration method, characteristic equation method. Introduction to generating functions. Solving recurrences using generating functions.

UNIT 4: MATHEMATICAL TECHNIQUES CO-4

Propositional Calculus, Principle of Inclusion and Exclusion, Principle of Mathematical Induction, Pigeon Hole Principle, Permutation and Combination, Derangements, Recursive Functions.

UNIT 5: LINEAR PROGRAMMING PROBLEMS CO-5

Introduction to Linear Programming Problems, Modeling and Formulation of LPP, Solution of LPP: Graphical methods, Simplex algorithm. Duality principle, Finding Duals of LPPs.

BOOKS:

1. K. H. Rosen, Discrete Maths and its Applications, McGraw Hill International Editions.
2. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill International Editions.
3. Thomas Koshy, Discrete Maths with Applications, Elsevier Academic Press.
4. E. G. Goodaire, Discrete Maths with Graph Theory, Pearson.
5. J L Mott, AKandel, T P Baker, Discrete Maths for Computer Scientists & Mathematicians, Pearson.
6. Kolman, Ross & Busby, Discrete Mathematical Structures, Pearson
7. K. D. Joshi, Foundations of Discrete Maths, Wiley Eastern Ltd.

CSC- 302: DATA STRUCTURES

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will be able to **understand** the different Data Structures and its complexity and their uses along with their applications in the related problem.
2. Students should be able to **understand** the concepts of Stack and Queue and its related concepts and should be able to **apply** knowledge to write algorithms based on these concepts.
3. Students should be able to **understand** different types of Link List and should be able to write algorithm on this topic.
4. Students will be able to **analyze** tree data structure and their different types and should be able to solve competitive level questions on the topic.
5. Students should thoroughly understand graph data structure and should be able to **apply** it to solve the problems. They should also be able to **analyzing** different types of sorting algorithms along with their complexity.

UNIT 1:

Definition of Data Structure, Types & characteristics of Data structures, Abstract Data Type (ADT), Algorithms, Space and Time complexity, Characteristics of an array, Implementation of 1-D arrays, Row and Column Major Implementations of 2-D, 3-D and n-D arrays, Advanced concept of Pointers in C, Dynamic allocation of Memory.

UNIT 2:

Stack as an ADT, operations on stack, Stack implementation using array and linked list, Applications of

Stack: Polish and reverse Polish notations, Recursion, Garbage collection. Queue as ADT, Operations on queue, and Types of queues: Linear Queue, Circular Queue, Priority Queue, and Double Ended Queue, Applications of Queue.

UNIT 3:

Concept of a Linked List, Linear Single and Double link lists, Circular Single and Double link List, Header Linked list, Applications of Link List.

UNIT 4:

Tree, Tree as ADT, binary trees, Operations on tree, Binary Search Tree, Tree traversal Algorithms, Types of Binary tree, AVL Trees, Heap Tree, Expression tree, B – Tree and B+ Tree.

UNIT 5:

Graph: Different terminology associated with Graphs, Types of graphs – directed/undirected, connected/disconnected, cyclic/acyclic, Representation of graphs: Adjacency matrix, Incidence Matrix, linked list. Graph Traversal algorithm, Graph algorithms, Minimum Spanning Tree – Prim's and Kruskal's Algorithm, Sorting Algorithms

Recommended Books:

- Data Structure, Seymour Lipschutz, Schaumn Series, Tata McGraw publications.
- An Introduction to Data Structure with Applications by Trembley and Sorenson, McGraw Hill education.
- Fundamentals of Data Structure in C by Horowitz, Sahni and Anderson-Freed, University Press.
- Data Structure and Algorithm – John Beidler, Springer.

CSC- 303: DIGITAL LOGIC DESIGN

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students should thoroughly understand how to represent numbers and perform arithmetic in different bases, Encode symbols and numbers in binary codes.
2. Students should learn to evaluate and simplify logical functions using Boolean algebra and karnaugh map.
3. Students will be able to Implement logic functions with basic gates, NAND-NAND and NOR-NOR logic.
4. Students will be able to design and analyze combinational logic circuits containing adders, multiplexers, decoders, de-multiplexers etc.
5. Students should thoroughly understand the functionality of flip-flops for analysis and design of sequential circuits like counters, shift registers etc.

UNIT 1: BOOLEAN ALGEBRA AND LOGIC GATES

Introduction, Binary numbers, Base-conversions, Octal and hexadecimal numbers, complements, binary codes, concept of fixed and floating point numbers, Axiomatic definition of Boolean Algebra, Basic Theorems and

properties Boolean frictions and representation in canonical and standard forms, SOP and POS forms, other logic operations,

UNIT 2 FUNCTION MINIMIZATION

Digital logic gates. Karnaugh map methods, limitations of K-maps for larger variables, POS-simplification, NAND/NOR implementation, other 2-level implementations, Don't-care conditions, Tabular method.

UNIT 3: COMBINATIONAL SYSTEMS-1

Hardware aspect of arithmetic logic functions, Half-Adder, Full-Adder, Binary Adder/Subtractor, Decimal Adder

UNIT 4: COMBINATIONAL SYSTEMS-II

Magnitude Comparator, De-multiplexer, Multiplexer, encoder, Priority Encoder, Parity Checker/Generator,

UNIT 5: SEQUENTIAL SYSTEMS

Definition and state representation, Filip-Flops, RS, D, JK-M/S, their working characteristics, State Tables, Excitation Taties and triggering Asynchronous and Synchronous Counters-Design and Analysis, Counter Applications, Description and Operations of Shift Registers, Shift Register/Counters

Books :

- W.I. Fletcher, "An Engineering Approach to Digital Design", PHI, 1990.
- R.J. Tocci, "Digital Systems: Principles, and Applications", PHI 1990.
- T.C. Bartee, "Digital Computer Fundamentals", McGraw Hill, 1994.

CSC- 304: SYSTEM SOFTWARE AND BLOCKCHAIN TECHNOLOGY

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will be able to understand the fundamental of translators including Intermediate code generation of Compiler, language processing, language grammar, and address modifications uses along with their applications in the related problem.
2. Students will be able to understand the concept of pseudo assembly language programming, design specifications, Intermediate code, and code conversion from assembly to machine level and macro designing & programming
3. Students should thoroughly understand the basics and advance concepts of Linux operating system with their commands, I/O redirection, Piping, basics of Shell with advance shell scripting and should be able to make shell scripts efficiently.

4. Students will be able to understand Understanding the concept of Blockchain networks and Cryptocurrencies, regulatory and policy considerations for designing applications based on Blockchain technology
5. Understand how a company can reinvent itself or enter new markets using blockchain technologies, Comprehend the use Blockchain in real world scenarios and applications.

UNIT – 1: INTRODUCTION

Introduction to system software, introduction to language processor, fundamental of language processing and specification, language processor development tools, Data structure of language processing, scanning and parsing. Machine structure and Machine language. Introduction to complier design, Phases and machine code generation of compiler.

UNIT – 2: INTRODUCTION TO ASSEMBLER & MACRO DESIGN

Elements of assembly language programming, review of instruction format, Addressing modes, Functions of Assembler, Design of Assemblers: single pass assemblers, two pass assembler. Macro instruction, features of macro preprocessor, implementation of Macros, Relocation and linking concept, Design of linker, self-relocating program, linking of overlays.

UNIT – 3

INTRODUCTION TO LINUX SHELL COMMANDS, PIPING, I/O REDIRECTION & SCRIPTING

Linux basic commands, File system, I/O Redirection and piping, processes in Linux, Communication commands. Decision, Loops- while, until and for loops, break and continue, File meta characters, Functions of shell, exporting variables, trapping signals, shell variables $?, $$, $#, $*, $1, system administration.

UNIT – 4: Introduction to Blockchain

History, Digital Money to Distributed Ledgers, Design Primitives, Protocols, Security, Consensus, Permissions, Privacy. Design and consensus, Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms, Requirements for the consensus protocols, PoW and PoS, Scalability aspects of Blockchain consensus protocols.

UNIT – 5: Application of Blockchain

Types of Blockchain, Design goals, Consensus protocols for Permissioned Blockchains, Hyperledger Fabric, Decomposing the consensus process, Hyperledger fabric components, Smart Contracts, Hybrid models (PoS and PoW). Decentralized Cryptocurrency, Distributed Cloud Storage, E- Voting, Insurance Claims, Cross-Border Payments, Asset Management, Smart Appliances.

BOOKS:

- System programming and operating system By D.M. Dhamdere, TMH 2nd Revised edition.
- System programming By John J. Donovan , TMH.
- Unix programming By Allen Cox , Wrox publication
- Unix shell Programming By Yashvant Kanetker.
- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press.
- Wattenhofer, Roger, The science of the blockchain, CreateSpace Independent Publishing Platform.
- Bahga, Arshdeep, and Vijay Madisetti,. Blockchain Applications: A Hands-on Approach, VPT.

- Diedrich, Henning, Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations, Wildfire Publishing (Sydney).

CSC-401: COMPUTER ORGANIZATION AND ARCHITECTURE

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Understand the functions of basic components of a computer system and design of microoperations
2. Design of hardwired microarchitecture
3. Design of microprogrammed architecture
4. Design of memory subsystems
5. Analysis of Input/Output sub system

Unit 1: INTRODUCTION TO COMPUTER ORGANIZATION

Introduction, Basic Computer Organization – CPU, Memory, I/O, Performance Metrics, CPU organization - ALU, CU, Registers, Von Neumann Principle, Machine Instructions, Instruction Execution Cycle, Register Transfer and Micro-operations, Hardware Design of Micro-operations.

Unit 2: PROCESSOR DESIGN

Processing Unit – Instructions and Operations, Design of Microarchitectures, Single Cycle Data Path Design and Control, Design

Unit 3: PROCESSING DESIGN– II

Design of Microprogrammed Control, Microprogram Sequencer, Design of Microprogrammed Control, Horizontal and Vertical Microprogram.

Unit 4: MEMORY SUBSYSTEM

Memory Organization - Memory Hierarchy, Concept of Cache Memory, Mapping Techniques, Cache Organization and Design, Replacement Algorithms, Write Policies, Main Memory Unit - Internal organization of a Memory chip, Interleaved Memory, DRAM Chip Design.

Unit 5: INPUT/OUTPUT SUBSYSTEM

Access of I/O devices, I/O ports, I/O interfaces, Program controlled I/O, Interrupt controlled I/O, DMA controlled I/O.

Text Books:

- John D. Carpinelli **"Computer Systems Organization and Architecture"** Pearson Education.
- William Stallings, **"Computer Organization and Architecture: Designing for Performance"**9th Edition, Pearson Education, 2013.
- M. Morris Mano, **"Computer System Architecture"** Prentice Hall, 1993

Reference Books:

- D.A. Patterson and J.L. Hennessy, "**Computer Organization and Design, the Hardware/Software Interface**", Morgan Kaufmann, 1994.
- V.C.Hamacher, Z.G. Vranesic and S.G. Zaky, **"Computer Organization"**, 4th edition, McGraw Hill, 1996.

CSC- 402: DATABASE MANAGEMENT SYSTEMS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students will be able to understand fundamental conceptual of a database using Entity Relationship Model for a given Scenario.
2. Student will be able to **apply** normalization techniques to minimize data redundancy.
3. Student will be able to **Apply/Analyse** SQL queries to retrieve data for a given scenario.
4. Student will be able to **explain/design** the principles of various concurrency control and deadlock recovery.
5. Student will be able to **Apply /understand** how data is stored and retrieved in application specific databases: cloud based, Graph database, Fuzzy database.

UNIT 1: Introductory Concept of DBMS (CO1)

Introduction and application of DBMS, Data Independence, Database System Architecture – levels, Mapping, Database users and DBA, Entity – Relationship model, constraints, keys, Design issues, E-R Diagram, Extended E-R features- Generalization, Specialization, Aggregation, Translating E-R model into Relational model, Introduction to TRC,DRC,RA

UNIT 2: Data Base Design(CO2)

Dependency and Normal forms-dependencies theory-functional dependencies-Armstrong Axiom of FD's-closure set of FD's- minimal covers Definition of 1NF-2NF-3NF and BCNF-decomposition and desirable properties of them-algorithm of 3NF and BCNF normalization 4 NF and 5 NF

UNIT 3: STRUCTURED QUERY LANGUAGE (SQL and PL/SQL) (CO3)

SQL: Introduction to SQL constructors (SELECT FROM, WHERE GROUP BY HAVING ORDRDBY), Insert, Delete, Update, DROP, VIEW, Nested Quires, Integrity Constraint: Not null, unique, check, primary key foreign key,

PL/SQL: Variables literals, datatype, advantages of PL/SQL: control statements: if; iterative control loop, while, for, goto, function, cursor, trigger, View.

UNIT 4: TRANSACTION MANAGEMENT (CO4)

Concept of transaction processing, ACID properties, Concurrency control, locking based protocol, Time stamp based protocol,

UNIT 5: Advance Databases and its Emerging areas (C05)
Introduction to No SQL, Cloud Based DBMS, , Open source Data Base, Distributed Database, Object oriented Database, Mobile Database, Multimedia Database, Open Issues and Uncertainties.

Reference Books:

- "Fundamentals of Database Systems", Elmasri, Navathe, Pearson Education, IVth Edition. Pearson Education.
- "Database system concepts", Henry F Korth, Abraham Silberschatz, S. Sudurshan, McGraw-Hill.
- "An Introduction to Database Systems", C.J.Date, Pearson Education.
- "Data Base System", Michael kifer and et all, Pearson Education..
- "Database Management Systems" ,Ramakrishnan, Gehrke;Mcgraw-Hill.
- "The Database Book –Principle and Practice" By NarainGehani, University Press.
- "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson Education.

CSC- 403: OPERATING SYSTEM

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks

Duration of Exam : 3 Hours

Course Outcomes:

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1. Students will be **able** to describe the functions and structure of operating systems
2. Student will be **able** to understand the principles of process management, and possess the ability to **apply** various scheduling algorithms,
3. Ability to compare and contrast various memory management schemes
4. Student will be able to **understand** the principles of concurrent execution, synchronization, deadlock detection and avoidance and possess the ability to apply various algorithms
5. Students will be able to **analyze** various disk systems, file systems and I/O sub systems

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Course Description

UNIT – I INTRODUCTION TO OS

Introduction to OS, Multiprogramming, Time-sharing System, Operating System Operation, Dual Mode Operation: Kernel Mode, User Mode. Function of OS, Operating System Services, thread, multithreading model, System Call, Types of System calls, Operating system structure, The Process, Process State, Process Control Block, Process Scheduling, Operations on Processes, Schedulers and its types, Scheduling Criteria,

UNIT- II PROCESS SCHEDULLING

Scheduling Algorithms: First Come, First Served (FCFS), Shortest Job First(SJF), Shortest Remaining Time First(SRTF) , Longest Job First(LJF) , Longest Remaining Time First(LRTF), Highest Response Ratio Next (HRRN), Priority Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling(MLQ), Multilevel Feedback Queue(MLFQ) Scheduling, Multiprocessor Scheduling

UNIT- III MEMORY-MANAGEMENT STRATEGIES

Background: Basic Hardware, Address Binding, Logical vs. Physical Address Space. Swapping, Contiguous Memory Allocation, fixed partition, Best-Fit, First-Fit and Worst-Fit Memory Allocation Method, dynamic partitioning, compaction, Buddy System, fragmentation-internal and external , Non-Contiguous Allocation, Paging, hardware support for paging, Translation Look Aside Buffer, Structure of Page Table, Hierarchical Paging, Hashed Page Table, Inverted Page Table, Segmentation, Segmentation with paging, Virtual Memory: Background, swapping, Demand paging, Page Replacement Algorithms, First in First out(FIFO),Least-recently-used(LRU), optical page replacement, Least Frequently Used(LFU), Belady's Anomaly

UNIT- IV SYNCHRONIZATION AND DEADLOCK

The Critical- Section Problem, Race condition, Synchronization Hardware, Peterson's Solution, Semaphores, Mutex and Classical Problems of Synchronization: Bounded- Buffer Problem, The Reader- Writers Problem, Sleeper barber problem, Dining- Philosophers Problem, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Banker's Algorithm, Deadlock Detection, Recovery from Deadlock

UNIT – V FILE-SYSTEM INTERFACE AND MASS- STORAGE STRUCTURE

File Concept, Access methods, Allocation Methods. Secondary Storage Disk- structure, Disk-scheduling: FCFS, SSTF, SCAN, C-SCAN,LOOK,C-LOOK Scheduling algorithms

References / Text Books:

- Operating system concepts: Silberchatz Galvin, Gagne: john Wiley & Sons, inc.2007
- Operating systems: A Concept-based approach: D M Dhamdhere 2nd edition TMH 2007
- Operating systems: Deitel Deitel Choffnes 3rd edition Pearson Education 2007
- Milenkovic, Milan: Operating system concepts and Design, McGraw Hill, 1994.e.g. Mac or Linux Operating System, Bash Shell, Gedit, GCC
- http://quiz.geeksforgeeks.org/

CSE- 501: INTRODUCTION TO DATA MINING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand the data mining concepts and the various tasks related to data mining.
2. Apply preprocessing methods in order to prepare data for applying various data mining task.
3. Analyze and evaluate various association rule mining algorithms and should write algorithms to implement it.
4. Analyze various classification algorithms and should be able to apply the algorithms on different datasets.
5. Apply various clustering algorithms on real and large datasets. Students should be able to take research level problems related to data mining and should be able to implement it.

UNIT 1:

Introduction to Data Mining: KDD, Process and Data Mining; KDD Steps; Types of Data for Data Mining, Data Mining Functionalities, Overview of data mining techniques.

Data Preprocessing: Introduction to Data Preprocessing; Descriptive Data Summarization: Measuring and Central Tendency and Dispersion of Data; Visualization of Descriptive Data Summaries; Data Cleaning: Handling Missing Values, Filtering Noisy Data – Binning Method; Data Integration; Data Transformation: Smoothing, Aggregation, Generalization, Normalization and Feature Selection; Data Reduction. Corerelation analysis

UNIT 2:

Association Rule Mining: Market basket Analysis; Frequent Item sets, Closed Item sets, and Association Rules; Support and Confidence; Apriori Algorithm for Mining Frequent Itemsets Using Candidate Generation; Generating Association Rules from Frequent Item sets; Improving the Efficiency of Apriori Algorithm; FP-Growth Algorithm for Mining Frequent Item sets without Candidate Generation; Mining Closed & Max Frequent Itemsets;

UNIT 3:

Basic Classification: Introduction to Classification and Prediction; Classification by Decision Induction; Attribute Selection Measures: Information Gain, Gain Ratio, and Gini Index; Tree Pruning; Bayesian Classification: Bayes'Theorem, Naïve Bayesian Classification

UNIT 4:

Advanced Classification: Bayesian Belief Networks; Classifier Accuracy Measures: Sensitivity, Specificity, Precision, and Accuracy; Predictor Error Measures; Accuracy Evaluation Methods: Holdout, Random Sub sampling, Cross-validation, and Bootstrap Bagging and Boosting; Lazy Learners: K-Nearest- Neighbour Classifier; Prediction: Introduction to Linear and Non-Linear Regression.

UNIT5:

Cluster Analysis: Introduction to Cluster and Clustering; Features Required for Clustering Algorithms; Data Types and Dissimilarity Measures in Cluster Analysis; Categorization of Clustering Methods; Partitioning-Based Clustering: k-means Algorithms, k-Medoids algorithms, Hierarchical Clustering: Agglomerative and Divisive Methods.

Introduction to Web Mining and Text mining, Problem discussion.

Recommended Books:

- Data Mining by Hanand Kamber, Elsevier Publication.
- Introduction to Data Mining by Tan, Steinba chand Kumar, Pearson Publication.
- Practical Machine Learning Tools and Techniques with Java Implementations by H. Witten and E. Frank Morgan Kaufmann.
- Advances in Knowledge Discovery and Data Mining by U. M. Fayyad, G. Piatetsky-Shapiro, P. Smyth, and R. Uthurusamy, MITPress.

CSC- 501: AUTOMATA THEORY

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

1. Design different types of Finite Automata, their equivalence and applications.
2. Design Regular expressions from Finite Automata and solve problems using pumping lemma for Regular Languages.
3. Understand the Chomsky classification of Languages. Design Context Free Grammars for languages along with their simplification.
4. Design PDA for various problems, construction of PDA from a CFG along with the concept involving use of PDA to build Parsers.
5. Design Turing machines for various class of problems.

UNIT 1:

INTRODUCTION TO FINITE AUTOMATA: Introduction to Finite Automata, strings, alphabets and languages, graphs & trees, state tables & diagram, NDFA & DFA concepts, Conversion of NFA to DFA, Minimization of FA, Mealy & Moore machines.

UNIT 2:

REGULAR EXPRESSION: Introduction to Regular Expressions, Identities for Regular expressions, Arden's Theorem, Conversion of Finite Automata to Regular Expression, properties of regular languages. Pumping Lemma for Regular sets.

UNIT 3:

CONTEXT FREE GRAMMARS& LANGUAGES: Introduction to Grammars and Languages, Chomsky Classification of languages, Context free Grammar, Left Most & Right Derivations, Derivation tress, Ambiguity, Simplification of CFG, Conversion to Chomsky Normal Form.

UNIT 4:

PUSH DOWN AUTOMATON: Introduction to Push Down Automaton (PDA) for Context Free languages, Basic Design of a PDA, Instantaneous configuration of PDA, Construction of PDA for Context free languages, conversion from CFG to PDA.

UNIT 5:

TURING MACHINES &COMPUTABILITY: Introduction to Turing Machines (TM), Computing with Turing Machines, Non-deterministic TM, Primitive Recursive functions**,** Halting Problem of the TM, Computability and Types of Problems in Computer Science.

Books:

- J.E. Hopcroft & J.D. Ullmann, "Introduction to Automata Theory Language and Computation", Narosa Publications.
- K. L. P. Mishra & Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI
- H.R. Lewis & C.H. Papadimitrou, "Elements of the Theory of Computation", PHI
- John C. Martin, "Introduction to Languages and the Theory of Computation", McGraw-Hill International
- D.A. Cohen, "Introduction to Computer Theory", John Wiley.

CSC- 502: MICROPROCESSOR

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will be able to understand Timing diagram and architecture of 8085, 8086 and other microprocessors.
2. Students will be able to write and use the instructions in Instruction set of 8085, 8086 correctly.
3. Students will be able to write 8085 programs.
4. Students will have understanding of Interfacing and Interrupt of 8085.
5. Students will be able to develop 8086 Programs, software interrupt and can interface peripheral devices with 8086.

UNIT 1:

Review, Organization and architecture of 8085,8086 and other Microprocessors, Instructions of 8085 & Programming techniques, Machine Language Vs Assembly Language, Basic concepts of timing & control unit, Timing Diagrams for 8085 instructions. Study of important 8 – bit Microprocessors & their Comparison, Introduction to 16 – bit processors – 8086, 8088 and 68000 Coprocessor & comparison. Introduction to 32 – bit Microprocessors.

UNIT 2:

Instruction set of 8085, instruction set of 8086, Syntax and illustration of different types of instructions along with their use.

UNIT 3:

Programs using instruction set of 8085, maximum, minimum, searching ,sorting, division, multiplication, factorial ,conversion from binary to decimal and ASCII, decimal to Binary , matrix addition and other relevant programs using instruction set of 8085, Subroutine, Counter, delay calculations,

UNIT 4:

Minimal System, Necessity for interfacing, Address space partitioning – Memory mapped I / O & I / O Mapped I / O, Advantages and Disadvantages, Types of Interfacing devices – I / O ports, Programmable peripheral interfaces 8255, Various interrupt Schemes, Multiple Interrupt, Enabling, Disabling and Masking of Interrupts Particularly in 8085, DMA & DMA Controller.

UNIT 5:

TASM, MASM, programs based on 8086 instruction set, Software Interrupt, Assembly language programming in C, Interfacing with 8086, Microprocessors based system design

Books:

- K.M. Bhurchandi and A.K. Ray, Advanced Microprocessor and Peripherals, Tata McGraw Hill
- A.P. Mathur, "An Introduction to Microprocessors" Tata McGraw Hill, 1995.
- K.L. Short, "Microprocessor & Programmed Logic", 2nd Ed., PHI, 1994
- R.G. Gaonkar, "Microprocessor Architecture programming and application", Wiley Eastern Ltd., 1994.

CSC- 503: COMPUTER NETWORKS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students will be able to memorize and remember the Fundamentals of Computer Networks.
2. Student will be able to understand various switching techniques, Communication media, and Digital Analog formats.
3. Student will be able to Apply Flow Control Algorithms and Evaluate the Error Detection and Correction Methods.
4. Student will be able to Analyze the performance of the Computer Networks.
5. Student will be able to configure and create Routing Tables and Private Networks.

UNIT 1:

Introduction:

Introduction to Computer Networks, LAN, MAN, WAN, Uses of Computer Networks, LAN Technologies- Transmission Topologies, Access methods. Network Architecture, Protocol and standards, References Model: OSI-ISO and TCP/IP, Overview: Circuit switching, Message switching and Packet

switching.

UNIT- 2

The Data Link Layer:

Data Link Layer design issues, Framing, Error Detection and Correction, Flow control Protocols, Stop and Wait protocol, Sliding - window flow control, Error control, stop and wait ARQ, Go-back-N, Selective repeat ARQ, Examples of Data link Protocols- HDLC.

UNIT- 3

The Medium Access Control Sub Layer:

The channel allocation problem, ALOHA, Multiple access Protocols, Collision free Protocols, IEEE Standards for LANs and MANs, Wireless LAN: IEEE 802.11, High speed LANs.

UNIT – 4

The Network Layer:

Addressing in IPV4: Classful addresses, CIDR notation, Classless addresses, Special addresses, Network Design: Sub-netting and Super-netting, Network Address Translation, IPV6.

UNIT – 5

Routing Algorithms-Dijsktra's, Distance vector: RIP, Link state: OSPF, BGP,Multicast Routing, and Hierarchical Routing. Delivering and forwarding of IP Packets, Datagram.

Books :

- B.A. Forouzan, " Data Communication and Networking", TMH, 5TH Edition.
- A.S. Tanebaum, " Computer Networks", 4th Edition Pearson Education.
- W. Stallings, " Data and Computer Communication", 7th Edition , Pearson Education.
- Comer E. Doughlas, " Computer Networks and Internet", 2nd Edition Pearson Education.

CSC- 504: SOFTWARE ENGINEERING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students will be able to understand fundamental theories of Software Development life cycle & various SDLC Models.
2. Student will be able to understand various types of Requirements, Techniques for Requirement Elicitation and SRS Document, COCOMO, Risk Management activities etc.
3. Student will be able to understand coupling and Cohesion and its types, Software Reliability and Quality assurance using ISO9001:2008, ISO9001: 2015 Standards and SEI-CMM.
4. Student will be able to understand various types of Software Testing and Generating test cases using various testing approaches and Debugging.
5. Student will be able to understand Software Maintenance, Types of maintenance, various models of maintenance, Software RE-ENGINEERING and REVERSE Engineering and Configuration Management & CASE Tool etc

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Unit 1: Introduction Definition, Program Vs Software, Software processes, Software life cycle models: Build and Fix, Waterfall, Prototype, Iterative Enhancement Model, Evolutionary and Spiral model, V Model & RAD Model.
Unit 2: Software Project Planning. Crucial process steps of Requirement Engineering, Types of requirements, Requirement Elicitation techniques and Requirement Documentation, SRS, COCOMO model, Risk management.
Unit 3: Software Requirement Analysis and Specifications, Design & Software Reliability. Problem Analysis, Data Flow Diagrams, use case diagrams, Software Prototyping, Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design, User Interface Design. Software Reliability: Failure and Faults, Overview of Quality Standards like ISO 9001, SEI-CMM
Unit 4: Software Testing Software Testing terminology, Functional testing: Boundary value analysis, Equivalence class testing, Cause- effect graphing, Structural testing: path testing, Data flow and mutation testing, unit testing, integration and system testing, Validation testing Debugging techniques & Approaches and Testing Tools.
Unit 5: Software Maintenance Software Maintenance & its types: Management of maintenance, The Maintenance Process, Maintenance Models: Quick fix, Iterative Enhancement, Reuse Oriented. Reverse Engineering, Software RE-engineering, Configuration Management.

BOOKS:

- Prof: KK Aggarwal & Yogesh Singh: SOFTWARE ENGG:
- Pankaj Jalote, " An Integrated Approach to Software Engg" Narosa Publishing House, New Delhi.
- Pressman,"Priciples of Software Engg" TMC, 5th Ed. 2005

CSC- 505: OBJECT ORIENTED PROGRAMMING

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will **define** and **critique** the fundamental features of object oriented programming.
2. Students will **write** C++ programs to **demonstrate** polymorphism
3. Students will **explore** C++ programs with and without inheritance
4. Students will **develop** object-oriented programs in a new programming language
5. Students will **use** templated/generic components to **build** reusable software components

UNIT 1: OBJECT ORIENTED PROGRAMMING USING C++

Object Oriented Paradigm, Structured vs Object Oriented Development, Concept of Object and classes, Encapsulation, Polymorphism, Inheritance, Merits and demerits of OOP. Class specification, Class objects, Defining member function, Inline functions, Data Hiding, Empty class, Passing objects as parameters, Returning objects from functions, Static data and member functions. Constructors and destructors, overloading of constructors, Dynamic initialization through constructors, Copy constructors,

Static data members with constructors and destructors. Pointers to objects, Array of objects, this pointer

UNIT 2: IMPLEMENTING POLYMORPHISM IN C ++

Function and Operator overloading, Overloading of unary and Binary operators, Limitations of overloading of increment and decrement operators, overloading of arithmetic, Relational, assignment, new and delete, subscript operators. Data conversion between objects. Complete conversion. Overloading through friend functions. Tracing of memory leaks.

UNIT 3: INHERITANCE AND VIRTUAL FUNCTIONS

Declaration of derived class, forms of inheritance, constructors and destructors in derived class, types of inheritance, abstract class, Virtual functions: Need of virtual functions, Pointers to derived class objects, pure virtual functions, Virtual destructors, Rules of writing virtual function

UNIT 4: OBJECT ORIENTED PROGRAMMING USING JAVA

Classes, objects and constructor in Java, Implementing inheritance and polymorphism - dynamic binding, method overriding, abstract classes and methods. Interfaces - Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interfaces.

UNIT 5: GENERIC PROGRAMMING IN JAVA

Introduction to Exception Handling, Generic programming in Java. Why Use Generics? Types of Java Generics. Generic classes. Generic functions. Generics, Inheritance, and Subtypes. Type inference. Wildcards. Type erasure.

BOOKS

1. The C++ Programming Language by B.Stroustrup, Pearson Education.
2. Thinking in C++ by Bruce Eckel, Pearson Education
3. Object Oriented Programming in C++ by N.Barkakati, PHI
4. Mastering C++ by Venugopal and et all, Tata McGraw Hill
5. C++ How to Program by Deitel and Deitel, Pearson Education
6. The Complete Reference Java by Herbert Shildt, Tata McGraw Hill
7. Object-Oriented Programming in C++ by Robert Lafore, 4th Edition, Pearson Education.
8. Java Generics and Collections: Speed Up the Java Development Process, 1st Edition. O'Reilly.

CSC- 601: ANALYSIS AND DESIGN OF ALGORITHMS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

1.Students will be able to **analyze** algorithms and to determine asymptotic-complexity orders.

2.Students will be able to **understand** algorithmic design paradigms such as divide-&-conquer and their methods of **analysis**.

3.Students will be able to **analysing** number of greedy algorithms for problems in engineering and problems involving graphs.

4. Students will be able to **apply** algorithm design techniques such as dynamic programming, branch & bound, and backtracking to solve real-world problems.
5.Students will be able to **understand** solve problems related to string matching and compare algorithms based on their complexity correctness/class.

UNIT I

Introduction to algorithm, analyzing algorithm, RAM Model of Computation. Best-case, worst-case and average-case complexity analyses. Asymptotic Notations: Big-Oh, Big-Omega, Theta notations, Small-oh, Small-omega notations, Rules of notations. Solving recurrence equations: Iterative method, Recursion-tree method, Guess method, Master method, Master's theorem, Rate of growth of functions and their ranking. Review and analysis of searching and sorting algorithms

UNIT II

Divide and Conquer Strategy: Introduction, Counterfeit coin detection, binary search, merge sort, quick sort, Heap sort, integer multiplication, matrix multiplication (Strassen's algorithm), exponentiation problem, polynomial multiplication, when to avoid divide-&-conquer strategy.

UNIT III

Graph Algorithm: Introduction, topological sorting, Dijkstra's algorithm shortest path for weighted graph, DFS algorithm, BFS algorithm, Greedy Algorithm: Introduction, activity selection problem, change-making problem, Huffman coding, Minimum spanning tree problem, disjoint set data structure, prims and kruskal algorithm, 0/1 knapsack problem using greedy, backtracking and branch and bound, fractional knapsack problem,.

UNIT IV

Dynamic Programming: Introduction, Fibonacci series calculation, 0/1 knapsack problem, matrix chain multiplication, Longest common subsequence problem, memoization, Floyd-Warshal's algorithm. Backtracking

UNIT V

String Search Problem: Naïve algorithm, Rabin-karp algorithm, FSA based algorithm, Complexity theory: P class of problem, NP-class of problem, Decidability of problems, NP hardness and NP completeness.

BOOKs:

- T H Cormen, C E Leisersor, and R L Rivest, Introduction to Algorithm, Third Edition, PHI.
- Richard Neapolitan and Kumarss Naimipour, Foundation of Algorithms, Fourtht Edition, Jones & Bartlet.
- A V Aho, J E Hopcroft and J D Ullman, The Design and analysis of computer algorithms, Pearson Education
- E Horwitz, and S Sahni, Fundamentals of Computer Algorithm, PHI
- Goodrich & Tamassia, Algorithm Design, Wiley
- A Levitin, Introduction to the Design & Analysis of Algorithms, 2nd Edition, Pearson Education.

CSC- 602: COMPILER DESIGN

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students understand the Language Processing System the role of a Compiler and the phases within it. They shall also be an explained about the design and role of a Lexical analyzer.
2. Students shall be able to Design Top-Down and Bottom-Up Parsers for unambiguous CFGs and apply these concepts to competitive questions.
3. Students will understand the task of semantic analysis phase. They shall also be able to construct semantic rules and the concept of type checking in a compiler.
4. Students will be able to Design Three address codes for various programming language constructs including arithmetic and conditional statements, loops, expressions, etc.
5. Students will apprehend the various issues in the design of the code generator and the task of code generation for a given intermediate code.

UNIT 1:

INTRUCTION TO COMPILER AND LEXICAL ANALYSIS PHASE: Introduction to compilation, Language processing system, Analysis of the Source Program, Phases and Passes in compilers,
Introduction to Lexical analysis, Input buffering, tokens, lexemes & pattern, FA and regular Expressions with related concepts, Specification, and recognition of tokens, and Design of lexical analyzer generator.

UNIT 2:

SYNTAX ANALYSIS PHASE (PARSING): Role and position of a Parser, Predictive Parsing, Context Free Grammar, Parsing approaches. Top-down Parsing: LL Parsing; Bottom-Up Parsing technique: LR Parsing, SLR, CLR & LALR Parsing

UNIT 3:

SEMANTIC ANALYSIS AND TYPE CHECKING: Syntax Directed Definitions and translations, Attributes and Attribute grammar, construction of syntax trees, Type Checking, Type checking for expression and statements.

UNIT 4:

INTERMEDIATE CODE GENERATION& OPTIMISATION: Intermediate representations, TAC statements, TAC implementations, Short circuit code, TAC generation for Assignment statements, Boolean expression and flow of control statements,
Various TAC Optimizations, Control Flow Analysis & Data Flow Analysis, Leaders & Blocks, Flow Graphs, Dominators, Natural Loops, Gen-Kill and IN-OUT information for blocks.

UNIT 5:

TARGET CODE GENERATION:

Issues in the design of a code generator, the target machine, code generation from DAG, Heuristic Node Listing Algorithm, Code generation from a tree, Labeling Algorithm, and Function Gencode.

Books:

- Aho, Sethi, Ullmann& Lam "Compilers: Principles, techniques and tools", Pearson Education Asia
- Keith Cooper& Linda Torczon, "Engineering a Compiler", Morgan Kaufmann publication.
- Levine, Mason, and Brown, "Lex&Yacc", O'Reilly publication.
- Vinu V. Das, "Compiler Design using FLEX and YACC" PHI.

CSC- 603: PARALLEL AND DISTRIBUTED COMPUTING

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will be able to understand architecture , dependency analysis and other issues of parallel Systems and performance laws to evaluate them
2. Students will be able to design and implement pipeline for solving real life problems.
3. Students will able to design parallel algorithm for solving a given problem and to parallelize sequential algorithms.
4. Students will be able to understand and write cluster program using MPI, multi core program using Open Mp and programming massive parallel processor GPU using CUDA.
5. Students will able to develop real life scalable distributed system and distributed applications

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UNIT 1:

Parallel system , Parallel computing, architectural classification schemes, Evolution of computer Architecture ,Parallel architecture, superscalar processor, Vector processors, Principle of multithreading, latency-hiding techniques, multi core processors, GPU, massive parallel processors, Cache coherence and synchronization mechanism, Arithmetic mean performance, geometric performance, harmonic performance, Performance laws, Amdahl's law, Gustafson's law, Sun and Ni' law, Bernstein's criteria, dependency analysis, flow dependency, anti-dependency, output dependency, dependency flow graph, Evaluating parallel programs, Debugging and evaluating parallel program empirically.

UNIT 2:

Pipeline, Design and analysis of pipeline and system based on it, optimal no. of stages, Instruction scheduling, pipeline hazards and their solutions, Tomasulo algorithm, Branch predictions, pipeline and branch predictor of recent processors, Collision free scheduling, Reservation table and stations.

UNIT 3:

Design and analysis of parallel algorithms, Preliminaries, decomposition techniques, characteristics of tasks and interactions, mapping techniques for load balancing, methods for containing interaction

overheads, parallel algorithm models, the task/channel model, Foster 's design methodology, matrix multiplication, Parallelizing sequential algorithms, SIMD algorithm for matrix multiplication, PRAM model

UNIT 4:

Parallel Programming, Cluster programming using MPI, Multi core programming using OPEN MP, Programming massive parallel processors using CUDA, GPU, OPENCL, OPENACC

UNIT 5:

Distributed system, distributed computing, distributed applications, paradigms of Distributed Computing, Cloud Computing, Distributed algorithms, Logical clocks, clock synchronization algorithms

Books:

- Michael J. Quinn, "Parallel Computing theory and practice", TATA McGraw Hill
- AnanthGramma, Anshulgupta, George Karypis&Vipin Kumar, "Introduction to parallel computing", Pearson Education.
- Michael J. Quinn, "Parallel Programming in with MPI and OpenMP" , Pearson Education
- Barry Wilkinson & Michael Allen, "Parallel Programming techniques and Applications using networked work stations and parallel computers", Pearson Education
- Kai Hwang, "Advanced Computer architectures, Parallelism, Scalability & Programmability", McGraw Hill.
- John L. Hennessey and David A. Patterson, "Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.
- David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors, A hands on approach, Morgan Kaufman publishers,Elsevier.
- Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.
- Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill,2003.
- 4. David B. Kirk and Wen-mei W. Hwu, "Programming Massively Parallel Processors",Morgan Kaufmann, 2010.
- AnanthGrama, George Karypis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", Second Edition, Pearson Education Limited, 2003.
- Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2006.
- Ian Foster, "Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering", Addison Wesley Longman Publishing Co., USA, 1995.
- David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A hardware/ Software approach" , Morgan Kaufmann / Elsevier Publishers, 1999.
- OpenMP Programmer's Manual.
- MPI Programmer's Manual
- Kai Hwang, Distributed and Cloud Computing, Elsevier
- Raj kumarBuya , Mastering Cloud Computing, TMH publications.

CSC- 604: ARTIFICIAL INTELLIGENCE

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

Students will be able

1. To understand how to represent simple facts in Logic–Predicate logic conversion into clause form and Resolution etc.
2. To understand informed and uninformed search Techniques A*, AO*Hill Climbing, Production system, Best first Search techniques etc.
3. To understand fundamentals of AI, Machine Learning, Deep Learning, IoT, and Game playing: Minimax Search Procedure and Alpha Beta etc.
4. To understand Learning, types of Learning, phases of NLP, Neural Network and its application etc.
5. To understand strong and weak Slot and filler Structures, Hopfield network etc.

UNIT-1

Introduction to AI

What is Artificial Intelligence, AI problems, Task domain of AI, AI Technique, Scope and areas of application of AI, representing simple facts in logic- predicate logic, Conversion to clause form, Resolution and Natural Deduction.

UNIT-2

Problems, problem spaces and Search, Heuristic Search Techniques

Defining the problem as a state space search, Production system, problem characteristics, informed and uninformed search technique: Generate and Test, Hill Climbing, Best first search, A*, AO*, Means-ends, analysis, Approaches to Knowledge Representation.

UNIT-3

AI, Machine Learning, Deep Learning & Game playing

Fundamental of AI, Machine Learning, Deep Learning, Application of Machine Learning, IoT, and Game playing: Minimax Search Procedure and Alpha- Beta algorithm.

UNIT-4

Learning, NLP, Neural Network

What is learning? Rote learning, learning by taking advice, learning in problem solving, learning from examples: Induction, Phases of Natural Language Processing, Neural Network, Learning in Neural Networks, Application of Neural Networks.

UNIT-5

Weak and strong slot-and–filler structures, Connectionist Models, Expert System.

Semantic Nets, Frames, Conceptual Dependency, Scripts & Reasoning: Forward versus Backward Reasoning, Monotonic Reasoning, Logics for Non monotonic Reasoning, Introduction to Hopfield Networks, Expert Systems: Characteristics, Architecture of Expert System, Some Major Applications of Expert System.

Books:

- Artificial Intelligence, 3RD Edition, E. Richand Knight(TMH).
- Introduction to Artificial Intelligence–Rajendra Akerkar, PHI.
- Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/Pearson Education.
- Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition,
- Artificial Intelligence and Expert Systems–Patterson PHI
- Expert Systems: Principles and Programming-Fourth Edn, Giarrantana/Riley, Thomson
- PROLOG Programming for Artificial Intelligence. Ivan Bratka-Third Edition–Pearson Education.

CSE- 601: EMBEDDED SYSTEMS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will have understanding of Design Challenges and recent trends in Embedded system design.
2. Students will be able to analyze Architecture of 8051, its memory map and how to interface it with other peripherals to design an embedded system product.
3. Students will be able to understand Instruction set of 8051 and be able to create programs for solving various real time problems.
4. Students will be able to implement programs related to Timer and Counters of 8051 and other microcontrollers for various applications.
5. Students will be able to implement programs related to serial and interrupt programming of 8051.

CO1- UNIT 1:

Embedded system:- Definition, components, I/O, Processor, Memory, Characteristics, attributes, design metrics , design challenges, application areas, Issues of designing efficient Embedded system, Difference between ES and PC, Design Technology, Integration and Testing of Embedded Hardware and Firmware, Embedded System Development Environment:-IDE, compiler, assembler, simulator, Emulator, debugging, Target hardware debugging and Boundary Scan , EDLC, Trends in the Embedded Industry:- Processor trends, OS trends, Development languages trends, Open Standard and framework, S/W H/W Co-design , RTOS:- introduction, type, overview of commercially available RTOS, Introduction to ES design using RTOS ., Soc, NOC

CO2- UNIT 2:

Microcontroller:-Introduction, criteria for choosing a microcontroller**,** Overview of 8051 Microcontroller family: Architecture, basic assembly language programming concepts, Memory Organization of 8051,SFR, Watch Dog Timer, Real Time clock. Interfacing to an external memory and Accessing External data Memory and External Code Memory, Interfacing to LCD/Keyboard, DAC/ADC, Sensors, a Stepper Motor, Interfacing with 8255

CO3- UNIT 3:

Addressing Modes, Instruction set including bit manipulating instruction and programming using it, Subroutine, Stack, , I/O port programming, programs based on the instruction set,

CO4- UNIT 4:

Programming of 8051 Timers, Counter Programming. Time delay generations and calculations, Basic Concepts of Interfacing, Introduction to Arm, Pic, and AVR Processors and other recent processors

CO5- UNIT 5:

basics of Communication with 8051**,** Basics of Communication, Overview of RS-232, I^2C Bus, UART, USB, 8051 connections to RS-232, 8051 serial communication programming, 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, Interrupt priority in the 8051

Books:

- Shibu K V , "Introduction to Embedded Systems" , TMH 2009
- M.A. Mazidi and J. G. Mazidi, "The 8051 Microcontroller and Embedded Systems", PHI, 2004
- Frank Vahid & Tony Givargis, "Embedded System Design ", John Wiley & sons , 2002
- David E. Simon, "An Embedded Software Primer", Pearson Education, 1999.
- Raj Kamal, "Embedded Systems", TMH, 2004.
- K.J. Ayala, "The 8051 Microcontroller", Penram International, 1991.
- Dr. Rajiv Kapadia, "8051 Microcontroller & Embedded Systems", Jaico Press
- Dr. Prasad, "Embedded Real Time System", Wiley Dreamtech, 2004.
- Wayne Wolf, "Computers As Components, Principle of Embedded Computing System Design" , Morgan Kauf man Publishers, 2008.
- Asang Dani & Yashavant Kanetkar, "Go Embedded", BPB Publications, 2008

CSE-701: Computer Vision and Image Processing

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. To understand the basic concept of computer vision.
2. To provide Knowledge of image processing concept
3. To understand different machine learning algorithm for computer vision .
4. To apply various methods of feature extraction and understand their practical application.
5. To apply computer vision techniques on real life application.

UNIT 1: Introduction to Computer Vision and Basic concept of Image Formation (CO1)
Introduction and Goal of computer vision and Human vision, Image formation Concept, Radiometry, Geometry transformations, Geometric camera model viewing through camera, Multiview Geometry

UNIT 2: Image Processing concepts and Image formation (CO2)
Camera calibration, Image formation in a sterio vision Setup, Image Reconstruction from a series of Projection, Image Transformation, Image filtering, Colour image processing.

UNIT 3: Machine learning Algorithm for computer vision(CO3)
Statistical Machine Learning Algorithm for computer vision, supervised and unsupervised learning, Gaussian classifier, parameter estimation, Clustering for Knowledge representation, Dimension Reduction, Artificial and Deep network for computer vision application.

UNIT 4: Image descriptor and Features (CO4)
Texture descriptor, color feature, Edge/Boundraies, Object boundary and shape representations, Histogram of Orident Gradient., Scale Invariant Feature Transform, Speedup Robust feature.

UNIT 5: Application of computer vision (CO5)
Artificial Neural Network for Pattern classification, Convolutional Neural Network, Autoencoders, Gesture
Recognition, Motion Estimation and Object tracking, Object dection using CNN and RCNN,Image Fusion,
YOLO, Deep learning Architecture in computer vision, Basics of GAN.

Reference Books:

- Handbook of Pattern Recognition and Image Processing, K.S. Fu and T.Y. Young, Academic
- Press.
- Digital Image Processing - Gonzalez & Woods, Person Education.
- Fundamental of Digital Image processing by Anil Jain , PHI,
- Digital Image processing and Analysis Chanda and Majumder, PHI Learning
- Digital Image processing –Jayaraman ,Esakkirajan and Veerakumar,TMH
- Digital Image processing –William k.Pratt,Wiely India
- The Image Processing Handbook, John C. Russ, CRC Press SIUE Library
- Computer vision: Algorithms and Applications by Richard Szeliski.
- Computer vision-A modern approach, by Forsyth and J.Ponce,Prentice Hall .
- Dictionary of Computer vision and Image processing, by Fisher et al.
- List of Open Source Software/learning website: Open CV, Python

CSE-702: MOBILE COMPUTING AND IOT

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Understand Principles and concepts, Mathematical model, Mobile generations, wireless frequencies.
2. Analysis and Mobile Designing with frequency allocations.
3. Operation process of calling system from Mobile to Mobile, Mobile to fixed line and vice-versa with security provision for both using GSM and CDMA.
4. Apply IoT Standards and Protocols and IoT communication models, in Home, City, Environment, Agriculture and Industry.
5. Design Hardware for IoT and WSN enable devices used in distance, motion and light detection system and store the data on cloud.

UNIT – I

Introduction to Mobile Computing and its Architecture, Basic cellular system, Transmission problems and its solution in cellular system, cellular geometry, components of a cellular Mobile network, Concept of Frequency re-use channels, Cell splitting, Sectoring and Clustering of a cell, Co-channel interferences and system capacity, Trunking and Grade of services.

UNIT- II

GSM Architecture, Channels used in GSM, GSM Transmission process to Network, Traffic cases in GSM. Location tracking and call setup, Mobility management, Frame structure for GSM, Handoff and dropped calls, Security and Authentication in GSM, GSM network identities.

UNIT- III

CDMA Architecture, Chipset sequences in CDMA, Channels used in CDMA, CDMA system design, capacity of a CDMA system, Next generation cellular technology.

UNIT – IV

Introduction to Internet of Things- Definition and Characteristics of IoT, IoT Standards and Protocols, IoT communication models, IoT Communication APIs, IoT Applications: Home, City, Environment, Agriculture and Industry.

UNIT- V

Sensors and Actuators in IoT, Controlling Hardware, Connecting LED, Buzzer, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, Stepper motors, Light sensor, temperature sensor with thermistor, Motion Detection Sensors, Distance Measurement with ultrasound sensors, Basic Networking with ESP8266 Wi-Fi module ,Data Management in IoT.

Text / References Books:

- Theodore S. Rappaport, Wireless communications Principles and Practice, Pearson Education.
- Jochen Schiller, Mobile Communications, Pearson Education 2012.
- Vijay K. Garg, Wireless communication and Networking, Elsevier Morgan Kaufmann Publishers.
- Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
- Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014
- Raj Kamal, “Internet of Things, Architecture and Design Principles”, McGraw Hill, 6th Reprint

2020.

Computer Usage / Software Requires: C++/ PYTHON / Mobile Simulator/Emulator/ IoT simulator.

CSE-703: CLOUD COMPUTING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students will be able to **articulate** the main concepts, key technologies, advantages and disadvantages of cloud computing
2. **Describe** and **explain** the architecture of a cloud computing system
3. **Understand** how network virtualization enables cloud computing
4. **Demonstrate** basic usage and configuration of the OpenStack cloud framework
5. **Use** Kubernetes technology to **automate** software deployment

SYLLABUS

Unit 1 Introduction to Cloud Computing

Ubiquitous Cloud Computing, Properties of Cloud Computing, Definition of Cloud Computing, The Emergence and Development of Cloud Computing, The Advantage of Cloud Computing, Classification of Cloud Computing, Cloud Enabling Technology, Cloud Computing Applications

Unit 2 Cloud Computing System

Cloud Infrastructure Mechanism, Cloud Management Mechanism, Cloud Security Mechanism, Basic Cloud Architecture, Virtualization Technology, Basic Knowledge of Server Virtualization, Supporting Technology of Server Virtualization, Main Functions of Virtual Machine

Unit 3 Network Basics in Cloud Computing

Computer Network Overview, Network Layering and Encapsulation, Network Interconnection Equipment, Network Virtualization, Software-Defined Network, Storage Basics in Cloud Computing, Basic Storage Unit, Storage Virtualization

Unit 4 OpenStack Cloud Framework

Overview of OpenStack, OpenStack Operating Interface Management, OpenStack Certification Management, OpenStack Image Management, OpenStack Computing Management, OpenStack Network Management

Unit 5 Container Technology

Overview of Container Technology, Overview of Kubernetes, Kubernetes Management Objects, Kubernetes Service, Kubernetes Network, Kubernetes Storage, Kubernetes Service Quality, Kubernetes Resource Management

Textbooks/References

Introduction to Cloud Computing Computing, Huawei Technologies, Springer Link, Open Access
https://link.springer.com/chapter/10.1007/978-981-19-3026-3_1#Sec1

CSE-704: Internet Protocols

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Introduce the student to different networking protocols and compare them with TCP/IP model. Preparing the student for entry Advanced courses in computer networking.
2. Explain how fixed and portable devices obtain IP Addresses and connects with each other.
3. Explain how the Internetworking devices are configured and controlled using network layer protocol. Also how Multicasting is done over internet.
4. Give students the concepts of different routing protocols.
5. Expose students with application layer protocols of TCP/IP model.

UNIT 1: INTRODUCTION TO COMPUTER NETWORKS

Introduction to Computer Networks, Overview of OSI Model, Introduction of TCP/IP Model, X. 25, Frame Relays Layered architecture and Packet Formats, ATM Protocol: Layered Architecture and packet Formats.

UNIT 2: ARP AND RARP &MOBILE IP

ARP, ARP Operation, Packet Format, Encapsulation, four Different cases using ARP, Proxy ARP, RARP, Packet format, Encapsulation, RARP servers, Alternative solutions to RARP. BOOTP operations, packet format, DHCP, Static address allocation, DHCP packet. HDLC Protocol. Framing.

Stationary Hosts, Mobile Hosts, Agents, Three Phases, Inefficiency in Mobile IP, Double crossing, Triangle routing,

UNIT 3: ICMP AND IGMP

ICMP encapsulation, Types of Messages, Message Format, Error Reporting messages: Destination unreachable, source Quench, Time Exceeded, Parameter Problem Query Messages: Echo Request & Reply, Timestamp request & Reply, Address- Mask Request and Reply, Router solicitation and Advertisement. Group management, IGMP messages, IGMP Operations, Joining a group, Leaving a Group, Monitoring Membership, Encapsulation, TCP, UDP. IP.

UNIT 4: RIP, OSPF, AND BGP

Intra and inter domain routing, distance vector routing, RIP, RIP Msg format, Timers in RIP, link state routing, OSPF, types of links, OSPF Packets, Path vector routing, BGP, BGP Services, Eternal & Internal BGP, Types of autonomous systems, Types of packets.

UNIT 5: APPLICATION PROTOCOLS.

FTP: control connection, data connection, communication, over control and data connection, TFTP Web Documents: Static Documents, Dynamic Documents, Active Documents, HTTP: Transaction, persistent v/s non-persistent connection, PROXY Server. Remote login, TELNET: concepts, time sharing environment, NVT (n/w virtual terminal)

Books :

- Comer, D: "Internetworking with TCP/IP", PHI, 1997. Vol. I, II,III.
- BreudansP.Kehoe: Zen and Art of Internet-A Beginner's Guide: PTR Prentice Hall (1994).
- TCP/IP Protocol Suite Fourth Edition by "Behrouz A. Forouzan"

CSE- 705: SOFT COMPUTING

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

Students shall be able to

CO1. Recall the basics of soft computing techniques, their strengths and relations.

CO2. Understand the models of artificial neural network as computation tool.

CO3. Apply the artificial neural network as learning tool along with its applications areas.

CO4. Understand the basics of fuzzy set theory, fuzzy relations, fuzzy logic, etc, and significances.

CO5. Apply concepts of defuzzifications, and operations of mutation, crossover in genetic algorithm for optimization problems.

UNIT I: INTRODUCTION CO-1

Introduction to Soft Computing, various types of soft computing techniques: Neural Networks, Fuzzy Logic, Genetic algorithm, Intelligent systems.

UNIT II: ARTIFICIAL NEURAL NETWORKS (ANN) CO-2

Function of Neuron, Biological Neuron, Artificial Neuron, Brain vs ANN, Basic Model of ANN: connections, weights, bias, activation functions. McCulloch-Pitts Neuron, Neuron as Memory element, Hebb Training algorithm, Linear separability, XOR problem.

UNIT III: ANN LEARNING CO-3

Neural Network architectures and characteristics, ANN Learning, Supervised learning: Perceptron, Delta Rule, ADALINE, MADALINE, Multi-layer perceptron, Back-Propagation algorithm. Unsupervised learning: Hopfield network- characteristics and algorithm.

UNIT IV: BASICS OF FUZZY LOGIC CO4

Introduction to Fuzzy logic, Fuzzy set theory, Fuzzy set vs Crisp set, Fuzzy relation & Crisp relation, Fuzzy logic operations, Tolerance & Equivalence relations, Membership functions, Features of membership functions, Basics of Fuzzy arithmetic.

UNIT V: FUZZY INFERENCE AND GENETIC ALGORITHM CO-5

Fuzzy If-Then rule, Features of If-then rules, Fuzzy Inference, Fuzzy rule base system, Fuzzification, Defuzzification and its methods, Basics of Genetic algorithm: working principle, Encoding, Fitness function, Selection, Cross-over, Mutation.

BOOKs:

1. F O Karray and C De Silva, "Soft Computing & Intelligent Systems Design", Pearson, 2009.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", Wiley, 2011.
3. Rajasekaran&Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", PHI, 2011.
4. J J S Roger, S Chuen-Tsai, E Mizutani, "Neuro-Fuzzy and Soft Computing", PHI.
5. David E Goldberg, "Genetic Algorithm in Search, Optimization & Machine Learning", Pearson, 2011.
6. S Haykin, "Neural Networks: A Comprehensive Foundations" Pearson,

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CSE-706: SOCIAL NETWORK ANALYSIS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. To understand the concept of semantic web and related applications.
2. To learn knowledge representation using ontology.
3. To understand and analyse human behaviour in social web and related communities.
4. To learn visualization of social networks.
5. To have access to a variety of descriptive measures for networks and software to calculate them, and have the ability to interpret the results.

Unit-I: INTRODUCTION

Introduction to Semantic Web: Limitations of current Web, Development of Semantic Web, Emergence of the Social Web. Social Network analysis: Development of Social Network Analysis, Key concepts and measures in network analysis. Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities, Web-based networks, Applications of Social Network Analysis.

Unit-II: MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation. Ontology languages for the Semantic Web: Resource Description Framework, Web Ontology Language. Modelling

and aggregating social network data: State-of-the-art in network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced representations.

Unit-III: EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Decentralized online social networks, Multi-Relational characterization of dynamic social network communities.

Unit-IV: PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES

Understanding and predicting human behaviour for social communities, User data management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, Trust models based on subjective logic, Trust network analysis, Trust transitivity analysis, Combining trust and reputation, Trust derivation based on trust comparisons, Attack spectrum and counter measures.

Unit-V: VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph theory, Centrality, Clustering, Node-Edge Diagrams, Matrix representation, Visualizing online social networks, visualizing social networks with matrix-based representations, Matrix and Node-Link Diagrams, Hybrid representations, Applications, Cover networks, Community welfare, Collaboration networks, Co-Citation networks.

TEXT BOOKS:

1. Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

REFERENCES:

3. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
4. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant and Stefan Decker, -The Social Semantic Web, Springer, 2009.

CSE- 707: ARTIFICIAL NEURAL NETWORKS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

CO-1: Understand building blocks of neural networks.

CO-2: Identify different types and learning strategies of models of neural networks.

CO-3: Analyze the different multi-layer neural networks.
CO-4: Understand the Self-organization Feature Maps.
CO-5: Understand the SVM & Radial Basis Functions.

UNIT I: INTRODUCTION
Introduction to Artificial Neural Networks, Historical evolution of ANN. Biological Neuron-Working principle, Biological Neural Networks, Artificial Neuron and its modeling, Comparison between BNN and ANN, Basic building blocks of Artificial Neural Networks, ANN terminologies.

UNIT II: ANN MODELS
Fundamental models of Artificial Neural Networks- McCulloch-Pitts Neuron Model, Neuron as Memory element, Hebb Training algorithm, Linear Separability, XOR problem, Hebbian Learning Rule Perceptron Learning Rule, Delta Learning (Widrow-Hoff Rule or Least Mean Square) Rule, ADALINE, Gradient Descent Rules, Competitive Learning Rule, Out Star Learning, Boltzmann Based Learning.

UNIT III: MULTI-LAYER ANN
Neural Network architectures, ANN Learning, Supervised learning, MADALINE, Multi-layer perceptron, Back-Propagation algorithm, Overfitting. Feedback Networks, Unsupervised learning, Discrete and Continuous Hopfield network- characteristics and algorithm. Bidirectional Associative Memory, Boltzmann Machine.

UNIT IV: SELF-ORGANIZATION FEATURE MAP
Maximal Eigenvector Filtering, Extracting Principal Components, Generalized Learning Laws, Vector Quantization, Self -organization Feature Maps, Application of SOM, Growing Neural Gas.

UNIT V: SVM & RADIAL BASIS FUNCTION
Learning from Examples, Statistical Learning Theory, Support Vector Machines, SVM application to Image Classification, Radial Basis Function Network (RBFN), Regularization theory, Generalized RBF Networks, Learning in RBFNs, RBF application to face recognition.

BOOKs:
1. Simon Haykin, “Neural networks A comprehensive foundations”, 2nd ed., Pearson Education, 2004.
2. B Yegnanarayana, “Artificial neural networks”, 1st ed., Prentice Hall of India P Ltd, 2005.
3. Sivanandam, S Sumathi, S N Deepa; “Introduction to Neural Networks”, 2nd ed.,Tata McGraw Hill, 2005.
4. Li Min Fu, “Neural networks in Computer intelligence”, 1st ed., Tata McGraw Hill, 2003
5. Rajasekaran & Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms”, PHI, 2011.
6. J.M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publications 1994.
Online Resources:
1. 1. https://ocw.mit.edu/courses/9-641j-introduction-to-neural-networks-spring-2005/
2. https://nptel.ac.in/courses/117105084

CSO-801: NETWORK SECURITY

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks

Credits : 3 **Total: 75 Marks**
Duration of Exam : 3 Hours

Course Outcomes:

The students who succeeded in this course will be able to;

1. Understand Principles and concepts of Network security, Ethics in Network Security, security services and mechanisms to counter them.
2. Concepts in Number theory and other related Mathematics used in Network Security.
3. Encrypt and decrypt messages using block ciphers and Stream Ciphers
4. Comprehend and apply relevant cryptographic symmetrical and asymmetrical techniques
5. Sign and verify messages using well known Digital signature generation and verification algorithms require or digital Identity.

UNIT – I

Introduction of Network Security, Security goals, The need of security, Security approaches, Principles of Security, Services and mechanism, Types of attacks, Traditional Symmetric key ciphers: Substitution ciphers, Transposition ciphers, Stream and Block ciphers, Steganography.

UNIT- II

Modular Arithmetic, Linear congruence, Algebraic structure, Totient function, Primality testing, Factorization, Chinese Remainder Theorem, Quadratic congruence, Fermat's Theorem, Euler's Theorem, Galois Field, Euclidean and Extended Algorithm, Diophantine equation. Exponentiation and logarithm.

UNIT- III

Modern Block ciphers, Stream ciphers, Symmetrical key cryptography: Data Encryption Standard: rounds, S-Boxes, analysis of DES, Uses of Secret key Cryptography, Advance Encryption Standard AES cipher: Transformations, Key expansion, analysis of AES.

UNIT- IV

Public key cryptography: Knapsack, RSA: keys generating, encryption and decryption, Taxonomy of potential attacks on RSA, Optimal Asymmetric Encryption Padding, Rabin cryptosystem, El-Gamal cryptosystem, Elliptical curve cryptography, and uses of public key cryptography.

UNIT – V

Cryptographic Hash function, Message Digest algorithms: Length of HASH, uses, Message Digest 5: algorithm (padding, stages, and digest computation.) SHA1 and SHA512: Overview, padding, stages. Message Authentication Codes (MACs), Digital signature techniques, Zero-knowledge signatures.

References / Text Books:

- Behrouz A Forouzan, Cryptography and Network Security, 3RD Edition 2016, McGraw Hill.
- Stallings, W., Cryptography and Network Security: Principles and Practice, Sixth edition., Pearson Print.,2016
- Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall Print, 2002.

Computer Usage / Software Requires: C++/ PYTHON /JAVA

CSO- 802: APPLICATION OF BLOCKCHAIN TECHNOLOGY

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks

Duration of Exam : 3 Hours

Course Outcomes:

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1. Students will be able Introduce and define Blockchain, explain Blockchain types, Platforms, Components and Its Applications.
2. Students will be able to understand Understand and explain about the various cryptography used in Blockchain along with Bitcoin Platform.
3. Students should thoroughly understand the innovation of the Smart Contract, Ethereum Blockchain, review its protocol, and explore the payment model for code execution in solidity.
4. Students will be able to Discuss the concepts used in various Consensus Protocols and Blockchain Security Threats.
5. Understand the need of Enterprise Blockchain Platforms, its features and should be able to propose Blockchain based solution for a given Use Cases.

UNIT – 1: INTRODUCTION TO BLOCKCHAIN AND APPLICATIONS

Introduction to Blockchain and Distributed Ledger, Blockchain Properties, Blockchain, Features, Blockchain Platforms, Generalized Architecture of Blockchain Platform, Applications of Blockchain

UNIT – 2: ESSENTIALS OF CRYPTOCURRENCIES

Distributed identity: Public and private keys, Digital identification, and wallets; Decentralized network- Distributed ledger: Permissioning framework, Blockchain data structure- Double spending; Network consensus- Sybil attack, Block rewards and miners, Difficulty under competition, Forks and consensus chain, the 51% attack, Confirmations and finality- The limits of proof-of-work- Alternatives to Proof of work.

UNIT – 3: BLOCKCHAIN FOUNDATIONAL CONCEPTS & BITCOIN PLATFORM

Bitcoin Architectures: Distributed peer-to-peer network, nodes, consensus protocol, mining: Type, Process, Bitcoin Crypto: Hashing, Digital Signatures, Wallet and Transactions in Bitcoin; Smart Contract and Ethereum Platform: Introduction Ethereum, Architecture, Smart Contracts, Elements of Smart Contracts, Ethereum Operations, Incentive Model, Transactions in Ethereum, Introduction Solidity.

UNIT – 4: CONSENSUS PROTOCOLS AND SECURITY ISSUES

Trust Essentials: Decentralized Systems, Consensus Protocols: Proof-of-Work (PoW), Proof-of-Stake (PoS), Delegated Proof-of-Stake (DPoS), Proof-of-Burn (PoB), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Proof-of-Activity (PoA), Proof of Elapsed Time (PoET). Blockchain Security Threats, Challenges and Issues.

UNIT – 5: ENTERPRISE BLOCKCHAIN PLATFORMS AND BLOCKCHAIN USE CASES

Introduction to Enterprise Blockchain Platforms and tools: Hyperledger, Corda, Ripple, Staler, Blockchain Use Cases in Finance and Banking, International Trade, Supply- Chain, Healthcare and Pharmaceuticals, Energy and Power, Government public services and Defense.

TEXT BOOKS:

- Debjani Mohanty, Blockchain from Concept to Execution: BitCoin, Ethereum, Quorum, Ripple, R3 Corda, Hyperledger Fabric/Saw Tooth/Indy, Multi Chain, IOTA, CoCo, BPB Publications, 2018.
- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University
- Andreas M. Antonopoulos, Gavin Wood Ph.D., Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2018
- Ashwani Kumar, Hyperledger Fabric In-Depth Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, BPB PUBN, 2020.
- Debajani Mohanty, R3 Corda for Architects and Developers with Case Studies in Finance, Insurance, Healthcare, Travel, Telecom, and Agriculture, Apress, 2019

REFERENCE BOOKs:

- Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978- 1- 78712-544-5, 2017
- Kenny Vaneetvelde, Ethereum Projects for Beginners: Build Blockchain-based Cryptocurrencies, Smart Contracts, and DApps, 2018
- Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014
- Jamiel Sheikh, Mastering Corda Blockchain for Java Developers,O'Reilly Media, 2020

CSO- 803: SOFTWARE TESTING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

Students will be able

1. To learn software testing, testing principles and the criteria for test cases.
2. To learn the design of test cases.
3. To learn the level of Testing.
4. To understand testing Tools & Test management techniques.
5. To learn Test Automation & apply test metrics and measurements.

UNIT-1 INTRODUCTION

Testing as an Engineering Activity – Testing as a Process – Testing axioms – Basic definitions – Software Testing Principles – The Testers Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design – Defect Examples– Developer/Tester

Support of Developing a Defect Repository

UNIT-2 TEST CASE DESIGN

Test case Design Strategies – Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing –Decision Table Based Testing- Cause-effect graphing – Compatibility testing – user documentation testing – domain testing – Random Testing – Requirements based testing – Using White BoxApproach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – code review, code inspection and code walkthrough & its advantages.

UNIT-3 LEVEL OF TESTING

The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Ad-hoc testing – Alpha, Beta Tests –Testing OO systems – Usability and Accessibility testing – Configuration testing.

UNIT-4 TESTING TOOLS & TEST MANAGEMENT

Introduction to Software Testing, Types of Software Testing, Benefits of using Testing tools, features of a good testing tools, how to select a proper testing tool, Types of testing tools, People and organizational issues in testing – Organization structures for testing teams – testing services – TestPlanning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist.

UNIT-5 TEST AUTOMATION

Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.

Books:

1. Ian Sommerville: Software Engineering
2. Roger S. Pressman: Software Engineering: a PRACTITIONER'S Approach.
3. Yogesh Singh & Prof. K.K. Aggarwal: Software Engineering.
4. Aditya P. Mathur: Foundations of software Testing
5. Rajiv Chopra: Software Testing (A Practical Approach)

CSO-804: DATA ANAYTICS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand different types of data including high dimensional data. Understand various dimensionality reduction techniques and should implement on data.
2. Analyze algorithms of constraint based mining, Sequence Mining and Graph Pattern Mining.
3. Explore various advanced classification algorithms like support vector machine, random forest, gradient boosting and neural network.
4. Analyze advanced clustering algorithms including density based, spectral clustering and Graph clustering.
5. Examine time series analysis algorithms and forecasting models.

UNIT- 1

Data Analysis Fundamentals: Data Analysis foundations – Univariate, Bivariate and Multivariate Analysis; Graph Data, Kernel Methods; Working with High Dimensional data; Dimensionality reduction methods.

UNIT- 2

Frequent Pattern Mining: Constraint based mining, Subspace clustering, Sequence Mining, Graph Pattern Mining.

UNIT – 3

Advanced Classification Rule Mining: Support Vector Machines, Random forest and gradient boosting, Neural networks.

UNIT – 4

Cluster Analysis: Hierarchical clustering, Density based clustering, spectral clustering. EM Clustering; Introduction to Graph Clustering.

UNIT – 5

Advanced topics in Data Mining: Time series Analysis and Mining: Topic modelling, Time series data preprocessing, Forecasting models, Trend analysis, Opinion mining

Books:

1. Zaki and Meira : Data Mining & Analytics – Cambridge University Press, 3rd Edition.
2. Ethem Alpaydin : Introduction to Machine Learning – MIT Press, 3rd Edition
3. Jiawei Han, Micheline Kamber: *Data Mining Concepts and Techniques*, 2nd Edition, Morgan Kaufman Publishers.
4. Tan, Steinbach and Kumar: Introduction to Data Mining – Pearson Publication.

CSO- 805: ADVANCED GRAPH THEORY

L	**T**	**P**	**Internal: 30 Marks**
2	**1**	**0**	**External: 45 Marks**
Credits : 3			**Total: 75 Marks**
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Understand the basics of graph theory and their various properties
2. Compute spanning trees for a given graph
3. Understand the concept of distance in a graph
4. Model matching problems using graphs and solve these problems algorithmically.
5. Analyze flow and capacity through a network and optimize the solutions to real- world problems like transport problems

UNIT – I

Introduction to Graphs & its Applications, Basics of Paths, Cycles, and Trails, Connection, Bipartite Graphs, Eulerian Circuits, Vertex Degrees and Counting, Degree-sum formula, The Chinese Postman Problem and Graphic Sequences.

UNIT- II

Trees and Distance, Properties of Trees, Spanning Trees and Enumeration, Matrix-tree computation, Cayley's Formula, Prufer code.

UNIT- III

Matchings and Covers, Hall's Condition, Min-Max Theorem, Independent Sets, Covers and Maximum Bipartite Matching, Augmenting Path Algorithm, Weighted Bipartite Matching, Hungarian Algorithm.

UNIT- IV

Stable Matchings and Faster Bipartite Matching, Factors & Perfect Matching in General Graphs, Matching in General Graphs: Edmonds' Blossom Algorithm.

UNIT – V

Connectivity and Paths: Cuts and Connectivity, k-Connected Graphs, Network Flow Ford- Fulkerson Labeling Algorithm, Max-Flow Min-cut Theorem, Menger's Proof using Max-Flow Min-Cut Theorem.

References / Text Books:

- D.B. West, Introduction to Graph Theory, Prentice Hall, 2001
- Jon Kleinberg and Eva Tardos, Algorithm Design, Addison-Wesley, 2005
- J.A.Bondy and U.S.R.Murty: Graph Theory, Springer, 2008.
- R.Diestel: Graph Theory, Springer(low price edition) 2000.
- F.Harary: Graph Theory, Narosa, (1988)
- C. Berge: Graphs and Hypergraphs, North Holland/Elsevier, (1973)

CSO- 806: APPLIED LINEAR ALGEBRA IN AI AND ML

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Perform simple linear algebraic operations in Python using NumPy
2. Solve linear algebraic problems using vector/matrix representations
3. Define eigenvalues, eigenvectors and the process of diagonalization
4. Apply the theory of singular value decomposition to ML problems
5. Frame ML algorithms as optimization problems

UNIT – I

Overview of linear algebra concepts and applications in machine learning, introduction to Python programming language for linear algebra operations using libraries such as NumPy, basic operations, arrays, and matrices in Python.

UNIT- II

Vectors and vector spaces, definition and properties of vectors, vector operations (addition, scalar multiplication, dot product), linear independence and basis, transformation of basis, introduction to matrices and their representation, matrix operations (addition, multiplication, transposition), inverse and determinant of a matrix, solving linear systems of equations, linear transformations.

UNIT- III

Understanding eigenvalues and eigenvectors, Diagonalization of matrices, Applications of eigenvalues in machine learning, principal component analysis, spectral clustering.

UNIT- IV

Introduction to Singular Value Decomposition, Applications of SVD in machine learning (dimensionality reduction, data compression), Truncated SVD and its implications.

UNIT – V

Introduction to optimization problems in machine learning, gradient descent and its connection to linear algebra, constrained optimization and Lagrange multipliers.

References / Text Books:

● Introduction to Linear Algebra, Fifth Edition (2016), Gilbert Strang, Wellesley- Cambridge Press
● Convex Optimization, Stephen Boyd and Lieven Vandenberghe, Cambridge University Press

Computer Usage / Software Requires: C++/ PYTHON /JAVA

CSO-807: DEEP LEARNING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes

1. Understand the Concept of Learning in Machines and ANN fundamentals.
2. Gain knowledge of the basic concepts to be taken care while building models.
3. Understand various CNN operations and related arithmetic.
4. Design Custom Convolutional Neural Networks and apply them to real world problems.
5. Introduced to sequence modelling concept using deep learning. Design Recurrent Neural Networks for real world problems.

UNIT – I
INTRODUCTION TO NEURAL NETWORKS
Learning and its types, Simple Neuron, Linear separability, XOR Problem, ANN Architectures, Review of Error Backpropagation algorithms, Need of Deep Neural Networks

UNIT- II
MODEL BASICS
Vector, scalar, Matrix & Tensor, Performance Metrics, Bias Variance, Underfitting, Overfitting, Model Regularizations, Early Stopping, Dropouts.

UNIT- III
CONVOLUTIONAL NEURAL NETWORKS
Introduction to Convolutional neural networks, CNN Operations, Convolutions & Strides, Pooling, Zero Padding, Convolution Arithmetic.

UNIT- IV
CNN ARCHITECTURES
CNN architectures LeNet-5, AlexNet, GoogLeNet, ResNet Optimizers for CNN, Network weight initialization techniques Optimizers for CNN.

UNIT- V
SEQUENCE MODELING
Introduction to Recurrent Neural Networks (RNNs), Encoder-Decoder Sequence to Sequence Architecture, Deep RNNs, Long Short Term Memory (LSTM) networks.

References / Text Books:

- Ian Goodfellow, YoushuaBengio and Aaron Courville, "Deep Learning", MIT Press.
- Simon Haykin, “A comprehensive foundation to Neural Networks” PHI.

Computer Usage / Software Requires: Python with Tensorflow API

Specialization Degree 1: Artificial Intelligence and Machine Learning

CSH-411: Introduction to Machine Learning	
L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes

1 Students will be able to understand the concept of machine learning.
2 Students will be able to analyze different types of regression techniques and its applications
3 Students will be able to apply different types of dimensionality reduction techniques used in machine learning
4 Students will be able to understand about the Artificial neural network and its uses in various field
5 Students will be able to understand about the deep learning and its component and their implementation to solve various types of problems

UNIT I

Introduction of Machine Learning, AI, ML and DL, Types of machine learning, fundamental of machine learning, challenges in Machine Learning, Application of ML, ML development life cycle (MLDLC), Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces ,List-Then-Eliminate algorithm, Find S Algorithm, and the Candidate Elimination Algorithm

UNIT II

Linear Regression, Regression Metrics, MAE, MSE, RMSE, R squared , Adjusted R squared, Multiple Regression, Gradient descent, Batch Gradient , Stochastic Gradient , Mini Gradient, Polynomial Regression, Bias, variance, bias-variance trade-off, regularization techniques, Regularization Methods, Lasso Regression, Ridge Regression, Elastic Net Regression, Logistic regression, classification evaluation metrics, Accuracy, confusion matrix, Precision, Recall, F1-Score, macro and weighted F1-Score, SoftMax regression or multinomial logistic regression, polynomial logistic regression

UNIT III

Dimensionality reduction, Subset selection, Forward selection, Backward selection, Principal component analysis **,** Linear Discriminant Analysis, Fisher's criterion, t-Distributed Stochastic Neighbor Embedding (t-SNE), Independent Component Analysis

UNIT IV

Neural Network based machine Learning, McCulloch-Pitts Neuron Model, Boolean Functions Using M-P Neuron, The Perceptron, Logistic regression using perceptron , Activation Functions, Multilayer

Perceptron(MLP), Multilayer Forward propagation , Back Propagation: Input, output and hidden layer computation, Memorization

UNIT V

Introduction to Thompson Sampling, Reinforcement Learning, Markov Decision Process, Q-learning, Bellman Equation, Meta-Learning in Machine Learning, AUC ROC Curve in Machine Learning, cross-validation methods such as leave-one-out (LOO) cross-validation, k-folds Cross validation

BOOKs:

- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
- Deep Learning, by Goodfellow, Bengio, and Courville.
- The Hundred-Page Machine Learning Book by Andriy Burkov by Andriy Burkov
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition

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CSH-511- DATA ANAYTICS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand different types of data including high dimensional data. Understand various dimensionality reduction techniques and should implement on data.
2. Analyze algorithms of constraint based mining, Sequence Mining and Graph Pattern Mining.
3. Explore various advanced classification algorithms like support vector machine, random forest, gradient boosting and neural network.
4. Analyze advanced clustering algorithms including density based, spectral clustering and Graph clustering.
5. Examine time series analysis algorithms and forecasting models.

UNIT- 1

Data Analysis Fundamentals: Data Analysis foundations – Univariate, Bivariate and Multivariate Analysis; Graph Data, Kernel Methods; Working with High Dimensional data; Dimensionality reduction methods.

UNIT- 2

Frequent Pattern Mining: Constraint based mining, Subspace clustering, Sequence Mining, Graph Pattern Mining.

UNIT – 3

Advanced Classification Rule Mining: Support Vector Machines, Random forest and gradient boosting, Neural networks.

UNIT – 4

Cluster Analysis: Hierarchical clustering, Density based clustering, spectral clustering. EM Clustering; Introduction to Graph Clustering.

UNIT – 5

Advanced topics in Data Mining: Time series Analysis and Mining: Topic modelling, Time series data preprocessing, Forecasting models, Trend analysis, Opinion mining

Books:

1. Zaki and Meira : Data Mining & Analytics – Cambridge University Press, 3rd Edition.
2. Ethem Alpaydin : Introduction to Machine Learning – MIT Press, 3rd Edition
3. Jiawei Han, Micheline Kamber: *Data Mining Concepts and Techniques*, 2nd Edition, Morgan Kaufman Publishers.
4. Tan, Steinbach and Kumar: Introduction to Data Mining – Pearson Publication.

CSH- 611: DEEP LEARNING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand the Concept of Learning in Machines and ANN fundamentals.
2. Gain knowledge of the basic concepts to be taken care while building models.
3. Understand various CNN operations and related arithmetic.
4. Design Custom Convolutional Neural Networks and apply them to real world problems.
5. Introduced to sequence modelling concept using deep learning. Design Recurrent Neural Networks for real world problems.

UNIT – I

INTRODUCTION TO NEURAL NETWORKS

Learning and its types, Simple Neuron, Linear separability, XOR Problem, ANN Architectures, Review of Error Backpropagation algorithms, Need of Deep Neural Networks

UNIT- II

MODEL BASICS

Vector, scalar, Matrix & Tensor, Performance Metrics, Bias Variance, Underfitting, Overfitting, Model

Regularizations, Early Stopping, Dropouts.

UNIT- III
CONVOLUTIONAL NEURAL NETWORKS
Introduction to Convolutional neural networks, CNN Operations, Convolutions & Strides, Pooling, Zero Padding, Convolution Arithmetic.

UNIT- IV
CNN ARCHITECTURES
CNN architectures LeNet-5, AlexNet, GoogLeNet, ResNet Optimizers for CNN, Network weight initialization techniques Optimizers for CNN.

UNIT- V
SEQUENCE MODELING
Introduction to Recurrent Neural Networks (RNNs), Encoder-Decoder Sequence to Sequence Architecture, Deep RNNs, Long Short Term Memory (LSTM) networks.

References / Text Books:

- Ian Goodfellow, YoushuaBengio and Aaron Courville, "Deep Learning", MIT Press.
- Simon Haykin, “A comprehensive foundation to Neural Networks” PHI.

Computer Usage / Software Requires: Python with Tensorflow API

CSH- 711: SPECIAL TOPICS IN ARTIFICIAL INTELLIGENCE

L	**T**	**P**	**Internal: 30 Marks**
2	**1**	**0**	**External: 45 Marks**
Credits : 3			**Total: 75 Marks**
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Understand the concepts of Deep Reinforcement Learning, Self-Play Networks, and Recurrent Neural Network designs.
2. Design and Apply the Autoencoders, Deep Generative Models, in Computer Vision, Speech Processing problems.
3. Understand the design and architectures of the second-generation knowledge-based systems, Distributed AI, and its applications
4. Introduction to Quantum Machine Learning (QML) concepts and application.
5. Understand the concepts of neuro-computing and its possible role in AI.

UNIT- I [Duration: 6 Lectures]
Introduction to Deep Neural Networks, Bayesian Filtering; Recurrent Neural Networks,and Deep Reinforcement Learning. Self-Play Networks.

UNIT- II [Duration: 8 Lectures]
Autoencoders: types and their applications, Deep Generative Models, GANs Applications of Generative models in Computer Vision, Speech Processing and NLP

UNIT- III[Duration: 7 Lectures]
Architectures for second-generation knowledge-based systems, Distributed AI, and its applications. Machine Learning Applications in Audio and Signal Processing.

UNIT- IV [Duration: 8 Lectures]
An introduction to Quantum Computing, Concepts of Quantum Machine Learning (QML), Application of QML in the real world, Introduction to Qiskit SDK for QML implementation.

UNIT- V [Duration: 6 Lectures]
An introduction to neuro computing and its possible role in AI, The role of uncertainty measures and principles in AI.

References / Text Books:

- Ian Goodfellow, YoushuaBengio and Aaron Courville, "Deep Learning", MIT Press.
- Simon Haykin, “A comprehensive foundation to Neural Networks” PHI.
- Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley & Sons.
- M. Schuld and F. Petruccione. Machine Learning with Quantum Computers. Quantum Science and Technology. Springer International Publishing, 2021

Computer Usage / Software Requires: Python with Tensorflow API&Qiskit SDK

CSH- 811: NATURAL LANGUAGE PROCESSING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Apply basic text processing tasks and develop and evaluate text classification models.
2. Design probabilistic and neural sequence text models.
3. Understand and apply distributional and neural word embeddings.
4. Apply and analyze neural language models and attentional models.
5. Understand transfer learning based language models and large language models.

Unit 1. Basic Text Processing and Probabilistic Text Classification
Introduction to Text, Speech and Language Technologies, Basic Text Processing Tasks, N Grams, La Place Smoothing. Text Classification, Evaluation of Text Classification Model

Unit 2. Sequence Modelling
Sequence Modelling: Markov Models, Hidden Markov Models, Conditional Random Fields, Beam, Greedy and Viterbi inference, POS tagging, Named Entity Recognition, Sentiment Analysis, Recurrent Neural Networks, Sequence Evaluation

Unit 3.Vector Semantics
Vector Semantics: Distributed Representations, Word Context Matrix Generation, Word Embeddings Skip Gram with Negative Sampling, Neural Embeddings Word2Vec, Glove

Unit 3 Neural Language Models
Neural Language Models: Long Term Dependencies, Vanishing Gradients, Long Short Term Memory (LSTM), LSTM based language models, Convolutional Neural Networks (CNN), CNN based language models, LSTM and CNN based text Classification, Attention and Transformer, Types of Attention Mechanism, Neural Machine Translation

Unit 4.Large Language Models
Transfer Learning, Pre-Training, Fine Tuning, Masked Language Models, BERT, Variants of BERT, Question Answering, Chatbots, Natural Language Generation, GPT.

Books:

- Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 2nd Edition, Pearson Education, 2013.
- Yoav Goldberg, "Neural Network Methods in Natural Language Processing", Morgan & Claypool Publishers, 2017.
- Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O′Reilly, 2009.
- Manning and Schuetze, "Foundations of Statistical Natural Language Processing", MIT Press,1999.

Specialization Degree 2: Data Science

CSH-411: Introduction to Machine Learning

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes

1 Students will be able to understand the concept of machine learning.
2 Students will be able to analyze different types of regression techniques and its applications
3 Students will be able to apply different types of dimensionality reduction techniques used in machine learning
4 Students will be able to understand about the Artificial neural network and its uses in various field
5 Students will be able to understand about the deep learning and its component and their implementation to solve various types of problems

UNIT I

Introduction of Machine Learning, AI, ML and DL, Types of machine learning, fundamental of machine learning, challenges in Machine Learning, Application of ML, ML development life cycle (MLDLC), Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces ,List-Then-Eliminate algorithm, Find S Algorithm, and the Candidate Elimination Algorithm

UNIT II

Linear Regression, Regression Metrics, MAE, MSE, RMSE, R squared , Adjusted R squared, Multiple Regression, Gradient descent, Batch Gradient , Stochastic Gradient , Mini Gradient, Polynomial Regression, Bias, variance, bias-variance trade-off, regularization techniques, Regularization Methods, Lasso Regression, Ridge Regression, Elastic Net Regression, Logistic regression, classification evaluation metrics, Accuracy, confusion matrix, Precision, Recall, F1-Score, macro and weighted F1-Score, SoftMax regression or multinomial logistic regression, polynomial logistic regression

UNIT III

Dimensionality reduction, Subset selection, Forward selection, Backward selection, Principal component analysis **,** Linear Discriminant Analysis, Fisher's criterion, t-Distributed Stochastic Neighbor Embedding (t-SNE), Independent Component Analysis

UNIT IV

Neural Network based machine Learning, McCulloch-Pitts Neuron Model, Boolean Functions Using M-P Neuron, The Perceptron, Logistic regression using perceptron , Activation Functions, Multilayer Perceptron(MLP), Multilayer Forward propagation , Back Propagation: Input, output and hidden layer computation, Memorization

UNIT V

Introduction to Thompson Sampling, Reinforcement Learning, Markov Decision Process, Q-learning, Bellman Equation, Meta-Learning in Machine Learning, AUC ROC Curve in Machine Learning, cross-validation methods

such as leave-one-out (LOO) cross-validation, k-folds Cross validation

BOOKs:

- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
- Deep Learning, by Goodfellow, Bengio, and Courville.
- The Hundred-Page Machine Learning Book by Andriy Burkov by Andriy Burkov
- Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition

CSH-511: DATA ANAYTICS

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

---

1. Understand different types of data including high dimensional data. Understand various dimensionality reduction techniques and should implement on data.
2. Analyze algorithms of constraint based mining, Sequence Mining and Graph Pattern Mining.
3. Explore various advanced classification algorithms like support vector machine, random forest, gradient boosting and neural network.
4. Analyze advanced clustering algorithms including density based, spectral clustering and Graph clustering.
5. Examine time series analysis algorithms and forecasting models.

UNIT- 1

Data Analysis Fundamentals: Data Analysis foundations – Univariate, Bivariate and Multivariate Analysis; Graph Data, Kernel Methods; Working with High Dimensional data; Dimensionality reduction methods.

UNIT- 2

Frequent Pattern Mining: Constraint based mining, Subspace clustering, Sequence Mining, Graph Pattern Mining.

UNIT – 3

Advanced Classification Rule Mining: Support Vector Machines, Random forest and gradient boosting, Neural networks.

UNIT – 4

Cluster Analysis: Hierarchical clustering, Density based clustering, spectral clustering. EM Clustering; Introduction to Graph Clustering.

UNIT – 5

Advanced topics in Data Mining: Time series Analysis and Mining: Topic modelling, Time series data preprocessing, Forecasting models, Trend analysis, Opinion mining

Books:

1. Zaki and Meira : Data Mining & Analytics – Cambridge University Press, 3rd Edition.
2. Ethem Alpaydin : Introduction to Machine Learning – MIT Press, 3rd Edition
3. Jiawei Han, Micheline Kamber: *Data Mining Concepts and Techniques*, 2nd Edition, Morgan Kaufman Publishers.
4. Tan, Steinbach and Kumar: Introduction to Data Mining – Pearson Publication.

CSH- 611: DEEP LEARNING

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes

1. Understand the Concept of Learning in Machines and ANN fundamentals.
2. Gain knowledge of the basic concepts to be taken care while building models.
3. Understand various CNN operations and related arithmetic.
4. Design Custom Convolutional Neural Networks and apply them to real world problems.
5. Introduced to sequence modelling concept using deep learning. Design Recurrent Neural Networks for real world problems.

UNIT – I

INTRODUCTION TO NEURAL NETWORKS

Learning and its types, Simple Neuron, Linear separability, XOR Problem, ANN Architectures, Review of Error Backpropagation algorithms, Need of Deep Neural Networks

UNIT- II

MODEL BASICS

Vector, scalar, Matrix & Tensor, Performance Metrics, Bias Variance, Underfitting, Overfitting, Model Regularizations, Early Stopping, Dropouts.

UNIT- III

CONVOLUTIONAL NEURAL NETWORKS

Introduction to Convolutional neural networks, CNN Operations, Convolutions & Strides, Pooling, Zero Padding, Convolution Arithmetic.

UNIT- IV

CNN ARCHITECTURES

CNN architectures LeNet-5, AlexNet, GoogLeNet, ResNet Optimizers for CNN, Network weight initialization techniques Optimizers for CNN.

UNIT- V

SEQUENCE MODELING

Introduction to Recurrent Neural Networks (RNNs), Encoder-Decoder Sequence to Sequence Architecture, Deep RNNs, Long Short Term Memory (LSTM) networks.

References / Text Books:

- Ian Goodfellow, YoushuaBengio and Aaron Courville, "Deep Learning", MIT Press.
- Simon Haykin, “A comprehensive foundation to Neural Networks” PHI.

Computer Usage / Software Requires: Python with Tensorflow API

CSH- 711: SPECIAL TOPICS IN AI

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

---

1. Understand the concepts of Deep Reinforcement Learning, Self-Play Networks, and Recurrent Neural Network designs.
2. Design and Apply the Autoencoders, Deep Generative Models, in Computer Vision, Speech Processing problems.
3. Understand the design and architectures of the second-generation knowledge-based systems, Distributed AI, and its applications
4. Introduction to Quantum Machine Learning (QML) concepts and application.
5. Understand the concepts of neuro-computing and its possible role in AI.

Syllabus:

UNIT- I [Duration: 6 Lectures]

Introduction to Deep Neural Networks, Bayesian Filtering; Recurrent Neural Networks,and Deep

Reinforcement Learning. Self-Play Networks.

UNIT- II [Duration: 8 Lectures]
Autoencoders: types and their applications, Deep Generative Models, GANs Applications of Generative models in Computer Vision, Speech Processing and NLP

UNIT- III[Duration: 7 Lectures]
Architectures for second-generation knowledge-based systems, Distributed AI, and its applications. Machine Learning Applications in Audio and Signal Processing.

UNIT- IV [Duration: 8 Lectures]
An introduction to Quantum Computing, Concepts of Quantum Machine Learning (QML), Application of QML in the real world, Introduction to Qiskit SDK for QML implementation.

UNIT- V [Duration: 6 Lectures]
An introduction to neuro computing and its possible role in AI, The role of uncertainty measures and principles in AI.

References / Text Books:

- Ian Goodfellow, YoushuaBengio and Aaron Courville, "Deep Learning", MIT Press.
- Simon Haykin, “A comprehensive foundation to Neural Networks” PHI.
- Dr. Nilakshi Jain, Artificial Intelligence: Making a System Intelligent, John Wiley & Sons.
- M. Schuld and F. Petruccione. Machine Learning with Quantum Computers. Quantum Science and Technology. Springer International Publishing, 2021

Computer Usage / Software Requires: Python with Tensorflow API&Qiskit SDK

CSD- 821: Data Visualization

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand the importance of data visualization in data analysis and decision-making.
2. Gain proficiency in selecting appropriate visualization techniques for different types of data and tasks.
3. Learn principles of effective data visualization design, including visual perception and cognition.
4. Develop skills in using data visualization tools to create compelling and informative visualizations.
5. Apply theoretical knowledge through hands-on labs, projects, and case studies.

Syllabus:

Unit -1

Introduction to Data Visualization, Importance of data visualization, Overview of visualization tools and techniques, Principles of visual perception and cognition
Data Types and Visual Encodings
Types of data (numerical, categorical, temporal), Visual encodings (position, size, color, shape, etc.), Choosing appropriate visual encodings for different data types

Unit-2

Data Visualization Design Principles, Designing for clarity, accuracy, and efficiency, Exploratory Data Analysis, Univariate and multivariate data exploration, Distribution visualization (histograms, box plots, etc.), Correlation and relationship visualization

Unit-3

Static Visualization Techniques, Bar charts, line charts, and scatter plots, Pie charts, area charts, and heatmaps, Tree maps, bubble charts, and parallel coordinates, Interactive Data Visualization, Principles of interactive visualization, Tools for creating interactive, visualizations, Adding interactivity to static visualizations

Unit-4

Geographic Visualization, Choropleth maps, dot maps, and cartograms, Spatial data visualization techniques, Tools for geographic visualization, **Mapbox, Google Maps API** Story telling with Data, Narrative visualization techniques, Designing data-driven stories, Communicating insights effectively through visual storytelling

Unit-5

Data Visualization Tools and Technologies, Introduction to popular data visualization tools, **Tableau, Power BI, ggplot2,** Overview of programming libraries for data visualization, **matplotlib, seaborn, plotly,** Hands-on exercises using selected tools and technologies, Ethical and Responsible Data Visualization, Ethical considerations in data visualization, Avoiding bias and misrepresentation in visualizations, Communicating uncertainty and limitations

Textbook: "Data Visualization: A Practical Introduction" by Kieran Healy

Reference Materials:

- "The Visual Display of Quantitative Information" by Edward Tufte
- "Storytelling with Data: A Data Visualization Guide for Business Professionals" by Cole Nussbaumer Knaflic
- Online tutorials and resources

Specialization Degree 3: Cyber Security

CSD- 431: Introduction to Cyber Security

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

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1 To understand various types of cyber-attacks and cyber-crimes
2 To learn threats and risks within context of the cyber security
3 To have an overview of the cyber laws & concepts of cyber forensics
4 To study the defensive techniques against cyber attacks
5 To analyze various privacy issues and their specification.

UNIT I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

UNIT V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical, financial, etc

BOOKs:

• Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives,Wiley

• B.B.Gupta,D.P.Agrawal,HaoxiangWang,ComputerandCyberSecurity:Principle s, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.

CSD-531: DATA ENCRYPTION

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes

1. To develop classical techniques in cryptography.
2. To develop a mathematical foundation for the study of cryptography.
3. To Understand Number Theory and Algebra for design of cryptographic algorithms.
4. To understand the role of cryptography in communication over an insecure channel.
5. Analyze and compare symmetric-key encryption public-key encryption schemes based on different security models.

UNIT – I

Classical Cryptography and overview, Classical crypto-system and their crypto-analysis, Model of secure communication, Security services, Overview of attacks, X.800 Security Architecture for Open System Interconnection (OSI), and crypto-analysis.

UNIT- II

Cryptographic background, Introduction to Substitution techniques, Transposition techniques, Encryption and decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and key size.

UNIT- III

Mathematical background: Introduction to Number theory, Modular Arithmetic, Prime number generation, GCD, Euclidean Algorithm, Extended Euclidean Algorithm, Chinese Remainder Theorem, Fermat's and Euler's Theorem.

UNIT- IV

Private Key Cryptography, Symmetric Encryption, Definitions: Chosen –plaintext attack. Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, Variations on DES, RC4, RC5, and Blow fish, Hash Functions, Message Authentication Codes. Collision resistance.

UNIT – V

Public Key Cryptography: RSA, ElGamal, DSA, Elliptic Cruve cryto-systems, Public key cryptography standard (PKCS), PKI, Digital Certificates, and Key Management Techniques.

Security Protocols: Authentication, Kerberos, X.509 Authentication Service, Secure socket Layer (SSL), Secure Electronic Transaction(SET), Email Security, PGP, S/MIME, IP Security(IPSEC).

Reference Books/ Text Books

- Behrouz A Forouzan and D Makhopahpadhyay, Cryptography and Network Secrurity, McGraw Hill, 2nd Edition, 1st Reprint 2010.
- Jonathan Katz and Yehuda Lindell, introduction to modern cryptography, CRC Press.
- Stinson, D.R Cryptography: Theory and Practice Chapman and Hall.
- Wade Trapple, Lawrance C. Washington, Introduction to Cryptography with coding Theory, Pearson Education, 2nd Edition.

CSD- 631: STEGANOGRAPHY AND DIGITAL WATERMARKING (CEN-8XX)

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. To develop an understanding of digital watermarking and steganography basics, various approaches, characteristics and application domains.
2. To apply digital watermarking as an authentication tool for distribution of content over the Internet and steganography techniques for covert communication.
3. To understand the basics of the counter measures like steganalysis for assessing the data hiding methods.
4. To enable to evaluate and choose appropriate data hiding technique based on a multitude of security factors.

UNIT – 1: INTRODUCTION TO STEGANOGRAPHY

Introduction - Text Steganography Image Steganography: Data Hiding in Raw (BMP) Images - LSB (Least Significant Bit) Embedding - Data Hiding by Mimicking Device Noise (Stochastic Modulation). Data Hiding in Palette (GIF) Images - Palette Formats (GIF) - Hiding by Decreasing Colour Depth, Gifshuffle, - Optimal Palette Parity Assignment. Data Hiding in JPEG Images - JPEG Format - J-Steg Data Hiding Algorithm Hiding in Spatial Domain Hiding in Transform Domain Image Quality Metrics

UNIT – 2: AUDIO STEGANOGRAPHY

Temporal Domain Techniques - Low-Bit Encoding - Echo Hiding - Hiding in Silence Intervals. Transform Domain Hiding Techniques - Magnitude Spectrum - Tone Insertion - Phase Coding - Amplitude Coding - Cepstral

Domain Codecs Domain: Codebook Modification Bit stream Hiding Audio Quality Metrics

UNIT – 3: VIDEO STEGANOGRAPHY

Introduction Video Streams - Substitution- Based Techniques - Transform Domain Techniques - Adaptive Techniques - Format-Based Techniques - Cover Generation Techniques Video Quality Metrics - Perceptual Transparency Analysis - Robustness against Compression - Robustness against Manipulation

UNIT – 4: DATA HIDING & SPREAD SPECTRUM WATERMARKING

Relationship between Watermarking and Steganography. Digital Watermarking Basics: Mod- els of Watermarking, Basic Message Coding, Error Coding. Digital Watermarking Theoretic Aspects: Mutual Information and Channel Capacity, Designing a Good Digital Mark, Theoretical Analysis of Digital Watermarking Types of Watermarking Fragile, Semi-Fragile. Transform Domain Watermarking, Quantization Watermarking. Protocols: Buyer Seller Watermarking Protocols, Efficient and Anonymous Buyer-Seller Watermarking Protocol

UNIT – 5: WET PAPER CODES & STEGANALYSIS

Random Linear Codes - LT Codes - Perturbed Quantization, Matrix Embedding - Matrix Embedding Theorem - Binary Hamming Codes, Q-Ary Case Random Linear Codes for Large Payloads, Principles, Approaches, ROC Analysis - Sample Pairs Analysis - Attacks using Histogram Characteristic Function - Spatial Domain Steganalysis using Higher Order Statistics - Steganalysis using Resampling Calibration - Feature Selection - Calibration by Recompression

TEXT BOOKS:

J. Cox, M. L. Miller, J. A. Bloom, T. Kalker, and J. Fridrich, Digital Watermarking and Steganography, 2nd Ed. Amsterdam: Morgan Kaufmann Publishers In, 2007. (ISBN No. : 978-0-12-372585-1)

J. Fridrich, Steganography in Digital Media: Principles, Algorithms, and Applications. Cambridge: Cambridge University Press, 2009. (ISBN No.: 978-0-52-119019-0)

REFERENCE BOOKs:

R. C. Gonzalez, R. E. Woods, D. J. Czitrom, and S. Armitage, Digital Image Processing, 3rd Ed. United States: Prentice Hall, 2007. (ISBN No.: 978-0-13-168728-8)

P. Wayner, Disappearing Cryptography: Information hiding: Steganography and Watermarking, 3rd ed. Amsterdam: Morgan Kaufmann Publishers In, 2008 . (ISBN No. : 978-0-08-092270-6)

M. Arnold, M. Schmucker, and S. D. Wolthusen, Techniques and applications of digital Watermarking and content protection, 2nd Ed. Boston, MA: Artech House Publishers, 2003. (ISBN No.: 978-1-58-053664-6)

CSD- 731: DIGITAL FORENSICS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes

CO-1: Understand fundamentals of Cyber and Digital Forensics.

CO-2: Identify different types of Forensics Investigations and Analyses.

CO-3: Analyze the data acquisition concepts for Investigations.

CO-4: Understand the crimes, evidences, and legal system

CO-5: Understand the digital forensics software and hardware tools.

UNIT I

Computer Forensics Fundamentals, Need and Benefits Of Forensics, Computer Crimes, Computer Forensics Evidences and Courts, Legal Concerns and Private Issues, Types of Computer Forensics Technology, Scientific Method in Forensic Analysis.

UNIT II

Understanding Computing Investigations – Procedure for Corporate High-Tech Investigations, Digital Forensics Tools and Case Studies, Understanding Data Recovery Work Station and Software, and Investigations. Ethical Hacking: Essential Terminology, Windows Hacking, Malware, Scanning, Cracking.

UNIT III

Data Acquisition- Understanding Storage Formats and Digital Evidence, Determining the Best Acquisition Method, Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Remote Network Acquisition Tools, other Forensics Acquisitions Tools.

UNIT IV

Processing Crimes and Incident Scenes, Securing a Computer Incident or Crime, Seizing Digital Evidence at Scene, Storing Digital Evidence, Obtaining Digital Hash, Reviewing Case, Overview of Indian Legal System, Introduction to IT Act 2000, Amendment in IT Act.

UNIT V

Current Computer Forensics Tools- Software, Hardware Tools, Validating and Testing Forensic Software, Addressing Data-Hiding Techniques, Performing Remote Acquisitions, E-Mail Investigations- Investigating Email Crime and Violations, Understanding E-Mail Servers, Specialized E-Mail Forensics Tool.

BOOKs:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

2. Casey, Eoghan. Handbook of digital forensics and investigation. Academic Press, 2009.
3. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.
4. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.
5. Cyber Forensics - Concepts and Approaches, Ravi Kumar &B Jain,2006, ICFAI University Press.
6. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010.

CSD- 831: QUANTUM CRYPTOGRAPHY

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks
Duration of Exam : 3 Hours			

Course Outcomes:

Students can able to

CO-1: Understand the basics of quantum information, quantum bits, and operations.
CO-2: Understand the fundamentals of quantum gates, quantum logic, and simple quantum algorithms.
CO-3: Analyze the fundamental concepts of quantum cryptography and other related quantum algorithms.
CO-4: Understand the quantum key distribution protocols.
CO-5: Understand the post quantum cryptography, public key encryption, and quantum image cryptography.

Unit I:
Introduction to Quantum Computing, Basics of Quantum Information, Systems of two states: quantum bits (Qubits), Superpositions, Bloch Sphere representation, Operations through Kets and bras, the brackets as scalar products, Combining qubits using the tensor product, Measuring qubits, Performing operations on qubits.

Unit II:
Quantum Gates, Quantum gate diagrams as a flowchart of the computation, universal gate of cryptography, Bit commitment, Quantum Logic, Minimal set of quantum logic gates, evaluation of quantum Logic functions, Quantum algorithms: Deutsch, Deutsch-Jozsa and Vazirani.

Unit III:
Encrypting (quantum) bits: the classical and quantum one time pad, quantum pseudo-randomness, Boolean Fourier analysis, Quantum Fourier Transform, Grover's quantum search algorithm, Shor's quantum factoring algorithm, Hidden Subgroup Problem.

Unit IV:

Quantum key distribution: definitions and concepts, BB84 states and Six states, BB84 Protocol, Purifying protocols using entanglement, No Cloning. The B92 Protocol, Schmidt Decomposition, Sharing a classical secret using entangled quantum states, Monogamy of entanglement, Authentication.

Unit V:

Introduction to Post Quantum Cryptography, Lattices, Useful Lattice Problems, Learning with Errors and Short Integer Solution problem, Public key encryption, Quantum one time pad, Quantum public key encryption, Quantum Image, its representations and Image cryptography.

BOOKs:

1. Vidick, Thomas, and Stephanie Wehner. Introduction to quantum cryptography. Cambridge University Press, 2023.
2. Morsch, Oliver. Quantum bits and quantum secrets: how quantum physics is revolutionizing codes and computers. John Wiley & Sons, 2008.
3. Lala, Parag. Quantum Computing. McGraw Hill Professional, 2019.
4. Nielsen and Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press (2010)
5. Quantum Cryptography. N. Gisin et al., Rev. Mod. Phys. 74 no. 1, 145 (2002), arXiv:quant-ph/0101098.
6. Kollmitzer, Christian, and Mario Pivk, eds. Applied quantum cryptography. Vol. 797. springer, 2010.

Online Resources:

1. https://openlearninglibrary.mit.edu/courses/course-v1:MITx+8.370.1x+1T2018/course/
2. https://onlinecourses.nptel.ac.in/noc23_cs04/preview

Minor Degree: Computer and AI

CSC- 302- : Data Structures and Algorithms

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Students will be able to **understand** the different Data Structures and its complexity and their uses along with their applications in the related problem.
2. Students should be able to **understand** the concepts of Stack and Queue and its related concepts and should be able to **apply** knowledge to write algorithms based on these concepts.
3. Students should be able to **understand** different types of Link List and **analyze** tree data structure.
4. Students should thoroughly understand graph data structure and should be able to **apply** it to solve the problems.

5. Students will be able to **analyse** number of greedy algorithms for problems in engineering and **apply** algorithm design techniques such as dynamic programming to solve real-world problems.

UNIT 1:
Definition of Data Structure and Algorithms, Types of Data structures, Space and Time complexity, arrays, pointers, Asymptotic Notations: Big-Oh, Big-Omega, Theta notations, Small-oh, Small-omega notations, Divide and Conquer Strategy: Introduction, Counterfeit coin detection, searching and sorting using divide and conquer.

UNIT 2:
Stack, operations on stack, Stack implementation using array, Applications of Stack: Polish and reverse Polish notations, Recursion, Garbage collection. Queue, Operations on queue, and Types of queues: Linear Queue, Circular Queue, Priority Queue, and Double Ended Queue, Applications of Queue.

UNIT 3:
Concept of a Linked List, Linear Single and Double link lists, Circular Single and Double link List, Header Linked list, Applications of Link List, Tree, Tree as ADT, binary trees, Operations on tree, Binary Search Tree, Tree traversal Algorithms

UNIT 4:
Graph: Representation of graphs: Adjacency matrix, Incidence Matrix, linked list. Graph Traversal algorithm, topological sorting, Shortest Path algorithms, Minimum Spanning Tree

UNIT 5:
Greedy Algorithm: Introduction, activity selection problem, Dynamic Programming: Introduction, Fibonacci series calculation, 0/1 knapsack problem, matrix chain multiplication

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CSC- 402: DATABASE MANAGEMENT SYSTEMS

L	**T**	**P**	**Internal: 30 Marks**
2	**1**	**0**	**External: 45 Marks**
Credits : 3			**Total: 75 Marks**
Duration of Exam : 3 Hours			

Course Outcomes:

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1. Students will be able to understand fundamental conceptual of a database using Entity Relationship Model for a given Scenario.
2. Student will be able to **apply** normalization techniques to minimize data redundancy.
3. Student will be able to **Apply/Analyse** SQL queries to retrieve data for a given scenario.
4. Student will be able to **explain/design** the principles of various concurrency control and deadlock recovery.

5. Student will be able to **Apply /understand** how data is stored and retrieved in application specific databases: cloud based, Graph database, Fuzzy database.

UNIT 1: Introductory Concept of DBMS (CO1)

Introduction and application of DBMS, Data Independence, Database System Architecture – levels, Mapping, Database users and DBA, Entity – Relationship model, constraints, keys, Design issues, E-R Diagram, Extended E-R features- Generalization, Specialization, Aggregation, Translating E-R model into Relational model, Introduction to TRC,DRC,RA

UNIT 2: Data Base Design(CO2)

Dependency and Normal forms-dependencies theory-functional dependencies-Armstrong Axiom of FD's-closure set of FD's- minimal covers Definition of 1NF-2NF-3NF and BCNF-decomposition and desirable properties of them-algorithm of 3NF and BCNF normalization 4 NF and 5 NF

UNIT 3: STRUCTURED QUERY LANGUAGE (SQL and PL/SQL) (CO3)

SQL: Introduction to SQL constructors (SELECT FROM, WHERE GROUP BY HAVING ORDRDBY), Insert, Delete, Update, DROP, VIEW, Nested Quires, Integrity Constraint: Not null, unique, check, primary key foreign key,

PL/SQL: Variables literals, datatype, advantages of PL/SQL: control statements: if; iterative control loop, while, for, goto, function, cursor, trigger, View.

UNIT 4: TRANSACTION MANAGEMENT (CO4)

Concept of transaction processing, ACID properties, Concurrency control, locking based protocol, Time stamp based protocol,

UNIT 5: Advance Databases and its Emerging areas (C05)

Introduction to No SQL, Cloud Based DBMS, , Open source Data Base, Distributed Database, Object oriented Database, Mobile Database, Multimedia Database, Open Issues and Uncertainties.

Reference Books:

- "Fundamentals of Database Systems", Elmasri, Navathe, Pearson Education, IVth Edition. Pearson Education.
- "Database system concepts", Henry F Korth, Abraham Silberschatz, S. Sudurshan, McGraw-Hill.
- "An Introduction to Database Systems", C.J.Date, Pearson Education.
- "Data Base System", Michael kifer and et all, Pearson Education..
- "Database Management Systems" ,Ramakrishnan, Gehrke;Mcgraw-Hill.
- "The Database Book –Principle and Practice" By NarainGehani, University Press.
- "A first course in Database Systems", Jeffrey D. Ullman, Jennifer Windon, Pearson Education.

CSC- 503: COMPUTER NETWORKS

L	T	P	Internal: 30 Marks
2	1	0	External: 45 Marks
Credits : 3			Total: 75 Marks

Duration of Exam : 3 Hours

Course Outcomes:

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1. Students will be able to memorize and remember the Fundamentals of Computer Networks.
2. Student will be able to understand various switching techniques, Communication media, and Digital Analog formats.
3. Student will be able to Apply Flow Control Algorithms and Evaluate the Error Detection and Correction Methods.
4. Student will be able to Analyze the performance of the Computer Networks.
5. Student will be able to configure and create Routing Tables and Private Networks.

UNIT 1:

Introduction:

Introduction to Computer Networks, LAN, MAN, WAN, Uses of Computer Networks, LAN Technologies- Transmission Topologies, Access methods. Network Architecture, Protocol and standards, References Model: OSI-ISO and TCP/IP, Overview: Circuit switching, Message switching and Packet switching.

UNIT- 2

The Data Link Layer:

Data Link Layer design issues, Framing, Error Detection and Correction, Flow control Protocols, Stop and Wait protocol, Sliding - window flow control, Error control, stop and wait ARQ, Go-back-N, Selective repeat ARQ, Examples of Data link Protocols- HDLC.

UNIT- 3

The Medium Access Control Sub Layer:

The channel allocation problem, ALOHA, Multiple access Protocols, Collision free Protocols, IEEE Standards for LANs and MANs, Wireless LAN: IEEE 802.11, High speed LANs.

UNIT – 4

The Network Layer:

Addressing in IPV4: Classful addresses, CIDR notation, Classless addresses, Special addresses, Network Design: Sub-netting and Super-netting, Network Address Translation, IPV6.

UNIT – 5

Routing Algorithms-Dijsktra's, Distance vector: RIP, Link state: OSPF, BGP,Multicast Routing, and Hierarchical Routing. Delivering and forwarding of IP Packets, Datagram.

Books :

- B.A. Forouzan, " Data Communication and Networking", TMH, 5TH Edition.
- A.S. Tanebaum, " Computer Networks", 4th Edition Pearson Education.
- W. Stallings, " Data and Computer Communication", 7th Edition , Pearson Education.
- Comer E. Doughlas, " Computer Networks and Internet", 2nd Edition Pearson Education.

CSC- 403: OPERATING SYSTEM

L T P **Internal: 30 Marks**

2 1 0 **External: 45 Marks**
Credits : 3 **Total: 75 Marks**
Duration of Exam : 3 Hours

Course Outcomes:

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1. Students will be **able** to describe the functions and structure of operating systems
2. Student will be **able** to understand the principles of process management, and possess the ability to **apply** various scheduling algorithms,
3. Ability to compare and contrast various memory management schemes
4. Student will be able to **understand** the principles of concurrent execution, synchronization, deadlock detection and avoidance and possess the ability to apply various algorithms
5. Students will be able to **analyze** various disk systems, file systems and I/O sub systems

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Course Description

UNIT – I INTRODUCTION TO OS

Introduction to OS, Multiprogramming, Time-sharing System, Operating System Operation, Dual Mode Operation: Kernel Mode, User Mode. Function of OS, Operating System Services, thread, multithreading model, System Call, Types of System calls, Operating system structure, The Process, Process State, Process Control Block, Process Scheduling, Operations on Processes, Schedulers and its types, Scheduling Criteria,

UNIT- II PROCESS SCHEDULLING

Scheduling Algorithms: First Come, First Served (FCFS), Shortest Job First(SJF), Shortest Remaining Time First(SRTF) , Longest Job First(LJF) , Longest Remaining Time First(LRTF), Highest Response Ratio Next (HRRN), Priority Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling(MLQ), Multilevel Feedback Queue(MLFQ) Scheduling, Multiprocessor Scheduling

UNIT- III MEMORY-MANAGEMENT STRATEGIES

Background: Basic Hardware, Address Binding, Logical vs. Physical Address Space. Swapping, Contiguous Memory Allocation, fixed partition, Best-Fit, First-Fit and Worst-Fit Memory Allocation Method, dynamic partitioning, compaction, Buddy System, fragmentation-internal and external , Non-Contiguous Allocation, Paging, hardware support for paging, Translation Look Aside Buffer, Structure of Page Table, Hierarchical Paging, Hashed Page Table, Inverted Page Table, Segmentation, Segmentation with paging, Virtual Memory: Background, swapping, Demand paging, Page Replacement Algorithms, First in First out(FIFO),Least-recently-used(LRU), optical page replacement, Least Frequently Used(LFU), Belady's Anomaly

UNIT- IV SYNCHRONIZATION AND DEADLOCK

The Critical- Section Problem, Race condition, Synchronization Hardware, Peterson's Solution, Semaphores, Mutex and Classical Problems of Synchronization: Bounded- Buffer Problem, The Reader- Writers Problem, Sleeper barber problem, Dining- Philosophers Problem, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Banker's Algorithm, Deadlock Detection, Recovery from Deadlock

UNIT – V FILE-SYSTEM INTERFACE AND MASS- STORAGE STRUCTURE

File Concept, Access methods, Allocation Methods. Secondary Storage Disk- structure, Disk-scheduling: FCFS, SSTF, SCAN, C-SCAN,LOOK,C-LOOK Scheduling algorithms

References / Text Books:

- Operating system concepts: Silberchatz Galvin, Gagne: john Wiley & Sons, inc.2007
- Operating systems: A Concept-based approach: D M Dhamdhere 2nd edition TMH 2007
- Operating systems: Deitel Deitel Choffnes 3rd edition Pearson Education 2007
- Milenkovic, Milan: Operating system concepts and Design, McGraw Hill, 1994.e.g. Mac or Linux Operating System, Bash Shell, Gedit, GCC
- http://quiz.geeksforgeeks.org/

CEN-M1C5: Artificial Intelligence and Machine Learning

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

Students will be able

1. To understand how to represent simple facts in Logic–Predicate logic conversion into clause form and Resolution etc.
2. To understand informed and uninformed search Techniques A*, AO*Hill Climbing, Production system, Best first Search techniques etc.
3. To understand fundamentals of Machine Learning.
4. To analyze different regression and classification techniques.
5. To analyze various Evaluation Methods like precision, recall and accuracy.

Unit 1: Introduction to AI

What is Artificial Intelligence, AI problems, Task domain of AI, AI Technique, Scope and areas of application of AI, representing simple facts in logic- predicate logic, Conversion to clause form, Resolution and Natural Deduction

Unit 2: Problems, problem spaces and Search, Heuristic Search Techniques

Defining the problem as a state space search, Production system, problem characteristics, informed and uninformed search technique: Generate and Test, Hill Climbing, Best first search, A*, AO*, Means-ends, analysis, Approaches to Knowledge Representation.

Unit 3: Introduction to Machine Learning

Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning. Machine Learning Framework. Feature Extraction and Selection, Loss Functions

Unit 4: Supervised Learning Methods

Gradient Descent and its variants, Linear Regression, Multivariate regression, Polynomial Regression, Regression tree, Decision tree, Random Forest, K-Nearest Neighbor (KNN), Naive Bayes, Logistic Regression, Support vector machines.

Unit 5: Evaluation Methods

Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions. Other Evaluation measures: mAP, BLUE

CEN- M1C4: Data Mining and Analytics

L T P	**Internal: 30 Marks**
2 1 0	**External: 45 Marks**
Credits : 3	**Total: 75 Marks**
Duration of Exam : 3 Hours	

Course Outcomes:

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1. Understand the data mining concepts and the various tasks related to data mining. Also, to apply preprocessing methods in order to prepare data for applying various data mining task.
2. Analyze and evaluate various association rule mining algorithms and should write algorithms to implement it.
3. Apply various clustering algorithms on real and large datasets. Students should be able to take research level problems related to data mining and should be able to implement it.
4. Understand different types of data including high dimensional data. Understand various dimensionality reduction techniques and should implement on data.
5. Examine time series analysis algorithms and forecasting models.

Unit 1: Introduction to Data Mining

KDD, Process and Data Mining; KDD Steps; Types of Data for Data Mining, Data Mining Functionalities, Overview of data mining techniques. Descriptive Data Summarization: Measuring and Central Tendency and Dispersion of Data; Visualization of Descriptive Data Summaries; Data Cleaning: Handling Missing Values, Filtering Noisy Data – Binning Method; Data Integration; Data Transformation: Smoothing, Aggregation, Generalization, Normalization

UNIT 2:

Association Rule Mining: Market basket Analysis; Frequent Item sets, Closed Item sets, and Association

Rules; Support and Confidence; Apriori Algorithm for Mining Frequent Itemsets Using Candidate Generation; Generating Association Rules from Frequent Item sets; Improving the Efficiency of Apriori Algorithm; FP-Growth Algorithm for Mining Frequent Item sets without Candidate Generation; Mining Closed & Max Frequent Itemsets;

Unit 3: Cluster Analysis

Introduction to Cluster and Clustering; Features Required for Clustering Algorithms; Data Types and Dissimilarity Measures in Cluster Analysis; Categorization of Clustering Methods; Partitioning-Based Clustering: k-means Algorithms, k-Medoids algorithms, Hierarchical Clustering: Agglomerative and Divisive Methods.

Unit 4: Data Analytics

Data Analysis Fundamentals: Data Analysis foundations – Univariate, Bivariate and Multivariate Analysis; Graph Data, Kernel Methods; Working with High Dimensional data; Dimensionality reduction methods.

Unit 5: Advanced topics in Data Analytics

Time series data preprocessing, Time series Analysis, Forecasting models, Trend analysis, Spacio-temporal Modelling