MCA COURSES WITH CONTENTS
Annexure I

Revised MCA Courses with Contents

Semester I (All Compulsory)

1. Digital System Design

Data representation – number system, two’s complement, Arithmetic operations using 2’s and 1’s complements, floating-point representation and arithmetic operations;

Logic gates, Boolean algebra, K-map, Map simplification, Combinational circuit Design – Half adder, full adders, Decoders, Encoders, Magnitude Comparator, Multiplexer, Read-Only memory, PLAs, Sequential Circuit Design – Flip-Flops, Registers, shift registers, Counters, Processor

Logic Design – Arithmetic circuit, logic circuit, Accumulator, Status register; Control Logic Design – Hard-wired control, micro-program sequencer, Digital Integrated circuits – introduction to Bipolar transistor Characteristics, TTL, DTL, I^2L, TTI, ECL, MOS, CMOS.

Books:


Note: The italic part in the content has been shifted from the content of the course Computer Architecture in semester II, as per the decision of the Committee.

2. Discrete Mathematics

Sets, Relations, Functions, Logic operators, truth tables, normal forms, Propositional and predicate calculus, Boolean Algebra, Euclidean algorithms, Fibonacci numbers, Congruence and equivalence relation, Groups, Subgroups, semi-group, monoids, Error detecting & correcting codes, permutation & combination, pigeon hole principle, Principle of inclusion and exclusion, Ordinary and exponential generating functions, Recurrence relation; trees, graphs, bipartite graphs, planar & dual BFS & DFS algorithms, Floyd’s and Dijkstra shortest path algorithms, Kruskal & Prim’s algorithms for minimum cost spanning tree; Regular expression, Finite state machine, Grammars.

Books:


3. Numerical Computing


Books:


Approved in special committee meeting held on 4.10.2024
4. Programming and Problem Solving using C

An introduction to problem solving, Design of some important algorithms—factoring methods, array techniques, sorting, searching, pattern searching, recursive, Fundamental concepts for algorithm analysis. Implementation of the algorithms using C programming language. Topics in C language—types, operators (including bitwise operators), expressions, control structures (selection, loops), functions, scope rules and specific variables, arrays and pointers (including pointer arithmetic, pointers to function and command line arguments), strings; structures and unions, bit-fields, files, dynamic memory allocation; input-output and file access.

Books:
1. R.G. Dromey, *How to solve it by Computer*, PHI

5. Probability and Statistics

Probability – Axioms, Conditional probability, Bayes Theorem, random variables, Discrete RV – Binomial, geometric, Poisson; Continuous RV – Uniform, Exponential, Gamma, Normal, Expectation, Mean and Variance, Jointly distributed RVs, Co-variance, Sums of RVs, Central Limit Theorem, Moment generating functions, Sample Distribution, Inference concerning mean, Statistical inference—Parameter estimation, Maximum likelihood estimation, Hypothesis testing, Curve fitting. Methods of least squares, Curvilinear Multiple regression.

Books:

Semester II (All Compulsory)

1. Computer Architecture

Register Transfer and Micro-operations, instruction codes and formats, addressing modes, timing and control signal generation, instruction cycles, memory reference instructions, Input output instructions, Central Processing unit – stack organization, Data transfer and manipulation, program control, Pipeline and vector Processing—Arithmetic and Instruction Pipeline, vector operations, array processors; Input output organization – I/O versus memory bus, Isolated verses memory mapped I/O, Priority interrupts, DMA, I/O processors; Memory Organization – RAM, ROM, Associative memory, Cache memory, memory management hardware.

Books:
2. Data Structures

- Linear lists: Stack, Queue, Deque; Linked structures; Orthogonal lists, Multilinked Structures, Tree: Binary tree, Tree traversals; Binary Search trees; Tree deletion; Threaded binary tree, AVL trees; General ordered trees; Expression trees; Huffman trees; B-trees; B+ trees; Forest; Graphs analysis; Dynamic memory management.

Books:

3. Operations Research (moved from Semester III)

Introduction — Meaning of OR, Models in OR: Linear programming, Simplex method, Computational problems, Computer solution of linear programs, Network analysis — Assignment problems, Maximal flow problem, Shortest route problems, Minimal Spanning tree problems; Queueing Models — M/M/1 Model, Limited queue capacity, Multiple Servers; Reliability Models, Inventory Models — EOQ, nonzero lead time, Dynamic programming — developing an optimal decision policy, multiple state variables, Curse of dimensionality.

Books:

4. Object Oriented Programming

The Traditional Approach, Object Oriented Paradigm, Object Oriented Features, C++ Class, Objects, Member Functions, Static Class Members, Pointers, Union, Class Scope, Nested Classes, Object Arrays, Composite class, Constructor, Destructor, Copy Constructor, Friends, this pointer, Operator Overloading, Class Hierarchy, Multiple inheritance, Virtual functions, Virtual classes, Class template, Function Template, File operations, Stream classes, I/O, Exception Handling.

Books:

5. Operating Systems


Books:
1. Database Management Systems (Moved from Semester II)  

Books:

2. Computer Networks  
Overview of Computer Network, Data Communication – Analog and digital communications, signal and data, Channel characteristics, Nyquist theorem, Shannon’s formula, modulations, encoding schemes, Error Detection – VRC, LRC, CRC, Checksum, Transmission media; Multi-channel communication – multiplexing techniques, Multiple access techniques, Switching techniques – Telephone systems, ATM, Queuing Models – little’s theorem, Poisson Process, Markov Chain model, MM/1, MM/MS/K, M/G/1 queues; ALOHA systems; Local Area Networks – CSMA/CD, Token Ring, Token Bus, FDDI; Routing – spanning tree, Bellman-Ford, Dijkstra algorithms, Distance vector and link state routing; IP protocol fragmentation, reassembly, Transport Protocol – stop-and-wait, Sliding window protocols, congestion control, TCP, UDP, Application Protocols – FTP, Email.

Books:

3. Microprocessor Based System  
8085 Microprocessor, Bus structure and timing, Demultiplexing the bus (AD7:AD8), Instructions and timing, Interfacing peripherals, I/O, Memory and Applications, 8085 interrupts structure types and masking, priority interrupt structure.
Software model of the 8086/8088 microprocessor, Memory address space & data organisation, Segment registers & Memory segmentation, Dedicated & general use of memory, Instruction pointer, Data registers, Status register, Generating a memory address, stack, I/O address space, Addressing modes of 8086. The 8086 instruction set Minimum/maximum mode

Books:
Web-Based Programming


Books:
2. Crouch, Web Programming with ASP and COM, Pearson Education

5. Design and Analysis of Algorithms

Review of algorithm analysis: time, space, lower, upper bounds, asymptotic complexity, summation, recurrences, Design techniques: greedy methods, divide-and-conquer, backtracking, branch-and-bound, dynamic programming, basic graph algorithms, simulation; Selection of prototype algorithms; Choice of data structures and representation; NP-completeness: basic terminology, polynomial reductions, NP-complete problems. Some additional topics such as string searching, network-flow, geometric algorithms, parallel computing, etc.

Books:

Semester IV (All Compulsory)

1. Computer Graphics

Graphics devices – random scan and Raster-scan; Bresenham’s circle drawing algorithm, generation of ellipses, Curve drawing, Beziers and B-spline curves, 2-D graphics: polar coordinates, parametric functions, vectors, matrices operations; Transformation – homogeneous coordinate systems, translation, scaling, rotation, mirror reflection, parametric representation of a line segment; 3-D graphics: transformation- right handed coordinate system with vertical y-axis, matrices for translation, scaling rotation around axis, Parallel Projection – front and side views, Oblique view

Books:

2. Parallel and Distributed Systems (including Linux/Unix)

Parallel systems – Hardware, SIMD, MISD, MIMD, Multiprocessor systems, Parallel algorithms, Shared memory, message-passing, and data parallel programming, Shared memory multiprocessors, cache coherence, and memory consistency, Scalable multiprocessors, interconnection network design, and directory-based cache coherence protocols. Performance issues, simulation, and benchmarks, Multiprocessor real-time scheduling. Latency tolerance, techniques, Singlechip multiprocessors,
Distributed systems – hardware and software concepts, Client-server model; Communication – Lower-level protocols, transport protocols, higher-level protocols, RMI Remote Object Invocation, Stream-oriented communication, Synchronization, logical Clock, Election Algorithms, Mutual exclusion, distributed transactions, Consistency and Replication – Data-centric and client-centric consistency, distribution protocols, consistency protocols; Fault tolerance, Security, Distributed object-based systems, Distributed file systems.

Books:
1. Tenenbaum, Distributed Systems: Principles and Paradigms, Pearson Education

3. Software Engineering


Books:
1. Pressman, R.S.: Software Engineering – A Practitioner’s Approach, McGRAW-HILL
   International Edition
2. Sommerville, I.: Software Engineering – Pearson Education Asia

4. Formal Languages and Automata Theory

Models of Computation – classification, properties and equivalences.

Regular languages models: finite state machine (deterministic and non-deterministic), regular grammars, regular expressions, equivalence of deterministic and non-deterministic machine and of the three models; Properties: closure, decidability, minimality of automata.

Context-free languages models: grammars (including different normal forms), pushdown automata and their equivalence; Properties: closure, iteration theorem, parsing.

Recursive and recursively enumerable sets model: Turing machines, grammars, recursive functions and their equivalence; Church’s thesis; Properties: closure, decidability, undecidability, non computability, notion of reductions, computational complexity, NP-completeness

Books:

5. Artificial Intelligence

Overview of AI; Problem solving, various search strategies, Game playing: Minimax, Alpha-Beta pruning; induction to logic programming, inference mechanisms; Knowledge representation: logic, rules, semantics, frames, Conceptual dependency; Uncertain knowledge and reasoning; Expert systems; NLP; Learning; Process planning and robotics; Intelligent agents

Books:
Compulsory Course

1. Compiler Construction - CS - 121

Overview of a Compiler; Lexical Analyzer; Syntax Analysis; PDA, NPDA; Construction of Top-down and Bottom-up parsers from CFG, Recursive descent parser, LL(1) parser, Operator precedence parser, LR parsers; Semantic Analysis: SDF, Intermediate Code generation; Code Optimization: The principle sources of optimization, Optimization of basic blocks, Loops in flow graphs, Introduction to global data-flow analysis.

Books:

2. Course in Social Science (content to be developed)

Optional Course

1. Pattern Classification - CS - 122

Pattern recognition task; Statistical decision theory - Bayes rules, parametric models, logistic discrimination, predictive classification, computational learning approaches; classical linear discrimination, linear separation, Nonparametric methods - estimation of class densities, nearest neighbor methods, learning vector quantization, mixture representations; Tree structured classifiers - Finding Good Pattern Features - Bounds for the Bayes error Branch-and-bound techniques.

Books:

2. Image Processing and Computer Vision - CS - 123

Digital image definitions, Video parameters, Image model, Sampling, Quantization, Histogram equalization, DFT, FFT, QALSH transport, Smoothing Filters - mean median, mode filters, edge enhancement filters, edge enhancement, Run length coding, contour coding, Huffman coding, Image compression standards, Image segmentation, Thresholding, Application of morphology in IP.

Books:

3. Computer Oriented Statistical Methods - CS - 124

Multivariate analysis - Organization of data, Expected Values of sample mean and covariance matrix, Multivariate normal distribution, Inferences about a mean vector, Time dependence in

Books:

4. Decision Support Systems

Decision Support System Overview, DSS characteristics and capabilities, DSS taxonomies and frameworks, decision modeling using multi-criteria decision making, model management for decision support, DSS development approaches, DSS analysis DSS design methods, DSS systems, Active decision support systems, and symbiotic systems, integrated intelligent systems.

Books:

5. Natural Language Processing


Books:
3. Harris M.D. Natural Language Processing, Benjamin Cumming, 1991

6. Modeling and Simulation

Advantages and disadvantages of simulation systems, Components of system, Discrete and continuous systems, Examples – Simulation of queuing and inventory systems, concepts in discrete-event simulation, Simulation software – GPSS, CSIM, Simulation Packages; Statistical models in simulation, Queuing models – long run measures of performance, steady-state behaviour, MM/1, M/M/C/n/o, M/M/C/K/K, Pseudo random numbers, random variate generation, inverse transform technique, Acceptance – rejection technique, Analysis of simulation data, verification and validation of simulation models, Output analysis for single model, Simulation of computer systems.
1. Optimization Techniques


Books:
2. Rardin, Optimization in Operations Research, Pearson Education

8. Machine Learning

An overview of Machine learning, Inductive learning, ID3, C4.5; Learning Concepts and rules from Examples; Learning by analogy; Learning from observation and discovery; Learning by experimentation. Learning by training Neural Networks; Genetic Based Machine Learning (GBML) Learning Classifier System (LCS), Genetic Programming, Analytical learning; Reinforcement learning. Applications to KDD.

Books:
2. Winston, Artificial Intelligence, Addison Wesley

9. Internet and Web Technology


Books:
2. Crouch, Web Programming with ASP and COM, Pearson Education

10. Applied Bioinformatics

Information, Kullback-Leibler distance – DNA binding sites, Genome segmentation and Gene
frags.
Books:
Verlag, 2001

11. Information Theory

Information and Entropy – Shannon’s measure of Information, Mutual Information; Discrete
memoryless information source – Coding, Coding strategies; Discrete information source with
Capacity with additive Gaussian white noise; Rate distribution theory – Information transmission
Books:
1. van der Lubbe Jan C. A., Information Theory, Cambridge University, 1997

12. Data Mining and Knowledge Discovery

Introduction to Data Mining and knowledge discovery in databases (KDD) & data warehouse; Data
mining primitives, concepts, tasks, different machine learning, knowledge discovery and data mining
approaches and techniques: Concept Learning, Decision Tree Learning, Clustering and instance
based learning, Rule induction and learning, Bayesian networks and causality, Neural networks,
Genetic algorithms, Reinforcement learning, Analytical learning; Credibility, evaluating data mining
models.
Books:
1. Han J., Kamber M., Data Mining: Concepts and Techniques, Indian reprint, Morgan
3. Witten I.H. and Frank E., Data Mining: Practical Tools and Techniques with Java


Introduction to Multimedia, fundamental concepts of Video, Basics of digital audio, audio visual
integration, multimedia authoring and tools, multimedia data compression, multimedia
communication, multimedia processing in communication, multimedia communication standard,
multimedia communication across network, distributed multimedia systems.
Books:
Distributed Database Systems

... concepts and design of Distributed Database Systems (DDBMS): Data Fragmentation, Replication, and Allocation techniques for DDBMS; Methods for designing and implementing Overview of transaction management, concurrency and recovery in DDBMS; Distributed Deadlock Management and Replication Servers; Distributed Query Processing and Optimization, Distributed Interoperability including CORBA and Java RMI.


15. Object Oriented Analysis and Design (changed from Object Oriented Systems)


Books:
3. E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns: Elements of Reusable Object Oriented Software, Pearson Education, Asia
4. Object Oriented Programming

The Traditional Approach, Object Oriented Paradigm, Object Oriented Features, C++ Class, Objects, Member Functions, Static Class Members, Pointers, Union, Class Scope, Nested Classes, Object Arrays, Composite class, Constructor, Destructor, Copy Constructor, Friends, this pointer; Operator Overloading, Class Hierarchy, Multiple inheritance, Virtual functions, Virtual classes, Class template, Function Template, File operations, Stream classes, I/O, Exception Handling.

Books: