RANI RASHMONI GREEN UNIVERSITY
TARAKESWAR, HOOGHLY

Syllabus

of
Master of Science
in
Computer Science

Under Semester System
Course Duration: 2 years, 4 Semesters
[W.e.f.:2025-2026]

Subject…….

Programme Structure

Semester	CourseCode	CourseTitle	Full Marks	Credit (L+T+P)	Lecture hours
I	COS-101	Environmental Science	40+**10***	4 (3-1-0)	40
	COS -102	AdvancedComputerArchitecture	40+10	4 (3-1-0)	40
	COS -103	Advanced DBMS	40+10	4 (3-1-0)	40
	COS -104	Design & Analysis of Algorithms	40+10	4 (3-1-0)	40
	COS -105	Discrete Mathematics	40+10	4 (3-1-0)	40
	COS-196	DBMS and Algorithms Lab	40+10	4 (0-0-4)	40
	Total		**300**	**24**	**240**
II	COS-201	(CBCS-I) Fundamental of Computers	40+10	4 (3-1-0)	40
	COS-202	Advanced Operating Systems	40+10	4 (3-1-0)	40
	COS-203	AdvancedComputerNetwork &Security	40+10	4 (3-1-0)	40
	COS-204	TheoryofComputation	40+10	4 (3-1-0)	40
	COS-205	Artificial Intelligence and Machine Learning	40+10	4 (3-1-0)	40
	COS-296	Artificial Intelligence and Machine Learning using Python	40+10	4 (0-0-4)	40
	Total		**300**	**24**	**240**
III	COS -301	(CBCS-II)Fundamental of Programming	40+10	4 (3-1-0)	40
	COS-302	Data Mining & Data Warehousing	40+10	4 (3-1-0)	40
	COS-303	Image Processing	40+10	4 (3-1-0)	40
	COS-304	Cloud Computing	40+10	4 (3-1-0)	40
	COS-305	Advanced Software Engineering	40+10	4 (3-1-0)	40
	COS-396	Python Programming Lab	40+10	4 (0-0-4)	40
	Total		**300**	**24**	**240**
IV	COS-401	Deep Learning and Generative AI	40+10	4 (3-10)	40
	COS-402	Cyber Security	40+10	4 (3-1-0)	40
	COS- 403	Special Paper-I	40+10	4 (3-1-0)	40
	COS- 404	Special Paper -II	40+10	4 (3-1-0)	40
	COS- 495	Project	50	4 (0-0-4)	40
	COS- 496	Internship	50	4 (0-0-4)	40
	Total		**300**	**24**	**240**
GrandTotal			**1200**	**96**	**960**

Special Paper-I

Pattern Recognition

High Performance Computing

Internet of Things and Smart Systems

Special Paper -II

Mobile Computing

Computer Vision
Quantum Computing

Theory -50 Marks, Written - 40 Marks, Internal Assessment -10 Marks
Theory - … Marks, Written -…. Marks, Internal Assessment -… Marks Practical -100 Marks

For Theory :- X-0-X
For Practical/Project:- X-9-X
For Practical/Project, lecture hours would be twice of the theory

*Each student will obtain marks based on the plantation and growing up of a sapling that would produce fruits and attract the birds/animals.

Overview

Semester	Paper	No of Papers	FullMarks of Each Paper	CreditPoint OfEach Paper	TotalMarks	Credit Points	Total Credit Point
1st	Theoretical	5	40+10=50	4	300		24
	Practical	1	40+10=50	4			
2nd	Theoretical	5	40+10=50	4	300		24
	Practical	1	40+10=50	4			
3rd	Theoretical	5	40+10=50	4	300		24
	Practical	1	40+10=50	4			
4th	Theoretical	4	40+10=50	4	300		24
	Project Internship	2	50	4			
GrandTotal96CreditPoints							

Question Pattern :

- Question of 2marks (4 questions out of 6 questions, should be attended by the students) = 8 marks
- Questions of 4 marks (4 questions out of 6 questions, should be attended by the students) = 16 marks
- Questions of 8 marks (2 questions out of 4 questions, should be attended by the students) = 16 marks

Total=40 marks

Programoutcome(P.O):

Thepurposeofthepostgraduate……..atRaniRashmoniGreenUniversityistoprovidethekeyknowledge base /and laboratory resources to prepare students for careers as professional in the field of ……...

Aftercompletionoftheprogramstudentswillbereadyfor,

i. ……..
ii. …….

1st Semester				
Paper	Course	**Marks**	**Lecture hours**	**CreditPoint**
COS-101	**Environmental Science**			**4**
Unit-I	Introduction	5	4	
Unit-II	Elements of Ecology	5	6	
Unit-III	Pollutants and Contaminants	8	6	
Unit-IV	Air Pollution	5	6	
Unit-V	Water Pollution	5	6	
Unit-VI	Land Pollution	6	6	
Unit-VII	Noise Pollution	6	6	
	.			
COS-102	**Advanced Computer Architecture**			**4**
Unit I	The Evolution of Modern Computer Systems	8	6	
Unit II	Performance Enhancement of Processor by Pipelining.	8	8	
Unit III	Vector Processing	8	10	
Unit IV	High Performance Computing	8	8	
Unit-V	Embedded Systems and its Architecture	8	8	
COS-103	**Advanced DBMS**			**4**
Unit I	Introduction of DBMS	10	14	
Unit II	Transaction and Concurrency Control	8	10	
Unit III	Distributed Databases	12	10	
Unit IV	Database Recovery	10	6	
COS-104	**Design & Analysis of Algorithms**			**4**
Unit I	Time and Space Complexity, Divide & Conquer method.	8	10	
Unit II	Dynamic Programming	10	6	
Unit III	Greedy Method	10	6	
Unit IV	N-queen's Problem	5	6	
Unit V	Network Flow ,Complexity Classes	7	12	

COS-105	**Discrete Mathematics**			**4**
Unit I	Logic and Proofs .	5	4	
Unit II	Principles of Mathematical Induction	5	5	
Unit III	Sets and Sequence	5	8	
Unit IV	Counting and Combinatorics	5	8	
Unit V	Algebraic Structure	10	8	
Unit VI	Graph and Tree	10	7	
COS-196	DBMS and Algorithms Lab			**4**
Unit-I	DBMS Lab Topics	10	15	
Unit-II	Algorithms Lab Topics	20	15	
Unit-III	Lab Activities	10	10	
	TotalMarks	300		
	TotalCredit			24

2nd Semester

Paper	Course	Marks	Lecture hours	CreditPoint
COS-201	**Fundamental of Computers**			**4**
Unit-I	Introduction to Computers	5	5	
Unit-II	Computer Hardware and Software	5	5	
Unit-III	Number Systems and Data Representation	5	5	
Unit-IV	Operating System Basics	5	5	
Unit-V	Basics of Computer Networking & Internet	5	5	
Unit-VI	Office Automation and Productivity Tools	15	15	
COS-202	**Advanced Operating Systems**			**4**
Unit-I	Introduction of Operating Systems	5	5	
Unit-II	Process Management, CPU Scheduling & Deadlock	15	15	
Unit-III	Memory Management	10	10	
Unit-IV	File Systems and I/O Management	5	5	
Unit-V	Security and Protection	5	5	
COS-203	**Advanced Computer Network & Security**			**4**

Unit-I	Introduction	4	5	
Unit-II	Wireless Network	8	5	
Unit-III	IEEE 802.11 MAC Layer Fundamentals	8	10	
Unit-IV	Energy Management in Wireless Networks	10	10	
Unit-V	Network Security and cryptography	10	**10**	
COS-204	**Theory of Computation**			**4**
Unit-I	Introduction	5	5	
Unit-II	Regular languages and finite automata	10	10	
Unit-III	Context-free languages and pushdown automata	15	10	
Unit-IV	Turing machines	5	10	
Unit-V	Decidability	5	5	
COS-205	**Artificial Intelligence and Machine Learning**			**4**
Unit-I	AI Topics	10	12	
Unit-II	Machine Learningand Key Concepts	10	8	
Unit-III	Tools and Frameworks	10	8	
Unit-IV	Applications	10	12	
CS-296	**Artificial Intelligence and Machine Learning using Python(Lab)**			**4**
Unit-I	Key Topics	20	20	
Unit-II	Lab Activities	20	20	
	TotalMarks	300		
	TotalCredit			24

3rdSemester:Spl.

Paper	Course	Marks	Lecture hours	CreditPoint
COS-301	**Fundamentals of Programming**			**4**
Unit-I	Introduction to Computers	5	4	
Unit-II	Computer Hardware and Software	6	6	
Unit-III	Number Systems and Data Representation	6	6	
Unit-IV	Operating System Basics	6	6	
Unit-V	Basics of Computer Networking & Internet	7	6	
Unit-VI	Office Automation and Productivity Tools	10	12	
COS-302	Data Mining & Data Warehousing			4
Unit-I	Basics of Data Mining	5	5	
Unit-II	Data Warehouse	6	5	
Unit-III	Data Mining Techniques	5	7	
Unit-IV	Mining Association Rules	8	8	
Unit-V	Clustering Techniques	5	5	
Unit-VI	Classification Techniques	6	5	

Unit-VII	Application and Trends in Data Mining	5	5	
COS-303	Image Processing			4
Unit-I	Introduction	5	8	
Unit-II	Digital Image Formation	5	8	
Unit-III	Mathematical Preliminaries	10	8	
Unit-IV	Image Enhancement	10	8	
Unit-V	Image Restoration	5	8	
Unit-VI	Image Segmentation	5	8	
COS-304	**Cloud Computing**			4
Unit-I	Definition of Cloud Computing and its Basics	5	6	
Unit-II	Use of Platforms in Cloud Computing	10	12	
Unit-III	Cloud Infrastructures	15	12	
Unit-IV	Concepts of Services and Applications	10	10	
COS-305	**Advanced Software Engineering**			4
Unit-I	Software Design	4	4	
Unit-II	Estimation and Scheduling of Software Projects	6	6	
Unit-III	Software Testing: Verification and Validation	10	8	
Unit-IV	Software Quality	3	4	
Unit-V	Software Configuration Management	3	4	
Unit-VI	Agile	10	10	
Unit-VII	Web Engineering	4	4	
COS-396	**Python Programming Lab**			
Unit-I	Variable and Expression		2	
Unit-II	Control Statement and Iteration		8	
Unit-III	Collections		4	
Unit-IV	Function		4	
Unit-V	File Management		8	
Unit-VI	Errors and Exception Handling		4	
Unit-VII	Classes and Objects		4	
Unit-VIII	Modules& Packages		2	
Unit-IX	Modules Numpy		4	
	TotalMarks		300	
	TotalCredit			24

4th Semester:Spl.				
Paper	**Course**	**Marks**	**Lecture hours**	**CreditPoint**
COS-401	**Deep Learning and Generative AI**	5	**6**	**4**
Unit-I	Introduction to Deep Learning	5	8	
Unit-II	Convolutional and Recurrent Neural Networks	10	6	
Unit-III	Advanced Deep Learning Architectures	5	6	
Unit-IV	Generative Models	10	8	
Unit-V	Applications of Generative AI	5	6	
COS-402	**Cyber Security**			**4**
Unit-I	Advanced Cryptography	5	6	
Unit-II	Networks and Web Security	10	10	
Unit-III	Malware and Threat Intelligence	10	10	
Unit-IV	Security in Emerging Technologies	10	8	
Unit-V	Privacy, Ethics, and Regulations	5	6	
Special Paper-I				
CS-403A	**Pattern Recognition**			**4**
Unit-I	Basics of Probability, Random Processes and Linear Algebra	5	5	
Unit-II	Linear Algebra	5	5	
Unit-III	Bayes Decision Theory	5	5	
Unit-IV	Parameter Estimation Methods	5	5	
Unit-V	Dimensionality reduction	5	5	
Unit-VI	Linear discriminant functions	5	5	
Unit-VII	Artificial neural networks	5	5	
Unit-VIII	Non-metric methods for pattern classification	5	5	
CS-403B	**High Performance Computing**			**4**
Unit-I	Introduction to High Performance Computing	15	10	
Unit-II	Parallel and Distributed Algorithms	15	20	
Unit-III	Cloud-HPC Integration and Applications	10	10	
CS-403C	**IoT and Smart Systems**			**4**
Unit-I	Introduction to IoT	6	8	
Unit-II	Hardware and Communication Technologies	6	8	
Unit-III	IoT Platforms and Middleware	10	8	
Unit-IV	Smart System's Design	8	8	
Unit-V	Security, Standards, and Future Trends	10	8	
Special Paper-II				
CS-404A	**Mobile Computing**			**4**
Unit-I	Introduction	6	8	

Unit-II	Digital Cellular Systems	8	8	
Unit-III	Mobile Network and Transport Layer	8	8	
Unit-IV	Database Issues	8	8	
Unit-V	MobleAdhoc Networks	10	8	
CS-404B	**Computer Vision**			**4**
Unit-I	Images	6	**8**	
Unit-II	Image Processing	8	**8**	
Unit-III	Computer Vision Paradigms	8	**8**	
Unit-IV	Finding Edges and Lines	8	**8**	
Unit-V	Finding and Processing Regions	10	**8**	
CS-404C	**Quantum Computing**			**4**
Unit-I	Foundations	5	**6**	
Unit-II	Quantum Computation Model	10	**8**	
Unit-III	Core Quantum Algorithms	10	**8**	
Unit-IV	Quantum Error, Simulation & Applications	5	**8**	
Unit-V	Project & Evaluation	10	**5**	
COS - 495	Project	**50**		**4**
COS - 496	Internship	**50**		**4**
	TotalMarks		300	
	TotalCredit			24

SEMESTER-I

COS–101 Course Title- Environmental Science Marks:50 Credits:4 Classes:- 40 L

Unit-01
Unit Title:Introduction

Basic ideas of environment and interrelationship among man society and environment. Environmental problems and issues, Segments of environments, Natural Cycles of environments Mathematics of population growth and its associated problems, Logistic population growth

Unit-02
Unit Title:-Elements of Ecology

Open and closed system ecology, species, population, community, definition of ecosystem-components types and functions, Environmental perspectives, Montreal protocol

Unit-03
Unit Title:-Pollutants and Contaminants

Definition of primary and secondary pollutants and contaminants. Source and effects of different air pollutants suspended particulate matter, oxides of carbon, nitrogen, sulphur particulate

Unit-04
Unit Title:- Air Pollution

Structures of the atmosphere, global temperature models, Greenhouse effect, global warming; acid rain: causes, effects and control. Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution**.**

Unit-05
Unit Title:- Water Pollution

Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts. Biochemical effects of heavy metals; eutrophication: source, effect and control. Water quality parameters: DO, BOD, COD. Water treatment: surface water and wastewater

Unit-06
Unit Title:- Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal**.**

Unit-07
Unit Title:- Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control

Text Books/References

- Environmental Studies, M.P. Poonia& S.C. Sharma, Khanna Publishing House.
- Basic Environmental Engineering and Elementary Biology, GourKrishnaDasMahapatra,
- VikasPublishing House P. Ltd.
- Environmental Chemistry, A. K. De, New Age International.
- Environmental Engineering, G.M.Masters, Tata Mc Graw Hills
- Environmental Chemistry with Green Chemistry, A. K. Das, Books and Allied P. Ltd.

- Fundamentals of Environment & Ecology, D. De, D. De, S. Chand & Company Ltd

Course Outcome:-

The course will empower the undergraduate students by helping them to:

- Gain in-depth knowledge on natural processes and resources that sustain life and govern economy.
- Understand the consequences of human actions on the web of life, global economy, and quality of human life.
- Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- Acquire values and attitudes towards understanding complex environmental economic- social challenges, and active participation in solving current environmental problems and preventing the future ones.
- Adopt sustainability as a practice in life, society, and industry.

COS–102 Course Title-Advance Computer Architecture Marks:50Credits:4Classes:- 40 L

Unit-01

Unit Title:The evolution of modern Computer systems

The evolution of modern Computer systems – from DEC PDP-11, IBM 360/370 family, CDC Cyber 6600, Intel X86 architecture, Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. Introduction to high performance Computing – Overview, Flynn‟s classifications – SISD, SIMD, MISD,MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures, Performance measurement for parallel architectures – Flynn's measure, Fang's measure, Handler‟s measure, Amadahl‟s law of limitation for parallel processing, Gustafson‟slaw..

Unit-02

Unit Title:Performance Enhancement of Processor by Pipelining

Basic idea to enhance the performance of a processor, Concept of Pipelining, Pipeline performance, various hazard in pipeline, methods to solve the hazards. Pipeline performance measurement parameters- speedup, efficiency, throughput, classification of pipeline processor, pipeline structure of CPU, examples from design of arithmetic pipeline- floating point adder, multiplier. Multifunction pipeline, reservation table, Dynamic pipeline, pipeline latency.

Unit-03

Unit Title:Vector Processing

Characteristics of vector processing, vector instructions, special instruction, differences between scalar and vector processing with example, architecture of typical vector processor with multiple functional pipe. Pipeline chaining and vector loops

Unit-04

Unit Title:High Performance Computing

Performance measurement parameters – MIPS, MFLOPS, SPEC rating, CPI etc., introduction to high performance computing – Overview, Flynn's classification – SISD, SIMD,MISD, MIMD. , SIMD Array processors: SIMD computer organization, Masking and Data-Routing Mechanisms, Inter PE communication, SIMD Inter Connection Networks, SIMD Matrix Multiplication. Multiprocessor Architecture: Loosely Coupled and Tightly Coupled Multiprocessors.

Unit-05

Unit Title: Embedded System and its Architecture

Why embedded system, defination of Embedded system, Example of embedded systems, architecture of

embedded systems with some example., Classification of Embedded system, Code sign of Embedded system, Embedded System Development cycle), Processor interfacing, Embedded System Design Issues: Hardware issues (Processor, Memory, Peripherals) ,Software issues (Programming Languages, Time Criticality, RTOS)

Reference Books:

1. Advanced Computer Architecture Hwang (TMH)
2. Computer Organization & design – Patterson & Hennessy (Morgan Kaufmann)
3. Computer Architecture & Organization – J P Hayes (McGraw Hill))
4. Computer organization and architecture, designing for performance – Stalling (PHI)
5. Structured Computer Organization – Tanenbaum (PHI)
6. Embedded Systems Architecture – a comprehensive guide for engineers and programmers -Tammy Noergaard(Elsevier)

CourseOutcome(C.O.)

After successful completion of this course, students will be able to:

- Describe the merits and pitfalls in computer performance measurements and analyze the impact of instruction set architecture on cost-performance of computer design
- Explain Digital Logic Circuits, Data Representation, Register and Processor level Design and Instruction Set architecture
- Solve problems related to computer arithmetic and Determine which hardware blocks and control lines are used for specific instructions
- Design a pipeline for consistent execution of instructions with minimum hazards
- Explain memory organization, I/O organization and its impact on computer cost/performance.

COS-103Course title– Advanced DBMS Marks:50 Credits:4Classes:40L

Unit-01

Unit Title-: Introduction of DBMS

Structure of relational Databases, Relational Algebra, Relational Calculus, Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Lossless Decomposition Boyce-

Code Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF

Unit-02

Unit Title-: Transaction and Concurrency Control

Transaction processing , Concurrency control and Recovery Management, conflict and view serializability, lock based protocol, two phase locking.

Unit-03

Unit Title: Distributed Database

Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks. Time based and quorum based protocols. Comparison. Reliability- non-blocking commitment protocols.

Unit-04

Unit Title: Database recovery

Partitioned networks. Checkpoints and cold starts. Management of distributed transactions- 2 phase unit protocols. Architectural aspects. Node and link failure recoveries. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.

Reference Books:

1. Leon & Leon, Essentials Of DBMS, Mc.Graw Hill
2. Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
3. Saeed K. Rahimi, Frank S. Haug, Distributed Database Management Systems: A Practical Approach,Willey

CourseOutcome(C.O.)

After successful completion of this course, students will be able to:

- Identify the need for a database over the file system.
- Understand and implement the process of data insertion, retrieval, and manipulation.
- Understand and analyze the functional dependencies among attributes of the entity set and normalization between the relations.
- Implement SQL concept for a database transaction.
- Understand and Implement the Transaction control and concurrency control management.
- Evaluate the relational tables, PL/SQL programs, triggers, database files, indexing of RDBMS.

COS-104Course title– Design & Analysis of Algorithms Marks:50 Credits:4Classes:-40L

Unit-01

Unit Title: Time and Space Complexity, Divide & Conquer method

Time and Space Complexity, Recurrence for divide and conquer and its solution, Methods for solving recurrences, Merge sort, Heap sort, Quick sort and Complexity analysis

Unit-02

Unit Title: Dynamic Programming:

Matrix-chain multiplication, All pair shortest paths, Single source shortest path, Travelling salesman problem, 0-1 knapsack problem

Unit-03

Unit Title: Greedy Method

Knapsack problem, Job sequencing with deadlines, Activity – selection, Huffman codes, Minimum spanning tree by Prim's and Kruskal's algorithms

Unit-04

Unit Title: N-queen's Problem

Constraint Satisfaction, Backtracking, Forward Checking, Look-ahead, Conflict directed back jumping.

Unit-05

Unit Title: Network Flow ,Complexity Classes

P, NP, NP-Hard, NP-Completeness, SAT, 3-SAT, Graph Colouring, Hamiltonian Cycle, TSP,Approximation Algorithms, Randomized Algorithms

Reference Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithms".
2. A. Aho, J.Hopcroft and J.Ullman "The Design and Analysis of Algorithms"
3. D.E.Knuth "The Art of Computer Programming", Vol. 3
4. Jon Kleiberg and Eva Tardos, "Algorithm Design"
5. E.Horowitz and Shani "Fundamentals of Computer Algorithms"
6. Rajeev Motwani and P. Raghavan, "Randomized Algorithms". Cambridge University Press, New York. 7. Vazirani, Vijay V, "Approximation Algorithms". Berlin: Springer

Course Outcome:-

students will be able to do the following:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations

COS-105 Course title– Discrete Mathematics Marks:50 Credits:4 Classes: 40L

Unit-I
Unit Title:-Logic and Proofs
Propositional logic, Propositional equivalences, Predicates and quantifiers, Nested quantifiers, Rules of inference.

Unit-II
Unit Title:-Principles of Mathematical Induction

The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Unit-III
Unit Title:-Sets and Sequence

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Fuzzy set, Basic properties of fuzzy set

Unit-IV
Unit Title:-Counting and Combinatorics

Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and Combination.

Unit-V
Unit Title:-Algebraic Structure

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Unit-VI
Unit Title:-Graph and Tree

Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances

Reference Books:

1) S.B. Singh, Discrete Structures, Khanna Book Publishing, Delhi
2) Kandel& Baker- Discrete Mathematics for Comp. Scientists & Mathematicians, Mott, PHI
3) C.L.Liu- Discrete Mathematical Structure, C.L.Liu,TMH
4) G.S.RAO- Discrete Mathematical Structure, New Age International
5) DeoNarsingh - Graph Theory With Applications To Engineering And Computer Science, PHI Learning
6) Arumugam, Ramachandran- Invitation to Graph Theory, Scitech Publications

Course Outcome:-

- Understand fundamental concepts of discrete structures, including sets, relations, and functions.
- Develop problem-solving skills using mathematical reasoning and logic.
- Apply combinatorial techniques to count and analyze discrete structures.
- Gain proficiency in graph theory and its applications in computer science.
- Learn about algorithms and their efficiency through complexity analysis.
- Explore mathematical proofs and the importance of rigorous argumentation.
- Familiarize with number theory and its relevance in cryptography.
- Analyze discrete probability and its applications in decision-making.
- Understand the role of discrete mathematics in computer algorithms and data structures.
- Prepare for advanced topics in computer science and mathematics

COS-196Course Title-DBMS and Algorithms LabMarks:50 Credits:4 Classes:40L

Unit I: DBMS Lab Topics:

1. Introduction to Database Management Systems (DBMS)
2. SQL (Structured Query Language) basics
3. Creating and managing databases
4. Querying databases (SELECT, INSERT, UPDATE, DELETE)
5. Database design (ER diagrams, normalization)
6. Indexing and query optimization

Unit II: Algorithms Lab Topics:

1. Introduction to algorithms
2. Basic data structures (arrays, linked lists, stacks, queues)
3. Sorting algorithms (Bubble sort, Selection sort, Merge sort, Quick sort)
4. Searching algorithms (Linear search, Binary search)
5. Graph algorithms (DFS, BFS, Shortest path)
6. Dynamic programming and greedy algorithms

Unit III: Lab Activities:

1. Writing SQL queries to perform CRUD (Create, Read, Update, Delete) operations
2. Implementing algorithms in a programming language (e.g., Python, Java, C++)
3. Analyzing time and space complexity of algorithms
4. Solving problems using data structures and algorithms

References:

- "Database System Concepts" by Abraham Silberschatz
- "Introduction to Algorithms" by Thomas H. Cormen
- "Data Structures and Algorithms in Python" by Michael T. Goodrich
- "SQL Queries for Mere Mortals" by John D. Cook
- "Database Management Systems" by Raghu Ramakrishnan

Course Outcome:-

- Design and implement **ER models** and **relational schemas** using industry-standard notations and tools. *(Apply, Design)*
- Develop and execute **SQL queries** for data retrieval and manipulation in relational databases. *(Apply)*
- Implement **relational database operations** including join, subqueries, and aggregation. *(Apply, Analyze)*
- Implement various **algorithmic techniques** such as divide-and-conquer, greedy methods, and dynamic programming. *(Apply)*
- Analyze the **time and space complexity** of algorithms experimentally. *(Analyze)*
- Implement and compare **searching and sorting algorithms** for performance. *(Apply, Analyze)*
- Solve computational problems using **graph algorithms** like DFS, BFS, shortest path, and MST

SEM.-II

COS-201: Course title– Fundamental of Computers Marks:50 Credits:4 Classes:40 L

Unit 1:
Unit Title:-Introduction to Computers

- Definition and Characteristics of Computers
- Evolution and Generations of Computers
- Classification: Supercomputers, Mainframes, Minicomputers, Microcomputers
- Basic Organization of a Computer (Input, Process, Storage, Output)
- Applications of Computers in Various Fields

Unit 2:
Unit Title:-Computer Hardware and Software

- Hardware: CPU, RAM, ROM, Motherboard, Hard Drive, Peripherals
- Input & Output Devices: Keyboard, Mouse, Scanner, Printers, Monitors
- Storage Devices: HDD, SSD, USB, Optical Disks, Cloud Storage
- Software Types: System Software, Application Software, Utility Software
- Introduction to Open-Source and Proprietary Software

Unit 3:
Unit Title:-Number Systems and Data Representation

- Types of Number Systems: Binary, Decimal, Octal, Hexadecimal
- Conversions Between Number Systems
- Binary Arithmetic (Addition, Subtraction, Multiplication, Division)
- Character Encoding Standards (ASCII, Unicode)

Unit 4:
Unit Title:-Operating System Basics

- Functions of an Operating System
- Types of Operating Systems (Batch, Time-Sharing, Distributed, Real-Time, Mobile OS)
- File System and Process Management
- Introduction to Command Line (Windows CMD & Linux Terminal)

Unit 5:
Unit Title:-Basics of Computer Networking & Internet

- Network Types: LAN, MAN, WAN
- Network Topologies: Star, Ring, Bus, Mesh, Hybrid
- Introduction to IP Addressing, DNS, HTTP/HTTPS
- Cybersecurity Basics: Firewalls, Antivirus, Safe Browsing
- Cloud Computing Basics

Unit 6:
Unit Title:-Office Automation and Productivity Tools

- Word Processing (MS Word/Google Docs): Formatting, Tables, Mail Merge
- Spreadsheet Software (MS Excel/Google Sheets): Formulas, Charts, Data Analysis
- Presentation Software (MS PowerPoint/Google Slides): Templates, Animations

Course Outcomes

After successful completion of this course, students will be able to:

- **Describe the** basic components of a computer system**, including hardware, software, and their functions.** ***(Understand)***
- **Demonstrate knowledge of** number systems**, binary arithmetic, and basic logic gates.** ***(Understand, Apply)***
- **Explain the role and types of** operating systems**, application software, and system software.** ***(Understand)***
- **Identify and use basic** input/output devices**, memory types, and storage devices.** ***(Understand, Apply)***
- **Utilize basic** computer applications **such as word processing, spreadsheets, and presentation tools.** ***(Apply)***
- **Understand the fundamentals of** computer networking, internet, and cybersecurity principles**.** ***(Understand)***

COS-202 Course title–Advanced Operating Systems Marks:50 Credits:4Classes:-40L

Unit-01
Unit Title: Introduction of Operating System

Generations Concept of Operating systems, Systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Real Time Operating Systems, Distributed Operating Systems, Multiprocessor Operating System. Case Study: Architecture of Unix and Windows Operating Systems

Unit-02
Unit Title: Process Management, CPU Scheduling & Deadlock:

7 state process model, Process scheduling, Operations on processes, Inter-process communication, Threads overview, Benefits of threads, User and kernel threads.

CPU Scheduling: Scheduling criteria, Preemptive & non-preemptive scheduling, Scheduling algorithms (FCFS, SJF, RR, Priority, Multi-level queue, Multi-level feedback queue), Comparative study of the algorithms, Multiprocessor scheduling. Process Synchronization: Background, Critical section problem, Software solution – Peterson and Bakery algorithm, Synchronization hardware, Semaphores, Classical problems of synchronization.

Deadlocks: System model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. Case Study: Scheduling on Unix and Windows Operating Systems

Unit-03

Unit Title: Memory Management

Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms(Optimal, FIFO, SC, NRU and LRU), Thrashing Case Study: Unix Virtual Memory, Windows Virtual Memory

Unit-04

Unit Title: File Systems and I/O Management

File concept, Fundamental File System Organization and Access Methods, Directory structure, File system structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management (Bit vector, Linked list, Grouping), Directory Implementation (Linear list, Hash table), Efficiency and Performance. PC Bus Structure, I/O connections, Data transfer techniques (Programmed, Interrupt driven, DMA), Bus arbitration (Daisy chain, Polling, Independent request), Blocking and non-blocking I/O, Kernel I/O subsystem (Scheduling, Buffering, Caching, Spooling and device reservation, Error handling). Case Study: UnixFile System, Windows File System.

Unit-05

Unit Title:Security and Protection

Overview of Security and Protection, Goals of Security and Protection, Security Attacks, Formal and Practical aspects of Security, Encryption, Authentication and Password Security, Access Descriptors and the Access Control Matrix, Protection Structures, Capabilities, Case Study: Unix Security, Windows Security.

Reference Books:

- Operating System Concepts Essentials, 10th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
- Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
- Operating System Concepts, EktaWalia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
- Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
- Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison- Wesley
- Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India
- Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Outcome(C.O.)

After successful completion of this course, students will be able to:

- Describe the main components of OS and their working
- Explain the concepts of process and thread and their scheduling policies
- Explain the various memory management techniques
- Compare the different techniques for managing memory, I/O, disk and files
- Explains the security and protection features of an Operating System

COS-203Course title–Advanced Computer Network &Security Marks:50Credits:4Classes:40L

Unit-01

Unit Title:- Introduction

Overview and Introduction, Fundamental of wireless networks and security

Unit-02

Unit Title:-Wireless Network

Wireless LANS and PANS, Wireless WANS and MANS, AD HOC Wireless Networks, Wireless Sensor Networks, Wireless Body Area Networks

Unit-03

Unit Title:-IEEE 802.11 MAC Layer Fundamentals

CSMA/CA, IEEE 802.11 MAC Layer, Advanced, Routing Protocols for AD HOC Wireless Networks, Routing Protocols for AD HOC Wireless Networks

Unit-04

Unit Title:- Energy Management in Wireless Networks

Energy Management in Wireless Networks, Network Lifetime Enhancement

Unit-05

Unit Title:-Network Security and cryptography

Introduction, Overview, Security techniques, Cryptography: Concepts & Techniques, Symmetric Key Algorithm, Asymmetric Key Algorithm, Digital Signature and RSA, Internet Security Protocols, User Authentication, Electronic Mail Security, Firewall

Reference Book:

- Ad Hoc Wireless Networks, Pearson Education,C.Siva Ram Murthy, B.S. Manoj
- Cryptography and Nerwork Security, Tata McGraw-Hill, AtulKahate
- Protocols and Architectures for Wireless Sensor Networks, Paperback, Holger Karl, Andreas Willig

Course Outcome:-

- Understand advanced networking architectures, protocols, and emerging technologies.
- Learn cryptographic principles and secure communication mechanisms.
- Analyze various security threats and implement countermeasures.
- Gain hands-on experience in intrusion detection, firewall configuration, and ethical hacking.
- Explore cybersecurity trends, digital forensics, and AI-driven security solutions.

COS-204 Course title– Theory of Computation Marks:50 Credits:4 Classes-40L

Unit –I

Unit Title:- Introduction

Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages

Unit –II

Unit Title:- Regular languages and finite automata

Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata).

Unit –III

Unit Title:- Context-free languages and pushdown automata

Context-free grammars (CFG) and languages (CFL), Chomsky andGreibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFL

Unit –IV
Unit Title:- Turing machines

The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMsand equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsasenumerators.Context Sensitive Language, The model of Linear Bounded Automaton, relation between LBA and context sensitive language.

Unit –V
Unit Title:- Decidability

Decidability, decidable language and undecidable language, Halting problem of TM, Halting problem of TM

Reference Books:

- Introduction to Automata Theory, Languages, and Computation, John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson Education Asia.
- Theory of Computation, R.B. Patel &PremNath, Khanna Publishing House.
- Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, Pearson Education Asia.
- Theory of Computer Science, Automata Languages and computation, Mishra and Chandra shekaran, 2nd edition, PHI.
- Automata and Computability, Dexter C. Kozen, Undergraduate Texts in Computer Science, Springer.
- Introduction to the Theory of Computation, Michael Sipser, PWS Publishing.
- Introduction to Languages and The Theory of Computation, John Martin, Tata Mc Graw Hill., PEARSON.

Course Outcome:

After successful completion of this course, students will be able to:

- Understand the formal notation for strings, languages and machines.
- Design and Implement Finite automata to accept a string of a language.
- For a given language determine whether the given language is regular or not.
- Design context free grammars to generate strings of context free language.
- Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
- Understand and analyze the hierarchy of formal languages, grammars and machines.
- Distinguish between computability and non-computability and Decidability and un-decidability.

COS-205 Course title– AI and Machine LearningMarks:50Credits:4 Classes:-40L

Unit-I: AI Topics

1. Introduction to Artificial Intelligence (AI)
2. History and applications of AI
3. Intelligent agents and environments
4. Problem-solving and search algorithms
5. Knowledge representation and reasoning

Unit-II : Machine Learning Topics:

1. Introduction to Machine Learning (ML)
2. Supervised learning (regression, classification)

3. Unsupervised learning (clustering, dimensionality reduction)
4. Reinforcement learning
5. Deep learning (neural networks, convolutional neural networks)

Unit-III : Key Concepts:

1. Regression and classification algorithms (Linear Regression, Logistic Regression, Decision Trees, etc.)
2. Clustering algorithms (K-Means, Hierarchical Clustering, etc.)
3. Neural networks and deep learning architectures
4. Model evaluation and validation
5. Overfitting and regularization techniques

Unit-IV : Applications:

1. Natural Language Processing (NLP)
2. Computer Vision
3. Robotics and control systems
4. Predictive modeling and forecasting
5. Recommendation systems

Unit-V : Tools and Frameworks:

1. Python programming language
2. TensorFlow or PyTorch for deep learning
3. Scikit-learn for machine learning
4. Keras for neural networks

References

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Deep Learning" by Ian Goodfellow, YoshuaBengio, and Aaron Courville
3. "Pattern Recognition and Machine Learning" by Christopher M. Bishop

Course Outcome:-

- Understand the **fundamental concepts and techniques** of artificial intelligence and machine learning. *(Understand)*
- Apply **search strategies** such as uninformed, informed, and adversarial search in AI problem-solving. *(Apply)*
- Analyze and implement **machine learning algorithms** such as supervised, unsupervised, and reinforcement learning. *(Analyze, Apply)*
- Design and evaluate **classification and regression models** using techniques like decision trees, SVMs, and neural networks. *(Create, Evaluate)*
- Use **feature selection, dimensionality reduction, and model evaluation techniques** to improve model performance. *(Apply, Analyze)*
- •Develop **AI/ML applications** using libraries like scikit-learn, TensorFlow, or PyTorch. *(Create, Apply)*

COS-296Course title– AI and ML using Python**Marks:50 Credits:4 Classes:-40L**

Unit I: Key Topics

1. Introduction to Python for AI and ML
2. Machine Learning with Scikit-learn
3. Deep Learning with TensorFlow or PyTorch
4. Natural Language Processing (NLP)
5. Computer Vision
6. Recommendation Systems

Unit II: Lab Activities

1. Implementing machine learning algorithms using Scikit-learn
2. Building deep learning models using TensorFlow or PyTorch
3. Working on NLP projects (text classification, sentiment analysis)
4. Working on computer vision projects (image classification, object detection)
5. Developing recommendation systems using Python

Resources

1. Books: "Python Machine Learning" by Sebastian Raschka, "Deep Learning with Python" by François Chollet
2. Online Courses: Coursera, edX, Udemy
3. Tutorials: Official documentation, YouTube tutorials, blogs

Course Outcome:-

- Understand the basic concepts and principles of **AI and Machine Learning** and their real-world applications. *(Understand)*
- Implement **search algorithms, knowledge representation**, and basic reasoning techniques using Python. *(Apply)*
- Apply **supervised and unsupervised learning algorithms** using Python libraries such as scikit-learn. *(Apply)*
- Evaluate and optimize machine learning models using **performance metrics and cross-validation**. *(Evaluate, Analyze)*
- Use Python tools (e.g., NumPy, pandas, matplotlib) for **data preprocessing, visualization**, and exploratory data analysis. *(Apply)*
- Design and develop small-scale **AI/ML projects in Python** to solve practical problems. *(Create)*

SEM.-III

COS-301 Course title– Fundamentals of Programming Marks:50 Credits:4 Classes:-40L

Unit-I

Unit Title:-**Introduction to Programming**

- Overview of Computers and Programming Languages
- History and Evolution of Programming Languages
- Compilation and Execution Process
- Introduction to Algorithms and Flowcharts
- Writing Pseudocode

Unit-II

Unit Title:-**Basic Programming Constructs**

- Variables, Data Types, and Constants
- Operators and Expressions
- Input/Output Operations
- Type Conversion and Type Casting

Unit-III

Unit Title:-**Control Structures**

- Conditional Statements (if, if-else, nested if-else, switch-case)
- Looping Structures (for, while, do-while)
- Break and Continue Statements

Unit-IV

Unit Title:-**: Functions and Modular Programming**

- Defining and Calling Functions
- Function Parameters and Return Values
- Recursion
- Scope and Lifetime of Variables

Unit-V

Unit Title:-: Arrays and Strings

- Introduction to Arrays (1D and 2D)
- Array Operations (Traversing, Insertion, Deletion, Searching, Sorting)
- String Handling and Built-in String Functions

Unit-VI

Unit Title:-: Pointers and Dynamic Memory(For C/C++ based courses)

- Introduction to Pointers
- Pointer Arithmetic
- Dynamic Memory Allocation (malloc, calloc, free in C)

Unit-VII

Unit Title:-: Object-Oriented Programming (For Java/Python-based courses)

- Classes and Objects
- Encapsulation and Abstraction
- Inheritance and Polymorphism

Textbooks and References:

1. "C Programming Language" by Kernighan and Ritchie (For C-based courses)
2. "Python Programming: An Introduction to Computer Science" by John Zelle (For Python-based courses)
3. "Introduction to the Java Programming Language" by Y. Daniel Liang (For Java-based courses)

Course Outcomes:

- Understand the basics of programming languages.
- Develop problem-solving skills using algorithms and flowcharts.
- Learn fundamental programming constructs such as variables, control structures, functions, and data structures.
- Gain hands-on experience with a programming language (e.g., Python, C, or Java).

COS-302 Course title– Data Mining & Data Ware Housing **Marks:50Credits:4 Classes:-40L**

Unit-I

Unit Title:-Basics of Data Mining .

Data Mining Functionalities, Classification of Data Mining Mining Issues, Data Mining Goals. Stages of the Data

Mining Process Systems.

Unit-II

Unit Title:-Data Warehouse

Data Warehouse concepts, Data Warehouse Architecture, OLAP technology, DBMS , OLTP VS. Data Warehouse Environment, Multidimensional data model Data marts.

Unit-III

Unit Title:-Data Mining Techniques

Statistics, Similarity Measures, Decision Trees, Neural Networks, Genetic algorithms

Unit-IV

Unit Title:-Mining Association Rules

Parallel & Distributed Algorithm, Incremental Rules, Apriori Algorithm, Partition algorithm, Dynamic Item set Counting Algorithm, FP tree growth Algorithm, Boarder Algorithm

Unit-V

Unit Title:-Clustering Techniques

Partitioning Algorithms-K- means Algorithm, CLARA, CLARANS, Hierarchical Algorithm, DBSCAN

Unit-VI

Unit Title:-Classification Techniques

Statistical–based, Distance-based, Decision Tree- based Decision tree

Unit-VII

Unit Title:-Application and Trends in Data Mining

Applications, Advanced Techniques - Web Mining, Web Content

References Books:

1. Roiger&Geatz, Data Mining, Pearson Education
2. A.K.Pujari, Data Mining, University Press

3. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
4 J. Han and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufman.

Course Outcome:-

After successful completion of this course, students will be able to:

- Fundamental Concepts of Data Mining & Data Warehousing
- Data Preprocessing & Transformation
- Data Warehouse Design & Implementation
- Data Mining Techniques & Algorithms
- Pattern Recognition & Frequent Itemset Mining
- Advanced Topics in Data Mining
- Evaluation & Performance Tuning

COS-303 Course title– Image Processing Marks:50 Credits:4 Classes:- 40 L

Unit-I

Unit Title:-Introduction

Introduction Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.

Unit-II

Unit Title:-Digital Image Formation

A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Unit-III

Unit Title:-Mathematical Preliminaries

Neighbor of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Unit-IV

Unit Title:-Image Enhancement

Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Unit-V

Unit Title:-Image Restoration

Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation – Spatial Transformation, Gray Level Interpolation.

Unit-VI

Unit Title:-Image Segmentation

Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection – Local Processing, Global Processing via The Hough Transform; Thresholding -Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation – Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Reference Books:

1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, Springer India
3. Digital Image Processing &Analysis,Chanda&Majumder,PHI
4. Fundamentals of Digital Image Processing, Jain, PHI
5. Image Processing, Analysis & Machine Vision, Sonka, VIKAS

Course Outcome:

- After successful completion of this course, students will be able to:
- Describe the fundamental concept of the digital image processing system.
- Experiment the images in the frequency domain and spatial domain using various transforms.
- Evaluate the techniques for image enhancement and restoration.
- Explain different feature extraction techniques for image analysis and recognition.
- Categorize various compression techniques.
- Develop any image processing application.

COS-304 Course title– Cloud Computing Marks:50 Credits:4 Classes:-40L

Unit-I

Unit Title:- Definition of Cloud Computing and its Basics

Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing

Cloud Architecture: A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients

Services and Applications by Type IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)

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Unit-II

Unit Title:-Use of Platforms in Cloud Computing

Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance

Concepts of Platform as a Service Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks

Use of Google Web Services Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service. 4. Use of Amazon Web Services Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service

Use of Microsoft Cloud Services Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

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Unit-III

Unit Title:-Cloud Infrastructure

Types of services required in implementation – Consulting, Configuration, Customization and Support

Cloud Management An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an

overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle) Concepts of Cloud Security Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)

Unit-IV

Unit Title:- Concepts of Services and Applications

Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs .Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs

Cloud-based Storage: Cloud storage definition – Manned and Unmanned

Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services

Text/Reference Books:

- Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
- Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill Education (India) Private Limited, 2013
- Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
- Cloud Computing, Miller, Pearson
- Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson

Course Outcome:-

At the end of the course, the students are expected to:

- Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
- Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacenters to build and deploy cloud applications that are resilient, elastic and cost-efficient.
- Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
- Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS.
- Analyze various cloud programming models and apply them to solve problems on the cloud.

COS-305 Course title-Advanced Software Engineering Marks:50 Credits:4 Classes: - 40L

Unit-I:Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object- Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design. [4L]

Unit-II:Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts. [6L]

Unit-III:Software Testing: Verification and Validation: Error, Fault, Bug and Failure; Unit and Integration Testing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing,

Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing. [8L]

Unit-IV:Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability. [4L]

Unit- V:Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering. [4L]

Unit-VI:Agile: Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, Agile Testing Techniques, Test -Driven Development, User Acceptance Test. [10L]

Unit-VII:Web Engineering: Attributes of web-based applications, the WebE process, a framework for WebE, formulating, analyzing web-based systems, design and testing for web- based applications, Management issues. [4L]

Text/Reference Books:

- Roger S. Pressman, Software Engineering - A Practitioner's Approach, McGraw- Hill
- Somerville, Software Engineering, Pearson Education
- Jalote, Software Engineering, Narossa Publication
- Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices
- Succeeding with Agile : Software Development Using Scrum, Pearson (2010)

Course Outcome:-

At the end of the course, the students are expected to:

- To provide the idea of decomposing the given problem into Analysis, Desing, Implementation, Testing and Maintenance phases.
- To provide an idea of using various process models in the software industry according to given circumstances.
- To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

COS-396Course title– Python Programming Lab Marks:50 Credits:4 Classes:- 40L

Unit-I

Unit Title:-Variable and Expression

Variables as names for values; expressions (arithmetic and logical) and their evaluation (operators, associativity, precedence). Assignment operation; difference between left hand side and right hand side of assignment, Console input/output: taking input from user and printing user information.

Unit-II

Unit Title:-Control Statement and Iteration

If statement, else-if statement, multiple statements within if, multiple if statement. While Loop, For Loop, Nesting Loops, Controlling Loops using Break and Continue, Else Statement, Range Statement and Pass Statement in Loop.

Unit-III
Unit Title:-Collections
Strings, List, Tuples, Dictionary, Set, Selection sort, Bubble sort
Unit-IV
Unit Title:-Function
Built in function, user defined function, function passing values, function returning values, default parameter values, Recursive function
Unit-V
Unit Title:-File Management
Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files and directories
Unit-VI
Unit Title:-Errors and Exception Handling
Dealing with syntax errors, Exceptions, Handling exceptions with try/except, Cleaning up with finally
Unit-VII
Unit Title:-Classes and Objects
Create a Class, Create Object, __Init__() Function, Methods, Self Parameter, Modification and Deletion of Object Parameter, Deletion of Object, Pass Statement, Inheritance and Polymorphism, Scope, Module, Built-In Math Function, Math Module, Module datetime and Date Objects, RegEx Module andRegEx Functions, Exception Handling.
Unit-VIII
Unit Title:-Modules& Packages
Importing a module, Creating module, Function aliases, packages
Unit-IX
Unit Title:-Modules Numpy
ndArray, Pandas: reading files, exploratory data analysis, data preparation and processing,
Matplolib: Scatterplot, Line plot, Bar plot, Histogram, Box plot, Pair plot

Reference Books:

- N.S. Gill, Handbook of Computer Fundamentals, Khanna Publishing House
- Dr.Jeeva Jose-Taming Python by Programming, Khanna Publishing
- Martin C. Brown – The Complete Reference Python, Mc Graw Hill
- A. Martelli, A. Ravenscroft, S. Holden, Python in a Nutshell,OREILLY.
- Jason Rees-Python Programming:Practical introduction to Python Programming for total beginners,
- Anthony Brun - Python Programming: A Step By Step Guide From Beginner To Expert (Beginner, Intermediate & Advanced)
- Mark Pilgrim-Diva into Python, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG
- Summerfield Mark- Programming in Python 3,Pearson Education India

Course Outcome:
After successful completion of this course, students will be able to:
- Learn, understand and comprehend the concept of programming.
- Design algorithm to solve simple programming problem.
- Understand and remember syntax and semantics of Python.
- Create application using secondary storage.
- Understand and apply library for data analysis.
- Apply Python to implement different solutions for the same problem and analyze why one solution is better than the other.
- To write program for real life problem.

SEM-IV

COS-401Course title– Deep Learning and Generative AI
Marks:50 Credits:4 Classes:- 40L

Unit-I

Unit Title:-Introduction to Deep Learning

Review of neural networks and backpropagation , Activation functions, loss functions, optimizers, Regularization: dropout, batch normalization, Deep feedforward networks and training strategies, Introduction to frameworks: TensorFlow, PyTorch

Unit-II

Unit Title:-Convolutional and Recurrent Neural Networks

Convolutional Neural Networks (CNNs): architecture, filters, pooling, Applications in image classification and segmentation, Recurrent Neural Networks (RNNs), LSTM, GRU, Applications in sequence modeling and language tasks

Unit-III

Unit Title:-Advanced Deep Learning Architectures

Residual Networks (ResNet), DenseNet, Transformers and Attention Mechanisms, BERT and GPT models overview, Vision Transformers (ViT), Transfer learning and fine-tuning pre-trained models

Unit-IV

Unit Title:-Generative Models

Introduction to generative models: discriminative vs. generative, VariationalAutoencoders (VAEs): theory and implementation, Generative Adversarial Networks (GANs): architecture, loss functions, training instability, Variants: DCGAN, CycleGAN, StyleGAN, Conditional GANs, Evaluation metrics: Inception Score (IS), FID

Unit-V

Unit Title:-Applications of Generative AI

Text generation (ChatGPT-like models), Image synthesis and editing, Code generation, Data augmentation for ML tasks, Ethical concerns: deepfakes, hallucinations, copyright, Responsible AI and bias mitigation

Reference Books:

- Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, MIT Press
- Ian Goodfellow et al., NIPS 2014 Paper: Generative Adversarial Nets
- Francois Chollet, Deep Learning with Python, Manning Publications
- Sebastian Raschka, Machine Learning with PyTorch and Scikit-Learn, Packt
- OpenAI, DeepMind, and Google AI research papers
- Online documentation: TensorFlow, PyTorch, Hugging Face

Course Outcome:-

- Understand the **foundations of deep learning**, including neural networks, activation functions, loss functions, and optimization techniques. *(Understand)*
- Design and implement various **deep learning architectures** such as CNNs, RNNs, LSTMs, and transformers using frameworks like TensorFlow or PyTorch. *(Apply, Create)*
- Analyze and evaluate deep learning models using metrics such as accuracy, precision, recall, and confusion matrix. *(Analyze, Evaluate)*
- Understand the principles of **Generative AI** and **generative models** such as GANs (Generative Adversarial Networks), VAEs (VariationalAutoencoders), and diffusion models. *(Understand)*
- Implement **GANs and other generative models** using Python libraries and apply them to image, text, or audio generation tasks. *(Apply, Create)*
- Critically assess ethical concerns, bias, and limitations associated with deep learning and generative AI technologies.

COS-402Course title– Cyber SecurityMarks:50 Credits:4 Classes:- 40 L

Unit-I

Unit Title:-Advanced Cryptography

Elliptic Curve Cryptography (ECC) ,Post-quantum cryptography: lattice-based, hash-based, code-based schemes, Homomorphic encryption and secure multi-party computation ,Zero-Knowledge Proofs and zk-SNARKs

Unit-II
Unit Title:-Network and Web Security
Advanced firewalls and intrusion detection/prevention systems (IDS/IPS) ,Transport Layer Security (TLS) deep dive
DNS security (DNSSEC), BGP security, Web security threats: CSRF, Clickjacking, OAuth vulnerabilities ,API

security and rate-limiting techniques

Unit-III

Unit Title:-Malware and Threat Intelligence

Malware types and analysis (static vs dynamic), Advanced Persistent Threats (APTs), Threat modeling and attack simulation, Cyber threat intelligence (CTI) lifecycle, Tools: Cuckoo Sandbox, VirusTotal, MISP
Unit-IV

Unit Title:-Security in Emerging Technologies

Cloud security challenges and shared responsibility model,Container and Kubernetes security ,Blockchain security: consensus attacks, smart contract vulnerabilities, Security implications of IoT and edge computing, AI/ML security: adversarial attacks, model inversion, data poisoning

Unit-V

Unit Title:-Privacy, Ethics, and Regulations

Differential privacy and data anonymization, Privacy-preserving machine learning, Security governance and risk management ,Global data protection laws: GDPR, CCPA, HIPAA, Cyber ethics and responsible disclosure

Text/Reference Books:

- William Stallings, Cryptography and Network Security, Pearson
- Bruce Schneier, Applied Cryptography, Wiley
- Dan Boneh and Jonathan Katz, Introduction to Modern Cryptography
- NIST and OWASP documentation
- Research papers from IEEE S&P, USENIX, NDSS, ACM CCS

Course Outcome:
After successful completion of this course, students will be able to:

- Understand the **fundamentals of cyber security**, including security principles, threats, vulnerabilities, and risk management. *(Understand)*
- Identify and classify various types of **cyber attacks** such as malware, phishing, DoS/DDoS, and social engineering. *(Understand, Analyze)*
- Apply **cryptographic techniques** such as encryption, hashing, and digital signatures for securing data and communications. *(Apply)*
- Analyze the role of **network security tools** like firewalls, intrusion detection/prevention systems (IDS/IPS), and VPNs. *(Analyze, Apply)*
- Evaluate different **security policies, legal frameworks, and ethical practices** in cyber security. *(Evaluate)*
- Implement basic **cyber security practices** such as secure password policies, software updates, and system hardening.

COS-403ACourse title– Pattern RecognitionMarks:50 Credits:4 Classes:- 40L

Unit-I

Unit Title:-Basics of Probability, Random Processes and Linear Algebra
Probability: independence of events, conditional and joint probability, Bayes theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra.

Unit-II

Unit Title:-Linear Algebra
Inner product, outer product, inverses, eigen values, eigen vectors, singular values, singular vectors.

Unit-III

Unit Title:-Bayes Decision Theory
Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete feature

Unit-IV

Unit Title:-Parameter Estimation Methods
Maximum-Likelihood estimation :Gaussian case. Maximum a Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs. Nonparametric techniques for density estimation. K-Nearest Neighbour method.

Unit-V

Unit Title:-Dimensionality reduction
Principal component analysis - it relationship to eigen analysis. Fisher discriminant analysis - Generalisedeigen analysis.

Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning methods. Non negative matrix factorisation - a dictionary learning method

Unit-VI

Unit Title:-Linear discriminant functions

Gradient descent procedures, Perceptron, Support vector machines - a brief introduction

Unit-VII

Unit Title:-Artificial neural networks

Multilayer perceptron - feedforward neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks

Unit-VII

Unit Title:-Non-metric methods for pattern classification

Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART). K-Nearest Neighbour method

Reference Books:

- Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2/E, Wiley - Interscience, 2000.
- Christopher M. Bishop :, "Pattern Recognition And Machine Learning (Information Science and Statistics)" ,1/E, Springer, January 2008
- T. Hastie , R. Tibshirani, J. H. Friedman:, "The Elements of Statistical Learning",1/E ,Springer, Reprint 3/E, 2003
- Christopher M. Bishop ; "Pattern Recognition and Machine Learning", Springer, 2006
- Shigeo Abe, "Advances in Pattern Recognition", Springer, 2005

Course Outcome:

After successful completion of this course, students will be able to:

- Identify where, when and how pattern recognition can be applied.
- Equipped with basic mathematical and statistical techniques commonly used in pattern recognition
- Understand a variety of pattern recognition algorithms.
- Apply machine learning concepts in real life problems.
- Design and develop a pattern recognition system for the specific application
- Evaluate quality of solution of the pattern recognition system.

COS-403B Course title– High Performance Computing **Marks:50 Credits:4 Classes:- 40L**

Unit-I

Unit Title:-Introduction to High Performance Computing

Architecture of HPC systems: clusters, supercomputers, GPUs,Programming models: MPI, OpenMP, CUDA basics,Shared vs. distributed memory systems, Job scheduling and resource managers (SLURM, PBS), Performance metrics and benchmarking

Unit-II

Unit Title:-Parallel and Distributed Algorithms

Data partitioning and task parallelism, Scalability and Amdahl's Law, Load balancing and synchronization issues, Parallel algorithms for sorting, matrix operations, simulations, Case studies in scientific computing and engineering

Unit-III
Unit Title:- Cloud-HPC Integration and Applications

Hybrid cloud-HPC workflows ,Workflow orchestration: Apache Airflow, Nextflow, Big data analytics on cloud and HPC platforms (Spark, Dask), Use cases: Genomics, Weather modeling, Financial risk modeling, Security and cost optimization in large-scale computing

Text/Reference Books:

- RajkumarBuyya et al., *Mastering Cloud Computing*, McGraw-Hill
- Geoffrey Fox et al., *Introduction to High Performance Computing*
- Thomas Sterling, *High Performance Computing: Modern Systems and Practices*
- AWS, GCP, Azure documentation and tutorials
- Research papers and case studies from ACM/IEEE/Elsevier

Course Outcome:-

- Understand the **architectural concepts and design principles** of high performance computing systems, including multi-core, GPU, and distributed architectures. *(Understand)*
- Apply **parallel programming models** such as MPI, OpenMP, and CUDA for developing scalable applications. *(Apply)*
- Analyze the **performance of parallel algorithms** using metrics such as speedup, efficiency, and scalability. *(Analyze)*
- Identify and resolve issues related to **data dependencies, synchronization, and load balancing** in parallel applications. *(Analyze, Evaluate)*
- Use **profiling and debugging tools** to optimize code performance on high performance computing platforms. *(Apply, Evaluate)*
- Design and implement **high-performance solutions** for real-world computational problems in scientific and engineering domains.

COS-403C Course title– Internet of Things and Smart Systems Marks:**50 Credits:4 Classes:- 40** L

Unit-I
Unit Title:-Introduction to IoT

Definition, characteristics, and components of IoT, IoT architecture: perception, network, and application layers, IoT vs traditional embedded systems, Role of cloud and edge computing in IoT, IoT protocols overview: MQTT, CoAP, HTTP, XMPP

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Unit-II
Unit Title Hardware and Communication Technologies

Sensors, actuators, and interfacing, Microcontrollers (e.g., Arduino, ESP32, Raspberry Pi), Communication technologies: Bluetooth, Zigbee, LoRa, NB-IoT, Wi-Fi, LTE, 5G, Power management and energy-efficient design

Unit-III
Unit Title IoT Platforms and Middleware

IoT device management and middleware ,Open-source IoT platforms: Node-RED, ThingsBoard, Blynk, Cloud IoT platforms: AWS IoT Core, Azure IoT Hub, Google Cloud IoT, Data collection, storage, and stream processing

Unit-IV
Unit Title:-Smart Systems Design

Smart home and building automation, Smart cities: traffic, parking, lighting, and waste management ,IndustrialIoT (IIoT) and smart manufacturing ,Smart agriculture and environmental monitoring, Healthcare and wearable devices

Unit-V
Unit Title:-Security, Standards, and Future Trends

IoT security challenges: device, network, cloud, Secure boot, encryption, authentication in IoT, Standards: IEEE 802.15.4, 6LoWPAN, OCF, IETF CoRE, AI and ML integration in smart systems, Future directions: Digital twins, autonomous IoT systems

Text/Reference Books:

- ArshdeepBahga and Vijay Madisetti, *Internet of Things: A Hands-On Approach*
- RajkumarBuyya et al., *Internet of Things: Principles and Paradigms*
- Jan Holler et al., *From Machine-to-Machine to the Internet of Things*
- Online documentation: AWS IoT, Node-RED, Raspberry Pi tutorials
- IEEE IoT Journal and ACM Transactions on IoT

Course Outcome:
After successful completion of this course, students will be able to:

- Understand the **fundamentals of the Internet of Things (IoT)**, including architecture, protocols, and enabling technologies. *(Understand)*
- Identify and describe **IoT components** such as sensors, actuators, microcontrollers, and communication modules. *(Understand, Apply)*
- Develop basic **IoT applications** using platforms like Arduino, Raspberry Pi, or NodeMCU with appropriate sensors and actuators. *(Apply, Create)*
- Analyze and implement **communication protocols** (e.g., MQTT, CoAP, HTTP) for IoT data transmission. *(Apply, Analyze)*
- Evaluate the performance and challenges of **smart systems** in domains such as smart homes, smart cities, healthcare, and agriculture. *(Analyze, Evaluate)*
- Address **security, privacy, and ethical concerns** in the deployment of IoT-based smart systems

COS-404A Course title– Mobile Computing Marks:50 Credits:4 Classes:- 40 L

Unit –I

Unit Title:-Introduction:

Evolution and fundamentals of Mobile communication, Terminal mobility, Personal Mobility and Service Portability, The Cellular concept, A basic cellular system, Multiple access technologies of cellular systems, Analog & Digital cellular systems, Generations of systems, Cellular system operation and planning,Systemarchitecture,Locationupdatingandcallsetup,Handoff&powercontrol.

Unit –II

Unit Title:-Digital cellular systems:
Evolution of Mobile System, GSM, GSM standardization and service aspects, GSMreferencearchitectureandfunctionpartitioning,GSMradioaspects,GSMsecurityaspects,GSMprotocolmodel,GSMcallflowsequences,gprs,edge;(Wireless)MediumAccessControl:MotivationforaspecializedMAC(Hidden and exposed terminals, NearandFarterminals),SDMA, FDMA, TDMA, CDMA. (8 Lectures)

Unit –III
Unit Title:- Mobile network and transport layer:
Mobile IP: goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, DynamicHostConfigurationProtocol(DHCP).MobileTransportLayer:TraditionalTCP,IndirectTCP,SnoopingTCP, Mobile TCP, Fast retransmit/fast recovery ,Transmission /time-out freezing ,Selective retransmission, Transaction oriented TCP.

Unit –IV
Unit Title:-Database issues:
Hoarding techniques, caching invalidation mechanisms. client server computing with adaption,power-awareandcontext-awarecomputing,transactionalmodels,queryprocessing,recovery,andqualityofserviceissues. (8 Lectures)

Unit –V
Unit Title:-MobleAdhoc Network
Overview,PropertiesofaMANET,spectrumofMANET,applications,routingandvariousroutingalgorithms,securityinMANET's. (8 Lectures)

Reference :

- Mobile and Personal communication systems and Services–RajPandya
- Mobile Communications–SchillerJ.
- Mobile Cellular Telecommunications–LeeWilliamC.Y.
- Wireless Communications & Networks–Stallings,William

Course Outcome:
After successful completion of this course, students will be able to:

- Define mobile technologies in terms of hardware, software, and communications.
- Utilize mobile computing nomenclature to describe and analyze existing mobile computing frameworks and architectures.
- Evaluate the effectiveness of different mobile computing frameworks.
- Describe how mobile technology functions to enable other computing technologies.

COS-404B Course title– Computer Vision Marks:50 Credits:4 Classes:- 40 L

Unit –I
Unit Title:Images
Sourcesofimagery,Thephysicsofimaging,Representing,acquiring,anddisplayingimages,Grayscale,color,noise,lensdistortion,andfiltering.
Unit –II
Unit Title:-Image Processing Preprocessing,andimagecorrection,Enhancingfeaturesandcorrectingimperfections,Addressingnoise,lensdistortion,andblurring.
Unit –III
Unit Title:-Computer Vision Paradigms:
Bottom-up, top-down, neural net, feedback, Pixels, lines, boundaries, regions, and object representations, "Low-level", "intermediate-level", and "high-level" vision, Historical and illustrative examples.
Unit –IV
Unit Title:-Finding Edges and Lines:
Findingedges(lowlevel),Gradients,zerocrossingdetectors,linemodels,Roberts,Sobel,Cany,Findingandgroupinglines(intermediate-level),Boundarytracing,linefitting,Houghtransform.

Unit –V

Unit Title:-Finding and Processing Regions:

Finding "elementary regions" (low-level), Merging, splitting, and groupingregions (intermediate-level). Grouping and analyzing lines and regions (high-level), Guzman, ClowesandHuffman, Waltz. Stereo, and Motion, Optical Flow and FOE, Motion Understanding Texture, Fourier transformRepresenting the environment and Matching, Clouds, generalized cylinders, semantic nets, Matching line andregiongroupstoobjectrepresentations(high-level).

References:

- Digital Image Processing-R.C.Gonzalez&P.Wintz
- Computer Vision-D.H.Ballard&C.M.Brown
- SyntacticPatternRecognition:Anintroduction-R.C.GonzalezandM.G.Thomason
- PatternRecognition-AStatisticalApproach-P.A.DevijverandJ.Kittler
- Digital Image Processing-W.K.Pratt
- Fundamentals of Digital Image Processing-A.K.Jain
- Digital Picture Processing-A.RosenfeldandA.C.Kak
- Vision in Man and Machine-M.D.Levine

Course Outcomes:

Students will be able to:

- Describe the scope of challenges and applications addressed by computer vision
- Demonstrate and experiment with image filtering techniques
- Make use of geometric camera models and multiple view geometry
- Undertake video analysis problems such as tracking and structure from motion
- Explain the application of neural networks to computer vision
- Analyse cognitive tasks including image classification, recognition and detection

COS-404C Course title– Quantum ComputingMarks:50 Credits:4 Classes:- 40 L

Unit I: Foundations

- Postulates of Quantum Mechanics (QM)
- Qubits and Quantum States (Dirac notation)
- Quantum Gates and Circuits
- Superposition and Entanglement
- Bloch Sphere, Measurement, and No-Cloning Theorem

Unit II: Quantum Computation Model

- Tensor products, Multi-qubit systems
- Circuit model of computation
- Reversible computation, Quantum circuit equivalence
- Deutsch & Deutsch-Jozsa Algorithm

Unit III: Core Quantum Algorithms

- Quantum Fourier Transform (QFT)
- Quantum Phase Estimation (QPE)
- Grover's Algorithm
- Shor's Algorithm (concept only)

Unit IV: Quantum Error, Simulation & Applications

- Quantum decoherence and noise
- Quantum error correction basics
- Simulation of physical systems
- Applications in optimization, cryptography, and machine learning

Unit V: Project & Evaluation

- Student presentations on projects (algorithm implementation or simulation)
- Discussion on future of quantum computing and emerging research areas

Textbooks & References

- Michael A. Nielsen & Isaac L. Chuang – *Quantum Computation and Quantum Information*
- Thomas G. Wong – *Quantum Computing for the Quantum Curious*
- IBM Qiskit Documentation & Tutorials (https://qiskit.org/)
- Lecture Notes from MIT/Stanford Quantum Courses (Open Source)

Course Outcome:-

- Understand the fundamental principles of quantum mechanics relevant to quantum computing, including superposition, entanglement, and measurement.
- Explain the structure and functioning of a quantum bit (qubit), quantum gates, and quantum circuits.
- Analyze and implement basic quantum algorithms such as Deutsch-Jozsa, Grover's Search, and Shor's Algorithm.
- Apply quantum logic gates and circuits using quantum programming platforms such as Qiskit or Cirq.
- Evaluate the limitations and challenges of current quantum computing technologies, including decoherence and error correction.
- Compare classical and quantum computation in terms of efficiency, complexity, and practical applications.