Department of Computer Science
West Bengal State University, Barasat

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

FIRST SEMESTER						
THEORETICAL		Th	Tu	P	Credit	
CS101	ADVANCED COMPUTER ARCHITECTURE	3	1	0	4	50
CS102	ADVANCED DATABASE MANAGEMENT SYSTEMS	3	1	0	4	50
CS103	ADVANCED DATA STRUCTURES AND ALGORITHMS	3	1	0	4	50
CS104	COMPUTER NETWORKS	3	1	0	4	50
PRACTICAL						
CS105(P)	DATA STRUCTURES AND ALGORITHMS LABORATORY	0	0	3	3	50
CS106(P)	DATABASE LABORATORY	0	0	3	3	50
	TOTAL CREDIT: 22				TOTAL MARKS	300
SECOND SEMESTER						
THEORETICAL						
CS201	OBJECT ORIENTED PROGRAMMING	3	1	0	4	50
CS202	ADVANCED OPERATING SYSTEM	3	1	0	4	50
CS203	COMPUTER GRAPHICS AND MULTIMEDIA	3	1	0	4	50
CS204	FORMAL LANGUAGE AND AUTOMATA THEORY	3	1	0	4	50
PRACTICAL						
CS205(P)	GRAPHICS LABORATORY	0	0	3	3	50
CS206(P)	OBJECT ORIENTED PROGRAMMING LABORATORY	0	0	3	3	50
	TOTAL CREDIT: 22				TOTAL MARKS	300
THIRD SEMESTER						
THEORETICAL						
CS301	SOFTWARE ENGINEERING	3	1	0	4	50
CS302	COMPILER DESIGN	3	1	0	4	50
CS303	ARTIFICIAL INTELLIGENCE.	3	1	0	4	50
CS304	ELECTIVE - I	3	1	0	4	50
PRACTICAL						
CS305(P)	SOFTWARE ENGINEERING LABORATORY	0	0	3	3	50
CS306(P)	SEMINAR	0	2	0	2	25
CS307(P)	TERM PAPER LEADING TO PROJECT	0	0	3	2	25
	TOTAL CREDIT: 23				TOTAL MARKS	300
FOURTH SEMESTER						
THEORETICAL						
CS401	ELECTIVE - II	3	1	0	4	50
CS401	ELECTIVE - III	3	1	0	4	50
	PRACTICAL					
CS403(P)	GRAND VIVA-VOCE	0	0	0	3	50
CS404(P)	PROJECT	4	0	18	22	150
	Total Credit: 33				Total Marks	300

Total Course Credit: 100Total course Marks 1200

Set of Elective Papers:

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
13. WIRELESS COMMUNICATION AND MOBILE COMPUTING
14. NATURAL LANGUAGE PROCESSING
15. GRAPH THEORY
16. FUZZY LOGIC.

Department of Computer Science
West Bengal State University, Barasat

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 (or from any other University or Institution) 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 refered 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 100. The distribution of credits for each category is as follows:-

Subject	Credit
Theory and Tutorial	4
Laboratory	3
Project	22
Viva-voce	3
Term Paper	2
Seminar	2

4.2 Examination of a Theoretical Paper is of 2 hour duration and will usually carry 40 marks. 10 marks for each paper will be set aside for continuous assessments to be evaluated by the teacher(s) assigned for those classes.

4.3 For Theoretical papers, paper setters and examiners will be appointed from a Board of Examiners duly constituted.

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 paper a candidate must appear in each theoretical and practical papers. Pass marks for project, grand viva-voce and term paper will be 50% as in practical paper. Pass mark for each theoretical paper is 35%.

4.6 Each candidate will have to complete a term paper assignment in 3rd semester. He / She will have to make a presentation 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 3rd Semester. The project work would have to be completed under the supervision of faculty member(s) at the end of the 4th 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 4th 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 2nd to 4th 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 semester 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% will be in theoretical paper (i.e, 480 of 1200) and 50% or more in each of practical examination will be declared as passed with Second Class. A candidate scoring 60% or more marks in the total aggregate of all the Semester examinations will be placed in the First Class.
7. In case of any dispute the University Guideline will be followed.
8. The course structure is as given in Appendix – I

Department of Computer Science
West Bengal State University, Barasat

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

First Semester

CS101: ADVANCED COMPUTER ARCHITECTURE Full Marks:- 50

Computer Architecture & Organization. Control unit design, 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

References:

Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill,
Kai Hwang, Fayé Alayé Briggs, Computer architecture and parallel processing, McGraw-Hill,
D.A. Patterson, J.L. Hennessy, D. Goldberg, Computer Architecture : A Quantitative Approach 2nd Edn, Addison-Wesley.
Harold Stone, High-performance Computer Architecture (3rd edition), Addison Wesley.
Naresh Jotwani, ADVANCED COMPUTER ARCHITECTURE- 2/E :Parallelism-Scalability- Programmabilit,
Kai Hwang, Tata Mcgraw - Hill Education
P. V. S. Rao, Perspectives in Computer Architecture, PHI.
Hayes, Computer Architecture & Organization, 2nd & 3rd Edn

CS 102: ADVANCED DATABASE MANAGEMENT SYSTEMS Full Marks:- 50

Query Processing, 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, Database Security, Emerging Technologies.

References:

Elmasri,Navathe,Fundamentals of Database System,3/e,Pearson Education.
Ozsu,Principals of Distributed Database System,Pearson Education.
R. Chakrabarti, S. Dasgupta, ADVANCED DATABASE MANAGEMENT SYSTEM, Wiley
Carolyn Begg, Thomas Connolly, Database Systems, 4th Edition,Addison-Wesley
Dr. S. Sumathi, S. Esakkirajan , Fundamentals of Relational Database Management Systems, ISBN
Raghu Ramakrishnan , Database Management System 2nd Edition
Korth, Database Management System

CS 103: ADVANCED DATA STRUCTURES AND ALGORITHMS Full Marks: 50

Basic concepts about Algorithms, Data Structures, Recursion, Iteration, Big-O Notation, Brief Foundations and Applications of 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. complexity issues of different Sorting Algorithms. Binomial Heaps, Fibonacci Heaps, Amortized Analysis of Algorithms, Divide and Conquer algorithms: 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. Introduction to NP.

References:

T. H. Cormen et al -Introduction to Algorithms, PHI
E.Horowitz, S. Sahani- Fundamentals of Computer Algorithms –Galgotia.
S. Sahani, Data Structures, Algorithms And Applications In C++ 2nd Edition, ORIENT BLACKSWAN PVT LTD
Robert Sedgewick and Philippe Flajolet, An Introduction to the Analysis of Algorithms, Addison-Wesley
Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley
Udi Manber, Introduction to Algorithms: A Creative Approach, Addison-Wesley
Thomas H. Cormen, Algorithms Unlocked, MIT

CS 104: COMPUTER NETWORKS Full Marks: 50

Review on Computer Networks Basis Physical layer, 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. 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. Information Theory: Measure of Information, Entropy, Discreate and Continious channel, Shannon's encoding algorithms.

Reference:

B.Forouzan – Data Communication and Networking
A Tanenbaum – Computer Networks.
William Stallings, Computer Networking with Internet Protocols and Technology, TMH
James F. Kurose, Keith W Ross., Computer Networking: A Top-Down Approach Featuring the Internet,TMH
Poorna,Computer Networks, SCITECH
Olivier Bonaventure, Computer Networking : Principles,Protocols and Practice, The Saylor Foundation

Practical

CS 105(P): DATA STRUCTURES AND ALGORITHMS LABORATORY Full Marks: 50

Programming with C++: CAssignments on developing programs and functions related to the theoretical paper coverage on ANALYSIS OF ALGORITHMS.

CS 106(P): DATABASE LABORATORY Full Marks: 50

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. Assignments on developing programs and functions related to the theoretical paper coverage on DATABASE LABORATORY.

Second Semester

CS 201: Object Oriented Programming Full Marks:- 50

Abstraction, Encaputulation, 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_2 / 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
E. balaguruswamy,object oriented programming in java
Buyya Buyya R., Object Oriented Programming with JAVA Essentials & Applications, TMH

CS 202: - ADVANCED OPERATING SYSTEM Full Marks :50

Review of operating system. Introduction to Parallel and Distributed Systems. State recovery and clock models for distributed systems. Classification of control algorithms for dist and parallel systems process and mode synchronization, classical OS, Process Migration, termination detection, Remote Procedure Call. Case study on various operating systems.

References:

Tanenbum,A.S.,Distributed O/S ,Pearson Education.
Singhal,Shivaratri,Advanced Concepts In O/S,Tmh.
P.K.Sinha,Distributed O/S,Phi
Balakrishna Prasad, Operating Systems & Systems Programming - 2nd Edn., Scitech
Avi Silberschatz ,Peter Baer Galvin ,Greg Gagne , Operating System Concepts *Eight Edition*
Allen B. Downey, Think Os A Brief Introduction To Operating Systems, Green Tea Press
G. Coulouris, J. Dollimore, T. Kindberg, G. Blair, Distributed Systems Concepts And Design 5th Edition

CS 203: - COMPUTER GRAPHICS AND MULTIMEDIA Full Marks:- 50

Review of Computer Graphics, 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. 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.

Reference

Vaka Murali Mohan, Computer Graphics, Scitech
M.C. Trivedi, N.N. Jani, Kamaljit I. Lakhtaria & Gopal M. Dave, Computer Graphics & Animation, Jaico
John Dimarco, Computer Graphics And Multimedia: Applications, Problems And Solutions
A.P.Godse, D.A.Godse Computer Graphics And Multimedia
N. I. Badler, C. B. Phillips, B. L. Webber, Simulating Humans: Computer Graphics Animation And Control, Oxford
D. P. Mukherjee, Fundamentals Of Computer Graphics And Multimedia, Phi

CS 204: FORMAL LANGUAGE AND AUTOMATA THEORY Full Marks:- 50

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 Decidability and reccursively enumerable languages. Computability concept of Turing Machine.

References:

Aho, Ulman, Hopcroft, Ajtometa, Pearson Education.
Zvi Kohavi,Switching and finite automata theory, McGraw-Hill
Hopcroft, Introduction to Automata Theory, languages and Computation, 2/e,Pearson Education
K.l.P. MISHRA, N. CHANDRASEKARAN, THEORY OF COMPUTER SCIENCE Automata, Languages and Computation THIRD EDITION, Prentice'Hall

Practical

CS 205(P): - GRAPHICS LABORATORY Full Marks:- 50

Assignments on developing programs and functions related to the theoretical paper coverage on COMPUTER GRAPHICS.

CS 206(P): - Object Oriented Programming Laboratory Full Marks :50

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.

Third Semester

CS 301: - SOFTWARE ENGINEERING Full Marks:- 50

A generic view. Software architecture, Review of Software Development stages- analysis , design, implementation, testing .Program verification. Module relationship- Coupling, Cohesion. Effort Estimation models . Project Scheduling and project management Risk management .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. software reuse, emerging trends.

Reference

Roger S Pressman- Software Engineering.
Ian Somerville – Software Engineering.
Rajib Mall, Fundamentals of Software Engineering,PHI
P Jalote – An Integrated Approach to Software Engineering.
Pratap K.J. Mohapatra, Software Engineering, New Age International Publishers
Datta, Software Engineering ,Oxford
Behforooz,Hudson, Software Engineering Fundamentals, Oxford
Jawadekar, Software Engineering: Prime, TMH

CS 302: Compiler Design Full Marks:- 50

Compiler design, various phases; lexical analyzer, token, lexeme, and patterns. Regular definitions, Transition Diagrams, Syntax Analysis, ambiguity, associatively, 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, Symbol Tables. Runtime systems, Activation tree, Activation record, Basic Blocks, Dataflow analysis, Code optimization and code generation.

References:

Aho, Compilers: Principals, Techniques and Tools, Pearson Education.
Muneeswaran, Compiler Design,Oxford
Sudha Sadasivam, Compiler Design - 2nd Edn., SCITECH
Niklaus Wirth, Theory and Techniques of Compiler Construction, Addison-Wesley

CS 303: ARTIFICIAL INTELLIGENCE Full Marks:- 50

Importance of Al, Scope of Al, 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, α-β 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.
Soft computing basics. Fuzzy Systems: Fuzzy sets, Fuzzy logic. Fuzzy relations, Approximate Reasoning, Fuzzy logic control systems. Artificial Neural Networks: Feedforward Networks and Supervised Learning Perception learning rules, Adaline, Back propagation. Unsupervised Learning Networks. Genetic Algorithm (GA): Evolutionary Computing. Basics of Genetic Algorithms Reproduction, Crossover Mutation, Schemata, Finess function.

Reference:

CS 303: ARTIFICIAL INTELLIGENCE

E. Rich and K. Knight: Artificial Intelligence, TMH
Dan W. Patterson: Introduction to Artificial Intelligence and Expert Systems
S. Russel and P. Norvig, "Artificial Intelligence, A modern Approach"
Clocksin & Mellish, " Programming in PROLOG"
Cloksin & Mellish , Programming In Prolog ,Narosa Publishing House
Nillson, Principles Of Artificial Intelligence, Harcourt Asia & Morgan
Janakiraman, Sarukesi & Gopal Krishnan , Foundation Of Artificial Intelligence & Expert System, Macmillan

CS 304: Elective 1

Practical

CS 305(P): SOFTWARE ENGINEERING LABORATORY Full Marks:- 50

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 Assignments on developing programs and functions related to the theoretical paper coverage on SOFTWARE ENGINEERING.

CS 306 (P) : SEMINAR Total Marks: 25

Presentation on assigned topics.

CS 307 (P) : TERM PAPER LEADING TO PROJECT Total Marks: 25

Initial survey and presentation on the topic selected for project.

Fourth Semester

CS 401 Elective-II Total Marks: 50

CS402 Elective-III Total Marks: 50

CS 403 (P): Grand Viva – Vice Total Marks: 50

CS 404 (P): Project Total Marks: 150

Elective Papers:

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"
Kranthi Rekha, Digital Image Processing, SCITECH
Sridhar, Digital Image processing, Oxford
PAKHIRA, MALAY K., DIGITAL IMAGE PROCESSING AND PATTERN RECOGNITION, PHI
David Doermann, Karl Tombre, Handbook of Document Image Processing and Recognition, Springer
Frank Y. Shih, Image Processing and Pattern Recognition: Fundamentals and Techniques, Wiley-IEEE Press

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, Finess 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:

Jang, Sun, Mizutani, "Neuro-Fuzzy and Soft computing", Pearson
Haykin, "Neural networks: a comprehensive foundation", Pearson
Goldberg, "Genetic Algorithms", Pearson
G.J. Klir & B. Yuan, "Fuzzy Sets & Fuzzy Logic", 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:

M. K. Pkhira, Digital Image Processing And Pattern Recognition PHI.
R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York.
J. T. Tou and R. C. Gonzalez: Pattern Recognition Principles, Addison-Wesley, London, 1974.
Frank Y. Shih, Image Processing and Pattern Recognition: Fundamentals and Techniques, Wiley-IEEE Pres
Bishop, Neural Networks for pattern recognition, Oxford

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:

Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambr. Univ. Press
A. Yu. Kitaev, A. H. Shen, M. N. Vyalyi, Classical and Quantum Computation, Amer. Mathematical Society
Julia Kempe,Quantum Algorithms,
E. Kushilevitz and N. Nisan, Communication Complexity, Cambr. Univ. Press (1997)
Ronald de Wolf, Quantum Communication and Complexity,
Julia Kempe, Approaches to Quantum Error Correction, survey (2006)
Sahni, Quantum Computing, TMH

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, "Stastical 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"
Michael L. Raymer & Dan E.Krane, Fundamental Concepts of Bioinformatics, Pearson
Barani et.al, Projects in Bioinformatics, SCITECH

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 Netwrok 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"
Behrouz A. Forouzan, Debdeep Mukhopadhyay., Cryptography and Network Security, TMH
William Stallings, Cryptography and Network Security, TMH
Kahate, Cryptography and Network Security 3rd edition, McGrawHill
Rajaram, Network Security and Cryptography, SCITECH

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. 2nd 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

REFERENCES

Operations Research - Ronald Rardin, PHI
Operations Research: Applications and Algorithms,Wayne L. Winston, third edition, 1994

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:

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
Christian S. Jensen,Torben Bach Pedersen,Christian Thomsen Introduction to Business Intelligence and Data Warehousing, PHI
Ralph Kimball, John Wiley The Data Warehouse Lifecycle toolkit,.
Berson, Data warehousing, Data mining & OLAP, TMH
Tan,Introduction to Data Mining, Pearson

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

REFERENCES

Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar "Introduction to Parallel Computing", Second Edition, Addison Wesley, 2003. ISBN: 0-201-64865.
S.G.Akl, "The Design and Analysis of Parallel Algorithms", PHI, 1989.
F.T.Leighton, "Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes", MK Publishers, San Mateo California, 1992.
Wilkinson, M.Allen,"Parallel Programming Techniques and Applications using networked workstations and parallel computers", Prentice Hall, 1999.
Michael J. Quinn, "Parallel computer theory and practice", McGraw Hill, Second Edition, 1994.
S. Rajasekaran and J. Reif, Handbook of Parallel Computing: Models, Algorithms and Applications, Chapman and Hall/CRC, 2008.
J'aJ'a, J., An Introduction to Parallel Algorithms, Addison-Wesley Pub Co, Reading, MA, 1992.
F. T. Leighton, Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann, CA 1992.
J. H. Rief, Synthesis of Parallel Algorithms, Morgan Kaufman, San Mateo, CA, 1993.

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"
Das,Embedded System , Pearson

13 WIRELESS COMMUNICATION & MOBILE COMPUTING

Wireless Communication - Wired and wireless, Mobility of users and equipments, Overview of Electromagnetic Spectrum, Radio and Microwave communication, Infrared and Millimeter waves, Lightwave Transmission. Overview of Satellite Networks. Concepts of Spread Spectrum, CDMA System. Wireless LANs -MACA and MACAW protocols. Concepts of Cellular Network and related technologies like GSM, GPRS etc.
Mobile Computing – Characteristics, Infrastructure vs Infrastructureless Networks, Routing Protocols in Mobile Adhoc Network (MANET), Overview of Bluetooth Technology. Overview of Sensor Networks. Concepts of Mobile IP, Wireless Application Protocols and others. Overall security requirements and considerations in wireless and mobile computing systems. Concepts of fault tolerance.
References:

V.K.Garg & J.E.Wilks:Wireless and Personal Communication Systems: Fundamentals and Applications, IEEE Press and Prentice Hall,1996.
T.S.Rappaport, B.D.Woerner and J.H. Reed:Wireless Personal Communications: The Evolution of PCS,Dkyener Academic,1996.
G.I. Stuber: Principles of Mobile Communication,Kluener Academic,1996.
U.Black:Mobile and Wireless Networks, Prentice Hall PTR,1996.
Charles Parkins – Mobile Adhoc Ntworks
W. Stallings Wireless- Communication
J. Schiller – Mobile Communication
Reseach Papers of International Journals, Proceedings of Conferences.

14 **NATURAL LANGUAGE PROCESSING**

Parsing & Grammar - Lexical Functional Grammar, Tree Adjoining Grammar, Government & Binding, Paninian Grammar. Comparison of Paninian Grammar with others.
• Semantic Interpretation - Logical Semantics, Script, Conceptual Dependency.
• Discourse Interpretation - Paragraph, Story, Dialogue understanding. Anaphora Resolution.
• Natural Language Generation.
• Machine Translation with special reference to Indian Languages.
• NLP systems - Natural Language Interfaces to Databases.
References:

Grasz, Jones & Webber (Ed.): Readings in Natural Language Processing, Morgan Kaufmann, 1986.
Gazdar & Mellish: Natural Language Processing in PROLOG, Addision Wesley, 1989.
Leonard Bolc. (Ed.): Natural Language Parsing Systems, Springer Verlag, 1987.
McDonald & Bolc. (Ed.): Natural Language Generation Systems, Springer Verlag, 1987.
W. J. Hutchins: Machine Translation - Past, Present & Future, Ellis Horwood, 1986.
Bharati, Chaitanya and Sangal: Natural Language Processing- a Paninian perspective, PHI, 1985.

15 **Graph Theory**

Vertex Cover Matchings Pathcover Connectivity Hamiltonicity Vertex Coloring Edge Coloring Other Coloring Problems Perfect graphs Planar graphs Other special classes of graphs, Isomprphism, Reconstruction of graph, Random graph , compatibility graph.

References:

R. Diestel, "Graph Theory", Springer-Verlag, 2nd edition, 2000.
N. Alon and J. Spenser, "Probabilistic Methods", John Wiley and Sons, 2nd edition, 2000.
N. Deo, Graph theory, phi.

16 **Fuzzy Logic**

Module I : Biological foundations to intelligent systems I: Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.
Module II : Biological foundations to intelligent systems II: Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks.
Module III : Fuzzy and expert control (standard, Takagi-Sugeno, mathematical characterizations, design example), Parametric optimization of fuzzy logic controller using genetic algorithm.
Module IV : System identification using neural and fuzzy neural networks.
Module V : Stability analysis: Lyapunov stability theory and Passivity Theory.
Module VI : Adaptive control using neural and fuzzy neural networks, Direct and Indirect adaptive control, and Self-tuning Pill Controllers.
Module VII : Applications to pH reactor control, flight control, robot manipulator dynamic control, underactuated systems such as inverted pendulum and inertia wheel pendulum control and visual motor coordination.

Reference Books

1. Stanislaw H. Zak, Systems and Control, Oxford University Press, 2003
2. A.S. Poznyak, E. N. Sanchez and Wen Yu, Differential Neural Networks for Robust Nonlinear Control, World Scientific, 2001.
3. Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, Menlo Park, CA, 1998.