

**Revised Course Structure**  
**M.Sc. (Computer Science)**  
**(4 Semesters)**

<b>FIRST SEMESTER</b>		
<b>THEORETICAL</b>		
CS101	ADVANCED COMPUTER ARCHITECTURE	100
CS102	DATABASE MANAGEMENT SYSTEMS	100
CS103	ADVANCES IN DATA STRUCTURES AND ALGORITHMS	100
CS104	DATA COMMUNICATION	100
<b>PRACTICAL</b>		
CS105(P)	ADVANCES IN DATA STRUCTURES AND ALGORITHMS LABORATORY	100
CS106(P)	DATABASE MANAGEMENT SYSTEMS LABORATORY	100
<b>SECOND SEMESTER</b>		
<b>THEORETICAL</b>		
CS201	COMPUTER NETWORK	100
CS202	ADVANCED OPERATING SYSTEM	100
CS203	COMPUTER GRAPHICS	100
CS204	SOFTWARE ENGINEERING	100
<b>PRACTICAL</b>		
CS205(P)	GRAPHICS LABORATORY	100
CS206(P)	SOFTWARE ENGINEERING LABORATORY	100
<b>THIRD SEMESTER</b>		
<b>THEORETICAL</b>		
CS301	OBJECT ORIENTED PROGRAMMING	100
CS302	AUTOMATA THEORY & COMPILER DESIGN	100
CS303	INTERNET AND MULTIMEDIA TECHNOLOGY	100
CS304	ARTIFICIAL INTELLIGENCE.	100
<b>PRACTICAL</b>		
CS305(P)	OBJECT ORIENTED PROGRAMMING LABORATORY	100
CS306(P)	TERM PAPER LEADING TO PROJECT	100
<b>FOURTH SEMESTER</b>		
<b>THEORETICAL</b>		
CS401	ELECTIVE	100
CS402	ELECTIVE	100
<b>PRACTICAL</b>		
CS403(P)	GRAND VIVA-VOCE	100
CS404(P)	PROJECT WORK	200 + 100

Set of Elective Papers: (M.Sc.)

**Elective**

1. IMAGE PROCESSING
2. SOFT COMPUTING
3. PATTERN RECOGNITION
4. QUANTUM COMPUTING
5. BIOINFORMATICS
6. VLSI DESIGN.
7. CRYPTOGRAPHY AND NETWORK SECURITY
8. COMPUTER VISION
9. OPERATION RESEARCH
10. DATA WAREHOUSING AND DATA MINING
11. PARALLEL ALGORITHMS
12. EMBEDDED SYSTEM

MORE SUBJECTS WILL BE ADDED AS AND WHEN NECESSARY



**Regulations for  
Two-Year M.Sc. Course in Computer Science.**

1. The Department of Computer Science, West Bengal State University, Barasat shall provide instructions leading to 2-year, 4 Semester M.Sc. Degree in Computer Science.
2. A candidate who has passed 3-year B.Sc. Examination with Honours in Computer Science from West Bengal State University, Barasat can apply for admission to the M.Sc. course. Admission for candidates from other Universities/Colleges will be governed according to the university rules.
3. The examinations for the M.Sc. course shall be held in 4 Semesters. At the end of each semester, an examination of the papers covered in that semester would be held. This examination will be referred to as the M.Sc. examination of that semester. In any semester, the study break between the completion of regular classes and the commencement of the Semester Examination will generally be a maximum of 10 calendar days.
- 4.1 The total credits for the 2 year (4 semester) course in Computer Science will be 106. The distribution of credits for each semester examination is as follows:-

Subject	Credit
Theory	4
Laboratory	3
Project	12
Viva-voce	3
Term Paper	3

Total=14x4+8x3+12=90

- 4.2 Examination of a Theoretical Paper is of 3 hour duration and will usually carry 70 marks. 30 marks for each paper will be set aside for continuous assessments to be evaluated by the teacher(s) assigned for that class.
- 4.3 For Theoretical papers, paper setters and examiners will be appointed from a Board of Examiners considering of all the faculty members.
- 4.4 Evaluation of performance in a Practical paper will be based on Sessional work in that paper and on end-semester viva-voce. The distribution of marks for each Practical Paper would be as follows:-
  - i) 50% for experiments performed in the laboratory – the Sessional Work to be evaluated by the Teachers assigned for that course.
  - ii) 40% for viva-voce on the experiments to be conducted by a Board consisting of the faculty members and / or External examiners.
  - iii) 10% for Lab report to be evaluated by the viva-voce Board.

Only the total mark is to be shown in the mark-sheet.

- 4.5 In order to pass a semester examination, a candidate will have to score minimum of 40% of the total marks of theoretical papers and 50% in each practical papers a candidate must appear in each theoretical and practical papers. Pass marks for project, grand viva-voce and term paper will be 50% as for practical paper. Pass mark for each theoretical paper is 35%.
- 4.6 Each candidate will have to complete a term paper assignment in 3<sup>rd</sup> semester. He / She will have to deliver a lecture and submit a report on the topic of the term paper. This will lead to his/her project.
- 4.7 Evaluation of the performance in a Term paper will be done by a board of examiners.
- 4.8 Each student will have to undertake a project work at the beginning of the 3<sup>rd</sup> Semester. The project work would have to be completed under the supervision of faculty member(s) at the end of the 4<sup>th</sup> Semester; a student will have to submit, through the respective supervisors, a dissertation on the project work. The project work will be assessed by a Board of Examiners consisting of Faculty members of the Department & External Examiner(s).
- 4.9 At the end of the 4<sup>th</sup> Semester, a student will have to appear at a Grand Viva-voce. The grand viva-voce will be conducted by a Board of Examiners consisting of Faculty members and External Examiner(s).



- 5.1 A candidate shall be eligible to appear at the Semester Examinations provided he/she is present in regular course of studies with proper attendance as per University rules.
- 5.2 The 2<sup>nd</sup> to 4<sup>th</sup> Semester classes will begin immediately after the completion of the previous semester examination.
- 5.3 All candidates who have completed a semester examination shall join the next semester classes. Candidates failing to qualify in a Semester examination shall automatically revert back to the respective where in the next academic session immediately after publication of the result. However the candidate failing in a paper in the previous semester has to clear the paper(s) as per 5.4.
- 5.4 A candidate will get a maximum of three consecutive chances including the first one in his / her regular year in order to pass each of the Semester Examinations.
6. The final result (combining all the Semester results) will be determined by adding marks for all theoretical and practical papers separately. A candidate obtaining 40% in theoretical paper (i.e, 560 of 1400) and 50% in each of practical examination will be declared as passed with Second Class. A candidate scoring 60% marks in the total aggregate of all the Semester examinations will be placed in the First Class.
7. The course structure is as given in Appendix – I.



**REVISED (DETAILED) SYLLABUS FOR 2-YR. M. Sc. (4 SEMESTERS) IN COMPUTER SCIENCE IN  
WEST BENGAL STATE UNIVERSITY, BARASAT**

**First Semester**

**CS101: ADVANCED COMPUTER ARCHITECTURE**

**Full Marks:- 100**

Computer Architecture & Organization. Basic Parallel Processing Architecture, Taxonomy- SISD, MISD, SIMD, MIMD structures, Serial, Parallel & Concurrent Computation, CISC Vs RISC, Structure of Instruction of instruction sets and Desirable Attributes.

Basic Concepts of pipelining, Instruction Pipelining. Hazards, Reservation Tables, Collision, Latency, Dynamic pipeline, Vector processing & Vector processors.

Cache Memory & Virtual Memory: Structure, Analysis & Design.

I/O Systems: Design Issues, Performances Measures.

Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, Scalability, Models of Consistency, Application of

SIMD Structure.

Definition. Types of Interconnected Networks; Baselines, Shuffle- Exchange, Omega, Cuba, Comparison & Application.

Mapping Algorithm to array structures, Systolic processors. Mapping design & Optimization, Wave Front Array processor.

Data Flow Graphs, Petri nets, Static & Dynamic DFA.

Different Models, Languages, Compilers, dependency Analysis. Message Passing, Program mapping to Multiprocessors, Synchronization.

**Case Study:** Basic Features of Current Architectural Trends. DSP Processor, Dual core Technology

**CS 102: DATABASE MANAGEMENT SYSTEM**

**Full Marks:- 100**

Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Optimization Algorithms. Transaction concepts, Recovery and Concurrency Control, Locking and Timestamp based protocols, Multiversion and Optimistic Concurrency Control schemes, Threats and countermeasures. Object-oriented and Object Relational Databases, Distributed Databases, Data Warehouse and Data Mining.

References:

Elmasri, Navathe, Fundamentals of Database System, 3/e, Pearson Education.

Ozsu, Principals of Distributed Database System, Pearson Education.

**CS 103: ADVANCES IN DATA STRUCTURES AND ALGORITHMS**

**Full Marks: 100**

Basic concepts about Algorithms, Data Structures, Recursion, Iteration, Big-O Notation, Brief Foundations and Applications of Stacks, Queues, Arrays, Linked Lists – Singly, Doubly, and Circular Linked Lists, Trees – Definitions, Representations, Binary Tree and Its Usefulness, Binary Search Tree, Tree Traversal, Threaded Binary Trees, Binary Tree Representation of any Tree other than Binary Tree, Decision Trees, Balanced Tree Schemes – AVL Trees, 2-3 Trees. Basic concepts about Searching, B-Trees, Hashing. Different Sorting Algorithms and their complexity issues.

Binomial Heaps, Fibonacci Heaps, Amortized Analysis of Algorithms, Disjoint Set Maintenance Techniques.

Review : Algorithms, Complexity, Order. Divide and Conquer : Multiplications of Large integers , Strassen's Matrix Multiplication algorithm. Dynamic Programming : shortest path, chained matrix multiplication, optimal binary search trees, Travelling salesman problem. Greedy Algorithm Knapsack problem. Computational Complexity and Intractability.

Review : NP-complete problems. Approximation Algorithms. Amortised Analysis. Backtracking: n-queen's problem. Parallel Algorithms.

References:

T.H.Cormen et al -Introduction to Algorithms , PHI

E.Horowitz, S.Sahani-Fundamentals of Computer Algorithms –Galgotia.

**CS 104: DATA COMMUNICATION**

**Full Marks: 100**

Introduction to communication systems, Data, signal and Transmission: Analog and Digital, Transmission modes, Transmission Impairments, Performance criteria of a communication system

Goals of computer Network, Networks: Classification, Components and Topology, Layered architecture of a Network software, OSI and TCP/IP model

Encoding: Line coding and Block coding, Error detection codes, Modulation: Digital to Analog and Analog to Analog conversion techniques

Bandwidth utilization techniques: Multiplexing: Frequency division, Time division and Wave division multiplexing,

Spread spectrum concepts



Transmission Media: Guided and Unguided: Architecture, Transmission characteristics and application  
Switched Networks: Circuit switching and Packet Switching, Circuit Switching principle and the Modems used in a Telephone network, Connection oriented and Connection-less approach in packet switching network  
Information Theory: Measure of Information, Entropy, Discrete and Continuous channel, Shannon's encoding algorithms  
Reference:

B.Forouzan – Data Communication and Networking  
A Tanenbaum – Computer Networks.

## **Practical**

### **CS 105(P): ADVANCES IN DATA STRUCTURES AND ALGORITHMS LABORATORY** **Full Marks: 100**

Programming with C: Control statements, array and pointers, functions, scope of variables, parameter passing, structures, union, files. General assignments on C programming language before the students start their work on Data Structure. Assignments on developing programs and functions related to the theoretical paper coverage on Data Structures.

### **CS 106(P): DATABASE LABORATORY** **Full Marks: 100**

Database Schema Design, Database Creation, SQL Programming and Report Generation using a RDBMS. Students are to be exposed to front-end development tools, ODBC; Internet based access to databases and database administration.

## **Second Semester**

### **CS 201: - COMPUTER NETWORK** **Full Marks:- 100**

Review on Computer Networks Basis Data Link control: Line discipline, Flow and error control protocols, Physical addressing, HDLC MAC Protocols: Dynamic channel allocation, Random access and Controlled access techniques, IEEE Standards. LAN Interconnection technologies and High Speed LANs, Virtual LANs. Virtual Circuit approach in WANs. IP address – subnetting, NAT, IP datagrams address mapping, error reporting and multicasting in network layer Static and Adaptive routing, Distance vector and Link-State routing, Broadcast routing, Unicast routing protocols: interior and exterior routing protocol. RIP, OSPF and BGP, Multicast routing protocols – Source-Based tree and Group-Shared tree approach. Reliable and Unreliable transport service, Flow and error control mechanism in transport layer. Congestion control and Quality of Service DNS, Electronic mail, FTP.

### **CS 202: - ADVANCED OPERATING SYSTEM** **Full Marks :100**

Introduction to Parallel and Distributed Systems. State recovery and clock models for distributed systems. Classification of control algorithms for distributed systems process and mode synchronization, classical OS, Process Migration, termination detection, Remote Procedure Call.

References:

Tanenbum,A.S.,Distributed O/S ,Pearson Education.  
Singhal,Shivaratri,Advanced Concepts in O/S,TMH.  
P.K.Sinha,Distributed O/S,PHI

### **CS 203: - COMPUTER GRAPHICS** **Full Marks:- 100**

Overview of CG, definitions of CG, types of CG, storage tubes displays, CRT technologies - Raster Scan Display, Computer graphics software.

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.

Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines.

Viewing pipeline, Window to Viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.

3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space; reflection through an arbitrary plane; general parallel projection transformation; clipping, Viewport clipping, 3D viewing, perspectives & Depth Cueing.

Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.

Introduction, Modeling Light Intensities and Sources, Diffuse Reflection, Lambert's Cosine Law, Specular Reflection, Halftoning, Color Models - RGB Color, CMY Color..

### **CS 204: - SOFTWARE ENGINEERING** **Full Marks:- 100**

A generic view. Review of Software Development stages- analysis , design, implementation, testing .Program verification. Module relationship- Coupling, Cohesion. Effort Estimation models . Project Scheduling .Software Maintenance. Software Quality Models. Software Reliability –Basics, Time-dependent and Time-independent models.



Software metric. Software Configuration management . Object- oriented software Engineering. Unified Modelling Languages – features and case study.

Reference

Roger S Pressman- Software Engineering.

Ian Somerville – Software Engineering.

P Jalote – An Integrated Approach to Software Engineering.

### **Practical**

#### **CS 205(P): - GRAPHICS LABORATORY**

**Full Marks:- 100**

2D Algorithms: Different Line Drawing algorithms. Different Circle generating algorithms. Different Filled Area primitives.

3D Algorithms: Representation & viewing of three dimensional objects. Implementation of Planar Geometric Projections.

Problems of GUI design – Representation of a region into Quadtree.

Different image transformation algorithms. Algorithms on Image enhancement, segmentation and restoration.

#### **CS 206(P): - SOFTWARE ENGINEERING LABORATORY**

**Full Marks:- 100**

Design and development of Softwares- Application and System Softwares.

e.g. Railway Reservation System , Examination System, Student Registration System,

Problems on compilation, Entity relationship.

Designing of test data for testing procedural and object-oriented programs.

Design and development of software for measurement of quality attributes of software.

Implementation of use-case diagrams and related notations

### **Third Semester**

#### **CS 301: Object Oriented Programming**

**Full Marks:- 100**

Abstraction, Encapsulation, Modularity, Links and Association, Generalization, Inheritance, Aggregation, Polymorphism, using Instantiation, Metadata & Metaclass, Typing, Concurrency, Persistence;

Events & States, Concurrency, Advanced Dynamic Model, Relation of Object and Dynamic Model.

DFD, Constraints, Relation of Functional to Object and Dynamic Model.

Analysis using Object, Dynamic and Functional Model.

System Design: Subsystems, Concurrency, Allocating Subsystems to Processors & Tasks, Software Control Implementation, System Architecture

Object Design: Combining three Models, Designing Algorithms, Design Optimization, Control Implementation, Design of Association, Packaging.

Design Modeling using UML

OO Languages Features, Survey of OO Languages, Multi method vs. Object Based vs. Class based languages, Java and C++, OO Data Model, Complex Object, Persistence, Transaction, Concurrency Control, OODB Architecture, Query Language for OO Relational Databases, Gemstone / O<sub>2</sub> / Orion

CORBA

Reference:

Ali Bahrami, - “Object –Oriented System Development” - Mc Graw Hill.

Rambaugh, James Michael, Blaha - “Object Oriented Modelling and Design” - Prentice Hall India

Patrick Naughton, Herbert Schildt – “The complete reference-Java2” - TMH

Priestley – “ Practical Object Oriented Design using UML” - TMH

Jana, C++ & Object Oriented Programming, PHI

Alhir, learning UML, SPD/O'Reily

#### **CS 302: Automata Theory and Compiler Design**

**Full Marks:- 100**

Introduction and Review of Finite State Machines: Deterministic, Nondeterministic M/cs, Minimization of FSM, Inverse FSM.

Regular Expression, properties applications : Definition, Regular Expression, Two way FA, Linear Bound Automata, Applications

Regular Set: Definition, Properties, Pumping Lemma, Decision Algorithm, Minimization

Grammar, Different types, Derivation Tree, Different Normal Forms, Ambiguous Grammar and its implications, Chomsky hierarchy, Context Sensitive Languages, Different Classes of Languages, Deterministic Context Free Language and its Properties

Pushdown Automata: Definition, PDA and CFL, , Alternative Forms of PDA

Turing Machine: Introduction, Turing Machine Model, Church's Hypothesis

Compiler design, various phases; lexical analyzer, token, lexeme, and patterns. Regular definitions, Transition Diagrams, Syntax Analysis, ,ambiguity, associativity, precedence, Top down Parsing, recursive-descent parsing, predictive parsing,



Bottom up Parsing, Operator precedence grammar, LR parsers Syntax directed definitions: inherited and synthesized attributes, .Type checking. Runtime systems, Activation tree, Activation record, Basic Blocks, Dataflow analysis, Code optimization and code generation.

References:

Aho, Compilers: Principals, Techniques and Tools, Pearson Education.

Hopcroft, Introduction to Automata Theory, languages and Computation, 2/e, Pearson Education

### **CS 303: INTERNET AND MULTIMEDIA TECHNOLOGY**

**Full Marks:- 100**

Internet –introduction, addressing schemes, IPv4 and IPv6; World Wide Web. Protocols; HTTP, Telnet.

FTP and other Net utilities; Web mail. Netiquette.

Searching: portals, search engines, concepts of crawlers, web mining.

Web site design: HTML, XML and XHTML-Web authoring, Document Structure, Tags and Page Composition; multimedia elements- colour, graphics, photographs and image maps, Cascading Style Sheets (CSS) & Dynamic HTML (DHTML); Page editors.

Scripting language: client side and server side, applets, servlets, JSP, Common Gateway Interface (CGI); database connectivity.

Multimedia: definition, characteristics- interactive and non-interactive; local (standalone CD, DVD) and networked (videoconferencing, web video broadcasting, multimedia Email); large data volume, real-time property, continuous display, delay requirement. Various media types: captured and. synthesized; discrete (space dimension) and continuous (space and time dimension); text- plain and rich; graphics (revisable) and images (not revisable); video (captured or synthesized); animation; sound -speech and non-speech, natural and structured. File formats- text (doc, RTF, PDF): audio (WAV, MIDI).

Data compression and coding: entropy coding, lossy and lossless; text (run length; Huffman, arithmetic, vector, LZ, LZW); audio (Dolby), image and video standards- JPEG and. MPEG techniques.

### **CS 304: ARTIFICIAL INTELLIGENCE**

**Full Marks:- 100**

Importance of AI, Scope of AI, Goals of AI, AI and Related fields,

State-Space Graphs, Implicit and Explicit Graphs, Production Systems, Formulating the State-Space; Uniformed search: Depth-first Search, Breadth-first Search; Uniform Cost algorithm;

Use of Heuristics, A\* Algorithm, Admissibility of A\*; Analysis and comparison of Search algorithms;

Two-agent games, AND/OR Graphs, Minimax Procedure,  $\alpha$ - $\beta$  pruning procedure, Learning evaluation functions;

Introduction to ES, Knowledge-Based systems, Knowledge Representation: Rule\_Based approach: Forward and Backward Chaining, Semantic-Nets Based approach, Frame Based approach;

Introduction to Constrained Satisfaction Problems(CSP), Applications, Algorithms to CSPs, Symbolic constraints & Propagation;

Introduction to programming in logic. Declarative and Procedural Meaning, Data Objects, Lists, Operators, Controlled Backtracking

Reference:

Elaine Rich and Kevin Knight: Artificial Intelligence

Dan W. Patterson: Introduction to Artificial Intelligence and Expert Systems

S. Russel and P. Norvig, "Artificial Intelligence, A modern Approach"

Clocksinn & Mellish, " Programming in PROLOG"

ARTIFICIAL INTELLIGENCE \_ RICH & KNIGHT TMH - ISBN-0-07-052263-4

PROGRAMMING IN PROLOG-CLOCKSINN & MELLISH - Narosa Publishing House - ISBN-81-85198-15

PRINCIPLES OF ARTIFICIAL INTELLIGENCE - NILLSON Harcourt Asia & Morgan - ISBN - 1-55860-555-5

FOUNDATION OF ARTIFICIAL INTELLIGENCE & EXPERT SYSTEM \_ JANAKIRAMAN, SARUKESI & GOPAL KRISHNAN Macmillan

### **Practical**

#### **CS 305(P): Object Oriented Programming**

**Full Marks :100**

Programming with OOP : Pointers, Enumeration, References, Function Overloading, Classes and Objects, Constructors and Destructors, Self reference- This, Operator Overloading, Derived classes and Inheritance, Virtual Function, Virtual Base Class, Strings, Template, Exception Handling, Files & Streams, Standard Library, Header Files.

**Java:-**Data types, Operators, Statements, Methods, Class declaration, Java Programming, Objects, Inheritance, Argument Passing, Arrays and Strings, I/O to Text Files,

#### **CS 306: TERM PAPER LEADING TO PROJECT**

**Total Marks: 100**

Initial survey and presentation on the topic selected for project.

### **Fourth Semester**

#### **CS 401 Elective-I**

**Total Marks: 100**



**Elective****1. IMAGE PROCESSING**

Digital image, Steps of digital image processing systems, elements of visual perception, connectivity and relations between pixels. Simple Operations:-Arithmetic, logical, geometric operations.

2D orthogonal and unitary transforms – properties and examples , 2D DFT, FFT, DCT, Hadamard transform, HARR Transform, Slant transform, KL Transform – properties and examples. Image restoration:-

Matching by templates, classifiers models (statistical and neural network base Recognition techniques

Basics, Entropy and data compression, lossless and lossy, various error-free compression techniques, lossy compression techniques, Image compression standards.

Edge detection, line detection, curve detection, Edge linking and boundary extraction, boundary representation, region representation and segmentation, morphology – dilation.

## Reference:

R. C. Gonzalez and R. E. Woods, "Digital Image Processing"

B. Chandra and D. Dutta Majumder, "Digital Image Processing and Analysis"

Milan Sonka, V. Hlavac, R. Boyle, "Image Processing, Analysis and Machine Vision"

William K. Pratt, "Digital Image Processing"

**2. SOFT COMPUTING**

Fuzzy Systems: Fuzzy sets, Fuzzy logic. Fuzzy relations, Approximate Reasoning, Fuzzy logic control

systems Applications of Fuzzy Theory: Fuzzy Pattern Recognition. Fuzzy Database Human Maching Interactions

Artificial Neural Networks: Feedforward Networks and Supervised Learning Perception learning rules, Adaline, Back propagation. Associative Memories, Hopfield networks, Unsupervised Learning Networks, Self-organizing feature map.

Adaptive Resonance Theory, Radial Basis function. Recurrent Neural, Networks Reinforcement Learning

Applications of Neural Networks Sensor processing, Communication. System Identification and Control Genetic

Algorithm (GA):Evolutionary Computing. Basics of Genetic Algorithms Reproduction, Crossover Mutation, Schemata, Fitness function. Optimization problems with Constraints, Stochastic models Applications orGA:GA in Machine

Learning, Navigational Planning for Robots, GA in Optimization Problems, Intelligent Search Integrated Systems. Fuzzy Neural Systems for Pattern Recognition, Neural Fuzzy Controllers, Neural Network-driven Fuzzy Reasoning

## Reference:

“Neuro-Fuzzy and Soft computing”, Jang, Sun, Mizutani, Pearson

“Neural networks: a comprehensive foundation”, Haykin, Pearson

“Genetic Algorithms”, Goldberg, Pearson

“Fuzzy Sets & Fuzzy Logic”, G.J. Klir & B. Yuan, PHI.

**3. PATTERN RECOGNITION**

Pattern Recognition (20L): Introduction, decision boundaries, discriminant functions (linear and non-linear), Bayesian classification, training and test sets, parametric and non-parametric learning, minimum distance classifiers, k-NN rule, unsupervised learning, basic hierarchical and non-hierarchical clustering algorithms, dimensionality reduction, similarity measures, feature selection criteria and algorithms, principal components analysis, some applications.

## Reference:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York, 2000.

2. J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London, 1974.

**4. QUANTUM COMPUTING**

Quantum computing has emerged about a decade ago as a branch of theoretical computer science, with more and more connections to classical computer science. In this course we aim to give a basic introduction to this exciting field, giving students the basis to undertake research in this area, to integrate it into related areas, or simply to gain a deeper understanding of what quantum computing is.

We will study: axioms of quantum mechanics, quantum circuits, quantum algorithms (up to Shor's algorithm for factoring), quantum error correction, quantum complexity (classes, complete problems etc.), some quantum cryptography, quantum communication complexity, some classical results obtained "the quantum way".

## Reference:

Quantum Computation and Quantum Information, Michael A. Nielsen, Isaac L. Chuang, Cambr. Univ. Press (2000)

Classical and Quantum Computation, A. Yu. Kitaev, A. H. Shen, M. N. Vyalys, Amer. Mathematical Society (2002)



Quantum Algorithms, Julia Kempe, lecture notes - for the part on circuits and algorithms  
Communication Complexity, E. Kushilevitz and N. Nisan, Cambr. Univ. Press (1997) - for the classical background  
Quantum Communication and Complexity, Ronald de Wolf, Theoretical Computer Science, 287(1): 337-353 (2002)  
Approaches to Quantum Error Correction, Julia Kempe, survey (2006)

## **5. BIOINFORMATICS**

Basic concepts of Molecular Biology, Strings, Graphs and Algorithms, Pair-wise and Multiple alignments, Information retrieval from biological databases, Database homology Search, DNA Sequence fragment assembly, MSDN (Microbial Strain Data Network); Sequence analysis; Secondary Structure predictions; Tertiary Structure predictions; Markov Chain, Hidden Markov Models; Applications in Biotechnology:

Reference:

Setubal Joao and meidanis Joao, "Introduction to Computational Molecular Biology"  
Warren Ewens and Gregory R. Grant, "Statistical Methods in Bioinformatics an Introduction"  
R. Durbin, S. Eddy, A. Krogh and G. Mitchison, "Biological sequence Analysis"  
Attwood TK and Parry-Smith DJ, "Introduction to Bioinformatics"  
A Baxevanis & B Ouellette, "Bioinformatics : A Practical Guide to the Analysis of Genes & Proteins"

## **6. VLSI DESIGN**

Introduction to VLSI System Design: MOS Devices, Circuits and Fabrication, Design Principles and Characteristics of MOS Devices in Logic Circuits, Logic Implementation with nMOS, pMOS, CMOS and PLAs, Pass and Transistor Logic, Size and Complexity of Integrated Circuits, Feature Size, Impact of Shrinking, Clocking, Scaling, PLA Minimization and Folding, Inverters and Logic Gates, Design Rules and Layouts, Stick Diagram, Transistor Sizing.  
Logic Design: Static nMOS and CMOS Circuits, Steering Logic, Dynamic CMOS Circuits, Static vs. Dynamic CMOS Designs, Domino and NORA Logic Circuits, Charge Sharing, Clock Generation and Distribution, Transmission Gates.  
VLSI Design Process: System Specification, Functional Design, Logic Design, Circuit Design, Physical Design, Verification, Fabrication and Packaging.  
Design Styles: Custom Design, Standard-Cell Design, Gate-Array Design, FPGA and MCMs.  
Physical Design Issues: Partitioning, Floor-Planning and Placement, Routing, Compaction, Complexity Issues, Algorithms and Data Structures for Layout Designs.

Reference:

Pucknell D.A and Eshraghian K "Basic VLSI Design"  
Michael John Sebastian Smith "Application-Specific Integrated Circuits"  
Keshab K. Parhi - VLSI Digital Signal Processing Systems: Design and Implementation  
Wolf - Modern VLSI Design - System - on - Chip Design, 3ed  
Jayaram Bhasker - A VHDL Primer (3rd Edition)  
N.Sherwani, Kluwer - "Algorithm for VLSI Design & Automation".

## **7. CRYPTOGRAPHY AND NETWORK SECURITY**

Foundations of Cryptography and Security. Principles of Security. Types of Attacks. Cryptographic Techniques: Design Principal of Block Ciphers, Block Cipher Algorithms. Steganography.

Computer Based Symmetric Key Cryptographic Algorithms: Data Encryption Standard (DES). International Data Encryption Algorithm (IDEA). Computer Based Asymmetric Key Cryptographic Algorithms: RSA Algorithm. Hashes and Message Digests, Digital Signatures, Certificates and standards, Authentication, Electronic Mail Security, IP and Web Security Protocols, System Security: Computer Virus, Firewall and Intrusion Detection.

Reference:

Atul Kahate "Cryptography and Network Security"  
A Kahate and Godbole "Web Technologies"  
William Stallings, "Network Security Essentials"  
Gollmann, Dieter, "Computer Security"  
Micki Krause, Harold F. Tipton, "Handbook of Information Security Management"  
Pearlman and Kaufman "Private Communication in a Public World"

## **8. COMPUTER VISION**

Fundamentals of Image Processing Binary Image Analysis Pattern Recognition Concept Filtering and Enhancing Images Color, Shading and Texture Content-Based Image Retrieval Motion from 2D Image Sequence Image Segmentation Matching in 2D Perceiving 3D from 2D Images 3D Sensing and Object Pose Computation Models and Matching in 3D Virtual Reality Integration of a Machine Vision System Case Studies

Reference:

Davis, E. R. 1997. Machine Vision. 2<sup>nd</sup> Ed. San Diego, California: Academic Press.  
Jain, R. J., R. Kasturi and B. G. Schunck. 1995. Machine Vision. New York: McGraw-Hill, Inc.



Haralick, R. M. and L. G. Shapiro. 1992. Computer and Robot Vision. Vol. 1 & 2. Reading, Massachusetts: Addison-Wesley Publishing Company, Inc.

Faugeras, O. 1999. Three-Dimensional Computer Vision: A Geometric Viewpoint. Cambridge, Massachusetts: The MIT Press.

## 9. OPERATION RESEARCH

Resource Allocation - graphical solutions of two-product, multiple-resource production environments, simplex method of solution, linear programming (using the Solver plug-in for MS Excel)

Network Analysis and Design - Euler and Hamilton circuits, minimum traversal (i.e. shortest paths) algorithms, Dijkstra's method, spanning trees, Kruskal's method, and maximum flow networks.

Planning and Task Scheduling - list-processing algorithm, critical paths, critical path method (CPM), PERT, Hargrove and Nemhauser's method, EOQ model

Forecasting Techniques - moving average, exponential smoothing, regression

Deterministic Inventory models - classic EOQ, EOQ with bulk purchasing, EOQ with storage limitations

Transportation models - least cost method, NW corner method, stepping stone method, Vogel's approximation

## 10. DATA WAREHOUSING AND DATA MINING

Need for strategic information, Decision support system, Knowledge discovery & decision making, need for data warehouse, definitions of Data warehousing and data mining, common characteristics of Data warehouse, Data Marts, Metadata, Operational versus analytical databases, trends and planning of Data warehousing.

Defining business requirements, Data modeling strategy, Fact tables, dimensions, Star schema and other schemas, Multi dimensional data models, Data Cube presentation of fact tables, using the Data warehouse, Designing tools for Data warehouse, OLAP models and operations.

Architectural components, Infrastructure: Operational & Physical, Extraction, Transformation and Loading, Components of an Oracle Data warehouse, Data Transformation Functions, DBA responsibilities, Capacity Planning.

Implementation of Data warehouse, Physical design: steps, considerations, physical storage, indexing, Performance Optimization, Data warehouse deployment activities, Data security, backup and recovery concepts, Data warehouse Maintenance.

Basics of data mining, related concepts, Data mining techniques, Data Mining Algorithms -- Classification, Clustering, and Association rules, Knowledge Discovery in databases( KDD) Process, Introduction to Web Mining:

### **Reference Books:**

Data Warehousing Fundamentals , by Paulraj Ponnian, John Wiley.

Data warehousing with oracle by sima yazdani – shirley s. Wong

Data Mining Concepts and Techniques, Han Kamber, Morgan Kaufmann

Introduction to Business Intelligence and Data Warehousing, PHI

The Data Warehouse Lifecycle toolkit, Ralph Kimball, John Wiley.

## 11. PARALLEL ALGORITHMS

Overview, need for parallel computing, basic concepts and terminology -Flynn's classical taxonomy, general parallel terminologies, issues in high performance computing

Architecture and interconnection of parallel computers: Memory architectures -shared memory, distributed memory, hybrid distributed-shared memory. Interconnection networks

Parallel Programming Models: Overview, shared memory model, threads model, message passing model, data parallel model, advanced Models

Designing Parallel Algorithms: Automatic vs. manual parallelization. partitioning, communications, synchronization, data dependencies, load balancing, granularity, limits and costs of parallel programming, performance analysis and tuning

Parallel computing examples: array processing, PI calculation, simple heat equation, matrix vector multiplication, matrix-matrix multiplication, combinational search

## 12. EMBEDDED SYSTEM

Embedded Computing: Complex System and Microprocessors- Embedding Computers, Embedded System Design Process Requirements, Specifications, Design and Integration, formalisms for System Design, Design Example Instruction Sets: Preliminaries, ARM and SHARC Processor - Processor and Memory Organization, Data Operations. Flow of Control, Parallelism within Instruction.

CPU: Programming I/O, Supervisor Mode. Exception and Traps, Co-processors, Memory System Mechanisms, Performance Pipelining. Super Scalar

Execution, Caching, CPU Power Consumption, Design Example. The Computing System: CPU bus-protocol, DMA, Configurations, Examples, Memory ^Devices- Organization, RAM. ROM. I/O Devices- Timers, Counters, A/D and4)/A Converters, Keyboards, LEDs, Display, Touch Screen, Interfacing Memory and Device, Microprocessor-based Design-Architecture. Hardware Design, Development and Debugging, Manufacturing Testing, Design Example Program Design and Analysis: Design Patterns, Models, Assembling and Linking, Compilation Techniques, Interpreters and JIT Compilers, Analysis and Optimization- Execution Time, Energy and Power, Program Size, Validation and Vesting, Safety-critical System, Design Example



Reference:

Dreamtech Software Team, "Programming for Embedded Systems: Cracking the Codes"  
John Catsoulis, " Designing Embedded Hardware"  
Daniel Wesley Lewis, "Fundamentals of Embedded Software: Where C & Assembly Meet"

### **13 MOBILE COMMUNICATIONS**

Overview of Computer networks, Multiple Access Technology for Wireless Communication, Mobile Data Communication, Personal Wireless Communication Systems, Digital Cellular Systems and Standards (2G), Third Generation Mobile Services (3G).

Wireless LANS (WLANs), Wireless Application Protocol (WAP), Wireless in Local Loop (WLL), VSAT Systems and Network Security

Reference:

Raj Pandya, "Mobile and Personal Communication Systems & Services"  
Yi- Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architectures"  
Rajesh & Balasubramanian "Computer Networks : Fundamentals and Application"  
Jochen Schiller, "Mobile Communication"  
C.Y. William Lee, "Mobile Cellular Telecommunications : Analog & Digital Systems"  
Gilbert Held, "Building A Wireless Network"  
Theodore S. Rappaport, "Wireless Communications: Principles and Practice"

