<table>
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<tr>
<th>SEM</th>
<th>PAPER CODE</th>
<th>MARKS</th>
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<tr>
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<td>Data Structure and Analysis of Algorithms</td>
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<td>CMSM4124</td>
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<td>CMSM4156</td>
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<td>3</td>
<td>Laboratory 1: PL/SQL and OS Programming Lab</td>
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<td>CMSM4157</td>
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<td>Laboratory 2: Object Oriented Programming Lab</td>
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<td>Software Engineering</td>
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<td>Microprocessors and Micro controllers</td>
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<td>CMSM4256</td>
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<td>Laboratory 4: Internet Technologies I Lab</td>
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<td>4</td>
<td>Compiler Design</td>
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<td>CMSM4322</td>
<td>100</td>
<td>4</td>
<td>Artificial Intelligence</td>
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<tr>
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<td>CMSM4323</td>
<td>100</td>
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<td>VLSI Design</td>
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<tr>
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<td>CMSM4324</td>
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<td>Cryptography and Network Security</td>
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<td>CMSM4356</td>
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<td>Laboratory 5: Internet Technologies II and Artificial Intelligence Lab</td>
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<td>CMSM4357</td>
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<td>Term Paper</td>
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<td>CMSM4358</td>
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<td>CMSM4456</td>
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<td>Project 2</td>
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<td>CMSM4457</td>
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<td>Seminar</td>
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<td>CMSM4458</td>
<td>100</td>
<td>4</td>
<td>Grand Viva</td>
</tr>
</tbody>
</table>
### CMSM4121

**Marks: 100**  
Data Structure and Analysis of Algorithms

<table>
<thead>
<tr>
<th>Review of basic algorithmic analysis: Asymptotic analysis of upper and average complexity bounds; best, average, and worst case behaviors; big-Oh, big-Omega and big-Theta; standard complexity classes; empirical measurements of performance; time and space tradeoffs in algorithms; recurrence relations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Divide and Conquer:</strong> Merge Sort. Quick Sort, Selection Problem, Median and Order Statistics, Strassen’s Matrix Multiplication, Convex Hull Algorithms.</td>
</tr>
<tr>
<td><strong>Greedy Algorithm:</strong> Knapsack algorithm, Huffman Codes, Task Scheduling</td>
</tr>
<tr>
<td><strong>Dynamic Programming:</strong> Chained matrix multiplication</td>
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<tr>
<td><strong>Backtracking Algorithms:</strong> 8 queens problem</td>
</tr>
<tr>
<td><strong>Branch and Bound:</strong> Travelling Salesperson problem.</td>
</tr>
<tr>
<td><strong>Graph and Tree Algorithms:</strong> BFS, DFS, Topological Sort, Minimum Spanning Tree (Prim’s and Kruskal’s Algorithm), Dijkstra’s Algorithm, Bellman Ford Algorithm, Bipartite Graphs, Binary Search Tree, AVL tree, 2-3 Tree, Red Black Tree, Splay Tree – Amortised analysis.</td>
</tr>
<tr>
<td><strong>Complexity Theory:</strong> Tractable and intractable problems, Concepts of computable functions; Polynomial reducibility: P and NP: Definition of the classes P and NP, NP-completeness (Cook’s theorem), Standard NP complete problems,</td>
</tr>
<tr>
<td><strong>Books and References:</strong></td>
</tr>
<tr>
<td>1. T.H.Cormen et al -Introduction to Algorithms, PHI</td>
</tr>
</tbody>
</table>

### CMSM4122

**Marks: 100**  
Advanced Database Management System

<table>
<thead>
<tr>
<th>Transaction Management and Concurrency Control: States of Transaction, ACID properties, consistency model, storage model, cascading rollback, recoverable schedules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrency: Schedules, testing for serializability, Lock-based protocols-Two-phase locking protocol, Timestamp based protocol, optimistic techniques, deadlock handling.</td>
</tr>
<tr>
<td><strong>Recovery:</strong> Failure classification, storage hierarchy, log-based recovery, shadow paging</td>
</tr>
<tr>
<td><strong>Query processing and optimization:</strong> Steps of query processing, query interpretation, equivalence of expression, estimation of cost, join strategies</td>
</tr>
<tr>
<td><strong>Concepts of Normalisation:</strong> 4NF, 5NF.</td>
</tr>
<tr>
<td><strong>Distributed Database:</strong> Principles of distributed database, DDBMS, levels of distribution transparency, data fragmentation, replication and allocation techniques.</td>
</tr>
<tr>
<td><strong>Books and References:</strong></td>
</tr>
<tr>
<td>2. Korth, Silberschatz :Database System Concepts, McGrawHill,</td>
</tr>
<tr>
<td>3. Ozsu,Principals of Distributed Database System,Pearson Education.</td>
</tr>
</tbody>
</table>
### CMSM4123

Marks: 100

**Computer Architecture**

- **Introduction to Parallel Processing:** Parallel Computer Structures, Architectural Classification Parallel Processing Applications
- **Memory and I/O sub-systems:** Hierarchical Memory Structures, Cache Memories and Management, I/O sub-systems
- **Principles of Pipelining and Vector Processing:** Pipelining, Instruction and Arithmetic Pipelines, Principles of designing pipelined processors, vector processing requirements
- **Structures and Algorithms of Array Processors (SIMD Computers):** SIMD Array Processors, SIMD Interconnection networks, Parallel Algorithms for Array Processors
- **Algorithm examples** – matrix multiplication, sorting
- **Multiprocessor Architecture and Programming:** Functional Structures, Interconnection Networks, A few example multistage INs, Parallel Memory Organisations

**Books and References:**


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### CMSM4124

Marks: 100

**Distributed Operating System**

- Role and basic functionality, concurrent processing, scheduling, memory management, Device management, File Systems Management. Case Study –Unix/Linux (Architecture, study of system calls)

**Books and References:**

2. Singhal, Shivaratri, Advanced Concepts in Operating Systems, TMH.
3. P.K.Sinha, Distributed Operating Systems, PHI

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### CMSM4156

Marks: 100

**Laboratory 1: PL/SQL and OS Programming Lab**

- **Group A: PL/SQL Lab**
- **Group B: OS Programming Lab** (Special reference to OS as a concurrent program)

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### CMSM4157

Marks: 100

**Laboratory 2: Object Oriented Programming Lab**
### CMSM4221

**Marks: 100**  
**Software Engineering**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Project management:</strong></td>
<td>Process, software configuration process models, requirements change management process, Project management process</td>
</tr>
<tr>
<td><strong>Effort Estimation:</strong></td>
<td>Function Points, COCOMO, Project scheduling and staffing, Risk Management</td>
</tr>
<tr>
<td><strong>Software metrics and Reliability:</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Books and References:**       | 1. Roger S. Pressman, Software Engineering - A Practitioner’s Approach, McGraw-Hill  
  2. Somerville, Software Engineering, Pearson Education  
  3. Jalote, Software Engineering, Narossa Publication |

### CMSM4222

**Marks: 100**  
**Computer Networking and Internet Technologies**

<table>
<thead>
<tr>
<th>Network Architecture:</th>
<th>Layered architecture and protocol hierarchy TCP/IP protocol suite, Services and important functions of each layer.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Area Networks:</strong></td>
<td>Aloha and Carrier Sense Protocols, Ethernet, Token Ring, FDDI.</td>
</tr>
<tr>
<td><strong>Flow Control:</strong></td>
<td>Stop and wait ARQ, Sliding Window, Go Back N, Selective Repeat. <strong>802.11:</strong> Access points: Distributed Coordination (DCF) and Point Coordination(PCF).</td>
</tr>
<tr>
<td><strong>Connecting Devices:</strong></td>
<td>Bridges, Backbone Networks, Virtual LAN.</td>
</tr>
<tr>
<td><strong>Internetworking:</strong></td>
<td>Virtual Circuits and datagrams, IP addressing, Subnetting, CIDR.</td>
</tr>
<tr>
<td><strong>Routing Algorithms:</strong></td>
<td>Shortest path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast and Multicast Routing, Routing for mobile hosts.</td>
</tr>
<tr>
<td><strong>Routing Protocols:</strong></td>
<td>RIP, OSPF, BGP</td>
</tr>
<tr>
<td><strong>Process to Process Delivery:</strong></td>
<td>TCP and UDP.</td>
</tr>
<tr>
<td><strong>Congestion Control and Quality of Service:</strong></td>
<td>Congestion control Techniques, Congestion control in TCP. Techniques for improving the QoS.</td>
</tr>
<tr>
<td><strong>Application Layer:</strong></td>
<td>Sockets, DNS, WWW, SMTP, HTTP.</td>
</tr>
<tr>
<td><strong>WDMA:</strong></td>
<td>Description and implementation on fiber network.</td>
</tr>
</tbody>
</table>
| **Books and References:** | 1. B.Forouzan – Data Communication and Networking. TMH  
  2. A Tanenbaum – Computer Networks, PHI |
CMISM4223 Marks: 100 Microprocessors and Micro controllers

80x86 - Architecture and Organization, Instruction Set, Assembly Language Programming, Memory Interfacing, Data Transfer Techniques, I/O Ports, Interfacing, Programmable Interrupt and DMA Controllers, Serial Mode Data Transfer, Programmable Timer/Counter, Designing Microprocessor Based Systems.

8051 MICROCONTROLLER - Comparison of microprocessor and micro controller, architecture, pin function, CPU timings and machine cycle, internal memory organization, pc and stack, i/p-o/p ports, counters and timers, serial data i/p-o/p, interrupts. Instruction set, addressing modes, Programming 8051, programming timers, asynchronous serial data communication, timer and hardware interrupt, service routine.

External memory and memory address decoding, memory mapped I/O, time delay subroutines, look-up tables implementation, interfacing matrix keyboard and seven segment display through scanning and interrupt driven programmes, interfacing A/D and D/A converters using handshake signals and waveform generation interfacing with 8255 i/p-o/p, parallel printer. Examples and overview of advanced microcontrollers like 80196

Books and References:


CMISM4224 Marks: 100 Computer Graphics and Multimedia

Introduction to computer graphics & graphics systems

Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham’s line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

Transformation & Clipping: Basic transformations; Matrix representations & homogeneous coordinates; Transformation of points, lines, parallel lines, intersecting lines; general parallel projection transformation; clipping: viewport clipping, point clipping, line clipping, clipping circles, polygons & ellipse.

Curves: Curve representation, surfaces, Bezier curves, B-spline curves.

Surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method scan-line algorithm; Hidden line elimination. Color & shading models; Light & color model; interpolative shading model; Texture.


Books and References:

2. Van dam Foley: Computer Graphics, Addison-Wesley
### CMSM4256
Marks: 100  
Laboratory 3: Socket Programming, Microprocessor and Microcontroller Lab

**Group A:** Socket Programming Lab  
**Group B:** Microprocessor and Microcontroller Lab

### CMSM4257
Marks: 100  
Laboratory 4: Internet Technologies I Lab

- JavaScript, PHP, MySQL

### CMSM4321
Marks: 100  
Compiler Design

**Review:** Grammars, Languages – types of grammars and their recognizers, Basic concepts of translators: boot strapping, cross compiler, Different phases of compilation.

**Lexical analyzer:** Concepts, Tokens, Schemas, Design using FSM, LEX.

**Syntax Analysis:** Top down and Bottom up parser; Operator precedence; Recursive descent; LL (1); LR (1); LALR (1); Comparison, YACC.

**Intermediate code generation:** Three Address Code, Representation of three address code – Quadruples, Triples and Indirect Triples.

**Syntax directed translation:** Attributes, Semantic Actions, Translation schemes.

**Code generation:** Basic blocks, loop optimization, flow graph, DAG representations of basic blocks.

**Error handling:** detection, reporting, recovery and repair

**Symbol tables:** Organization and management techniques.

**Runtime storage management:** static allocation; dynamic allocation, activation records; heap allocation, recursive procedures

**Books and References:**

1. Alfred V. Aho and Jeffrey D. Ullman, Principles of Compiler Design, Narossa Publication
3. Peter Linz, Formal Language and Automata Theory, Narossa Publication
<table>
<thead>
<tr>
<th>CMSM4322</th>
<th>Marks: 100</th>
<th>Artificial Intelligence</th>
</tr>
</thead>
</table>

**Introduction**: AI applications, AI techniques, AI Problems. Importance of AI

**State Space search**: State Space Graphs, Implicit and explicit graphs, Production Systems, formulating the state-space; Uninformed search: breadth first search, depth first search; Uniform cost algorithm; Informed search: use of heuristics, A* algorithm, Admissibility of A*; Analysis and comparison of search algorithms.

**Adversarial Search**: Two agent games, AND/OR graphs, Minimax procedure, and game trees, Alpha – Beta pruning procedure, learning evaluation functions.

**Constrained Satisfaction Search**: Introduction to Constrained Satisfaction search (CSP), Applications, Algorithms to CSPs, Symbolic constraints and propagation.

**Expert Systems**: Introduction to ES, knowledge based systems, knowledge representation, rule based approach: forward and backward chaining, semantic nets based approach, frame based approach.

**AI tools and techniques**: First order predicate calculus, resolution, unification, natural deduction system, refutation

**Uncertainty**: different types of uncertainty - degree of belief and degree of truth, various probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes’ rule, other approaches to modeling uncertainty, Dempster-Shafer theory, fuzzy sets/logic.

**Advanced Concepts**: Introductory concepts of soft computing techniques.

**Books and References**:
1. Elaine Rich and Kevin Knight: Artificial Intelligence, TMH
2. Dan W. Patterson: Introduction to Artificial Intelligence and Expert Systems, PHI
3. S. Russel and P. Norvig, "Artificial Intelligence, A modern Approach"
### CMSM4323 Marks: 100 VLSI Design

**Introduction to VLSI systems:** Overview of VLSI technology, Fabrication and Layout of CMOS (Fabrication Process Flow, CMOS n-Well Process, Layout & Design Rules, CMOS inverter Layout Design), IC production process & Packaging, MOS Transistors, Circuit characterization and performance estimation, Circuit simulation, Combinational and sequential circuit design, Static and dynamic CMOS gates, Memory system design.

**VLSI automation Algorithms:** Partitioning: problem formulation, classification of partitioning algorithms, Group migration algorithms, Kernighan – Lin Heuristics.

**Floor planning & pin assignment:** problem formulation, placement and floor planning, floor planning algorithms for mixed block & cell design, Floor planning based on Simulated Annealing.

**Global Routing:** Global Routing between blocks, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches.

**Detailed routing:** Problem formulation, classification of routing algorithms, single layer routing algorithms, two layer channel routing algorithms, three layer channel routing algorithms, and switchbox routing algorithms, constrained & unconstrained via minimization.

**Digital Design using VHDL.**

**Books and References:**

### CMSM4324 Marks: 100 Cryptography and Network Security

**Cryptography:** Basic objectives of cryptography, private-key and public-key cryptography, mathematics of cryptography - one-way and trapdoor one-way functions, cryptanalysis, attack models, classical cryptography, block ciphers, stream ciphers, Computer Based Symmetric Key Cryptographic Algorithms: Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA). Computer Based Asymmetric Key Cryptographic Algorithms: RSA Algorithm, message digest, Digital Envelope, Digital Signatures, Certificates and standards, key exchange, entity authentication.


**Books and References:**
Introduction:
Introduction of Image Processing with its applications, Components of Image processing system, Image Formation model. Image digitization process.

Image Enhancement:
Introduction of Image enhancement, Image enhancement techniques: Contrast intensification by Linear stretching, Non-Linear stretching, Exponential stretching, Noise cleaning or Smoothing by Image averaging, Image sharpening, Basic transformations in the frequency domain

Colour Image Processing:
Pseudo and False colouring, Image fusion. Colour Models: RGB, CMY, HSI

Image Compression:
Introduction, Lossy Compression techniques and Loss less image compression techniques, Huffman coding, Run Length Encoding, JPEG, Block Truncation compression.

Image Segmentation:
Characteristics of segmentation, detection of discontinuities, thresholding, pixel and region based segmentation methods.

Pattern Representation and Recognition:
Representation, Boundary Descriptors, Regional Descriptors

Pattern Recognition and classification: Patterns and Pattern Classes, Recognition based on decision theoretic methods, structural methods

Books and References:
2. Digital Image Processing and Pattern Recognition, Malay K. Pakhira, PHI
3. Arthur Weeks, Fundamentals of Electronic Image Processing, PHI
**CMSM4431**  
Marks: 100  
Mobile Communications (Elective)

Introduction: Advantages and disadvantages, evolution, special considerations for node mobility;

Wireless transmission: Frequency band for signal transmission, signal propagation, multiplexing, modulation, spread spectrum, cellular systems;

Medium Access Control: Motivation for a specialised MAC, SDMA, TDMA, FDMA, CDMA;

Telecommunication systems: GSM architecture and protocol suite in details;

Wireless LAN: Infrastructure and ad-hoc network, IEEE 802.11 – PCF, DCF, frame format, services (association, authentication, etc.), Bluetooth – different profiles, introduction to its protocol stacks;

Mobile Network Layer: Mobile IP, DHCP, Mobile Ad-hoc networks;

Mobile Transport Layer: mobility and effects on transport protocols; TCP performance on wireless links – possible improvement;

Management issues in mobile/wireless environment: Location determination & management, mobility management, power management;

Mobile/Wireless applications: WAP, WML, mobile file access;

Security: Introduction to special security issues in mobile/wireless environment, notion of WEP;

Books and References:
1. Jochen Schiller, Mobile Communication, Pearson Education
2. Stallings, Wireless Communication, Pearson Education

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**CMSM4432**  
Marks: 100  
Data Mining and Data Warehousing (Elective)

Basic Concepts: Data Warehouse, Data Warehouse and On-line Transaction Processing System, Advantages and Drawbacks of Data Warehouse, Data Warehouse Architecture - Operational Data Source, Load Manager, Query Manager, Warehouse Manager, Detailed Data, Summarized Data, Archive/Backup Data, Metadata, End-User Access Tools, Data Warehouse Background Processes.


Data Marts: Basic concepts, Advantages and drawbacks of data mart, Components of data mart, Types of data mart.

Data Warehouse Design: Different views of designs, processes of design.

On-line Analytical Processing: Concepts, OLTP Vs OLAP, Multidimensional Data Model – Data Cube; OLAP Operations - Slicing, Dicing, Drill-Up, Drill-Down, Drill-Within, Drill-Across, Pivot; OLAP Tools – MOLAP, ROLAP, HOLAP.

Data Mining: Introduction to Data Mining, Architecture in a Data Mining System, KDD Vs Data Mining, Applications of Data Mining, Data Preprocessing

Mining Frequent Patterns and Association: Frequent Itemsets, Closed Itemsets, Association Rules, Market Basket Analysis, The Apriori Algorithm.

Classification and Clustering Algorithms: Classification, Prediction, Classification by Decision Tree Induction, Bayesian Classification, Cluster Analysis, Partitioning Methods for Clustering – K-Means, K-Medoids.

Books and References:
### Object Oriented Technology (Elective)

- **Principles of Object Oriented Programming (OOP):** Basic concepts, Programming Paradigms, Benefits of OOP, Applications of OOP.

- **Introduction to Object Oriented Analysis and Design:** Best Practices in Software Development, OOSDLC, Requirements modeling, Business modeling, Component based development, Quality criteria for software products, Frameworks - OMT, OOD,OOSE, The Unified approach.

- **Rational Unified Process:** Basic Concepts, Process overview, Phases and Iterations – the Time Dimension; Static structure of the process, Core Workflows.

- **Unified Modeling Language:** History of UML, Building Blocks of UML, Modeling Concepts - Structural modeling, Behavioral modeling.


### Books and References:

2. Rumbaugh, *Object Oriented Modelling and Design*, Pearson Education
3. Grady Booch, *Object Oriented Analysis and Design*