DETAILED SYLLABUS FOR 2-YR. M.Sc.
4 SEMESTERS EACH OF 6 MONTHS DURATION
IN COMPUTER SCIENCE
Sarsuna College (Affiliated to University of Calcutta)

First Semester

CSPG-101: ADVANCED COMPUTER ARCHITECTURE Full Marks:- 100

Introduction: 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.

Pipelining: Basic Concepts of pipelining, Instruction Pipelining. Hazards, Reservation Tables, Collision, Latency, Dynamic pipeline, Vector processing & Vector processors. **Memory Systems:** Cache Memory & Virtual Memory: Structure, Analysis & Design. **I/O Systems:** Design Issues, Performances Measures.

Multiprocessor Architecture: Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, Scalability, Models of Consistency, Application of SIMD Structure.

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

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

Data Flow Architecture: Data Flow Graphs, Petri nets, Static & Dynamic DFA. **Programming Environment:** 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

CSPG-102: DATABASE MANAGEMENT SYSTEM Full Marks:- 100

Overview of Database & Relational Database Design:

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

CSPG-103: DATA STRUCTURE — Full Marks: 100

Fundamentals of Linear and Non-Linear Data Structures

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.

Searching- Basic concepts about Searching, B-Trees, Hashing.
Sorting- Different Sorting Algorithms and their complexity issues.

Advanced Data Structures- Binomial Heaps, Fibonacci Heaps, Amortized Analysis of Algorithms, Disjoint Set Maintenance Techniques.

CSPG-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, Discreate and Continious channel, Shannon's encoding algorithms

CSPG-105(P): DATA STRUCTURE 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.

CSPG-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

CSPG -- 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.

Internetworking: IP address – subnetting, NAT, IP datagrams address mapping, error reporting and multicasting in network layer

Routing Protocols:- 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

Internet applications: DNS, Electronic mail, FTP.

CSPG -- 202: - DESIGN & ANALYSIS OF ALGORITHMS

Full Marks:- 100

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.

CSPG -- 203: - COMPUTER GRAPHICS & IMAGE PROCESSING

Full Marks:- 100

Introduction to Computer Graphics & Graphics Systems

Overview of CG, definitions of CG, types of CG, storage tubes displays, CRT technologies - Raster Scan Display, Computer graphics software.
Scan Conversion - Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

2D Transformation - Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines.

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

3D Transformation & Viewing -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.

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

Hidden Surfaces -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.

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

CSPG -- 204: - SOFTWARE ENGINEERING

Full Marks:- 100

Software Engineering – 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.

CSPG – 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.

CSPG – 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

CSPG -- 301: - Object Oriented Design

Full Marks:- 100

Object Model - Abstraction, Encaputulation, Modularity, Links and Association, Generalization, Inheritance, Aggregation, Polymorphism, using Instantiation, Metadata & Metaclass, Typing, Concurrency, Persistance

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

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

Object Oriented Design - 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

Object Oriented Programming using Java: -Pointers, Enumeration, Overloading, Object and Classes, Inheritance, Template, Exception handling, Associations

Object Oriented Languages- OO Languages Features, Survey of OO Languages, Multimethod vs Object Based vs Class based languages, Java

Object Oriented Data Structure using Java:- Lists, Stacks, Queue, Trees, Sorting, Searching, Graphs.

Object Oriented Database - Relational Database Design – Mapping Object Models to tables

OODB Features - OO Data Model, Complex Object, Persistance, Transaction, Concurrency Control, OODB Architecture, Query Language for OO Relational Databases, Gemstone / O_2 / Orion

Object Oriented Testing - Unit Testing, Integration testing, System testing

Distributed Object Oriented System - CORBA – A

Case Study

Reference:-

1. Object Oriented Analysis and Design - by Grady Booch
2. Object Oriented Modeling and Design - Ram Baugh el al, PHI
3. The C++ Programming Languages – B Stroutstrup, Addison Werelay

4. Database System Concepts – H. Korth el al, The Mc Graw Hill Companies, Inc.
5. Data Structure Using Java - A.M Tannenbaum el al PHI
6. Data Structure and Software Development in Object Oriented Domain – J. P. Trembley el al, Pearson Education Asia
7. Unified Modeling Language User Guide – Booch, Rambaugh., Jacobson, Addison Wereley.
8. Inside CORBA – Mowbray & Ruh, Addison Wereley
9. Foundation Of Object Oriented Languages – Kim Bruce PHI
10. Object Oriented databases – B. R. Rao, Mc. Graw Hill Inc

CSPG -- 302(A):- VLSI Design

Full Marks:- 50

Introduction(6L): VLSI design, popular technologies. Logic synthesis & Testable

Design (12L): Logic synthesis with nMOS, CMOS, DCVS and PLAs; Pass transistor vs. ratio logic, transit time, clocking, scaling. PLA minimization, folding, testing. Role of BDDs. Logic design tools-ESPRESSO, SIS, OCTOOLS.

High level synthesis(10L): Design description languages - introduction to features in VHDL, Verilog, Scheduling algorithms; Allocation.

Layout synthesis(12L): Design rules, design styles and parameters, design flow: physical design flow- partitioning, floor planning and placement, routing; FPGAs, CAD tools - MAGIC, XACT, VPR, etc.

Embedded Systems(10): Introduction, design specification, software design, hardware design, hardware software co-design, applications.

Reference: -

1. D. Pucknell and K. Eshraghian: Basic Principles of VLSI Design, Prentice Hall, Englewood Cliffs, 1985.
2. E. D. Fabricius: Introduction to VLSI Design, McGraw Hill, New York, 1990.
3. Mukherjee: Introduction to CMOS VLSI, Prentice Hall, Englewood Cliffs, 1993.
4. N. Weste and K. Eshraghian: Principles of CMOS Design, 2nd ed., Addison-Wesley, Reading, Mass., 1993.
5. Mead and L. Conway: Introduction to VLSI Systems, Addison-Wesley, Reading, Mass., 1980.
6. M. Sarrafzadeh and C. K. Wong: AN Introduction to VLSI Physical Design, McGraw Hill, New York, 1996.
7. N. Sherwani: Algorithms for VLSI Physical Design Automation, Kluwer Academic, Boston, 1999.

CSPG -- 302(B):- Artificial Intelligence (AI)

Full Marks:- 50

Introduction: Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.

Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Search techniques: Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.

Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems.

Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.

Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction.

Representing knowledge using rules: Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Natural Language processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Learning: Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.

Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition.

CSPG -- 303:- Elective 1 [Cryptography] Full Marks:- 100

Data or Information Security Introduction, Cryptography, Conventional Encryption, Classical Cipher, Substitution Codes, Transposition Codes, Cryptanalysis of Classical

Ciphers, General Attacks, Secret and Private Key Cryptography, Stream Cipher, DES, Modes of Operation of DES, Automatic Variable Key, Proof of DES, Merits and Demerits of DES, Qualification of Performance, Triple DES, International Data Encryption Algorithm, Advance Encryption Standard, Comparisons of Secret Key Cryptosystems, Introduction to AES, Limitations of AES, Limitations of Private Key Cryptography, Key Transport Protocol, Needham – Schroeder Protocol, Key Agreement Protocol, Diffioe – Hellman Protocol, Station to Station Protocol, Merkles's Puzzle Technique of Key Agreement, Quantum Security, Public Key Cryptography, RSA Algorithm, How Secured is RSA, Limitations of RSA Algorithm, Cryptographic hash function, Trapdoor Knapsack Problem, Digital Signature, Digital Signature under RSA Algorithm, Email Security, PGP, S/MIME, IP Securiry, SSL, TLS, SNMP, Firewall, Proxy Server.

Reference:-

1. Williams Stallings, Network Security Essentials, Pearson Education.
2. William & Friedman, Essentials of Cryptanalysis, Aegean Park Press, USA
3. Bruce Schneier, Applied Cryptography, John Wiley & Sons.
4. D.E.Denning, Cryptography & Data Security, Addison Wesley.

CSPG -- 304:- Elective 2 [Coding & Information Theory]

Full Marks:- 100

Introduction: A very abstract summary, History, Model of signaling system, Information source, Encoding a source Alphabet, Some particular codes, ASCII, Morse code, 2 out of 5 code, Radix r code

Error Detecting Codes: Why error detecting code? Simple Parity checkers, Error Detecting code, Independent error - White Noise, Re transmission of message, Simple Burst Error-Detecting codes, Alphabet Plus Number codes- weighted code, Review of modular arithmetic, ISBN Book Numbers.

Error Correcting Code: Need for error correction, Rectangular code, Triangular, Cubic, n-Dimensional code, Hamming Error correcting code, Equivalent code, Geometric approach, Single-Error-Correction plus Double-Error-Detection Codes, Applications of the Ideas.

Variable-Length Codes – Huffman Codes

Entropy and Shannon's First Theorem

Reference:-

1. Coding and Information Theory by R. W. Hamming, PHI
2. "Information Theory and Coding" by N. Abramson
3. Information Theory Coding and Cryptography by Ramjan Bose

CSPG -- 305(P):- Java UML Laboratory

Full Marks:- 100

Basic concepts of object-oriented programming (10L): Core Java (12L): Introduction, JVM, features of Java, C++ vs. Java, datatype, operator, construct, recursion, array, string manipulation, classes and objects, abstruct class, interface, exception handling, multithreading, deadlock, utility classes.

Client & server side programming (2L): Enterprise architecture styles: Single-tier, 2-tier, 3-tier, n-tier; Relative comparison of the different layers of architectures.

MVC Architecture (2L): Explanation, Need, Drawbacks, Different components & containers.

Applets (4L): Application vs. applet, life cycle, introduction to AWT and event-driven programming, event handling process and sensible event handling.

Java Database Connectivity (2L): JDBC/ODBC Bridge, connectivity model, Driver manager, connection interface, statement interface, resultset interface, data manipulation.

Java Servlet (6L): Introduction, Advantages over CGI, Lifecycle of servlets, designing of servlets, request and response methods, cookie methods, database connectivity.

Java Script (4L): Data types, variables, operators, conditional statements, array object, date object, string object.

JSP (6L): Introduction, Comparison between JSP & servlet, Architecture/Life cycle, Different types of JSP, relative comparison, Directives, Scripting elements, Actions; JSP implicit objects, Accessing user information using implicit objects, JSP servers

J2EE (2L): An overview of J2EE web services.

Reference:

1. Allamaraju and Buest, Professional JAVA Server Programming, SPD Publication.
2. Ivor Horton, Beginning J2EE 1.4, SPD Publication.
3. Austin and Pawlan, Advanced Programming for JAVA 2 Platform, Pearson.
4. Krishnamoorthy & S. Prabhu, Internet & Java Programming, New Age Publication.
5. Java Server Programming, J2EE edition. (VOL I and VOL II), WROX publishers
6. X-Window System, R.W.Scheifler & J. Gettys, PHI.
7. Cay S. Horstmann and Gery Cornell, Core Java 2 Vol I and II, Prentice Hall
8. Bruce Eckel, Thinking in Java Vol 3 at http://www.mindview.net/books/TIJ
9. Scripting reference at http://home.pacbell.net/ouster/scripting.html

CSPG -- 306:- Term Paper

Full Marks:- 100

Forth Semester

CSPG -- 401: - Compiler Design

Full Marks:- 100

Introduction to Compiling: Compilers, Analysis-synthesis model , The phases of the compiler, Cousins of the compiler.

Lexical Analysis: The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).

Syntax Analysis: The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.

Syntax directed translation: Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.

Type checking: Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions

Run time environments Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

Intermediate code generation: Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code optimization: Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.

Code generations: Issues in the design of code generator, a simple code generator, Register allocation & assignment.

CSPG -- 402: - Project

Full Marks:- 300

CSPG -- 403: - Grand Viva-voce

Full Marks:- 200