FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS

FOR

M.Sc. (Computer Science)
(Semester: I-IV)

SESSION: 2013-14

GURU NANAK DEV UNIVERSITY,
AMRITSAR

Note:  (i)  Copyrights are reserved.
       Nobody is allowed to print it in any form.
       Defaulters will be prosecuted.

(ii) Subject to change in the syllabi at any time.
     Please visit the University website time to time.
Eligibility:

Graduate with Computer Science / IT Computer Applications / Computer Maintenance as one of the elective subjects with 50% marks in aggregate.

OR

BCA/B.Sc. (IT)/ BIT or equivalent there to with atleast 50% marks in aggregate.

OR

Graduate with mathematics as an elective subject and Post-Graduate Diploma in Computer Applications / PG Diploma in Information Tech. / PG Diploma in E-Commerce & Internet Application or equivalent with 50% marks in the aggregate

**Scheme for M. Sc. (Computer Science) - 1st Semester**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS-101</td>
<td>Advanced Data Structures</td>
<td>100</td>
</tr>
<tr>
<td>MCS –102</td>
<td>Advanced Computer Architecture</td>
<td>100</td>
</tr>
<tr>
<td>MCS -103</td>
<td>Network Design &amp; Performance Analysis</td>
<td>100</td>
</tr>
<tr>
<td>MCS -104</td>
<td>Discrete Structures</td>
<td>100</td>
</tr>
<tr>
<td>MCS –105</td>
<td>Soft Computing</td>
<td>100</td>
</tr>
<tr>
<td>MCS –106P</td>
<td>Programming Laboratory - I (Based on Advanced Data Structures)</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total Marks 600**

**Scheme for M.Sc. (Computer Science) – 2nd Semester**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS-201</td>
<td>Theory of Computation</td>
<td>100</td>
</tr>
<tr>
<td>MCS - 202</td>
<td>Image Processing</td>
<td>100</td>
</tr>
<tr>
<td>MCS -203</td>
<td>Design &amp; Analysis of Algorithms</td>
<td>100</td>
</tr>
<tr>
<td>MCS -204</td>
<td>Formal Specification &amp; Verification</td>
<td>100</td>
</tr>
<tr>
<td>MCS –205</td>
<td>Distributed Database Systems</td>
<td>100</td>
</tr>
<tr>
<td>MCS –206P</td>
<td>Programming Laboratory – II (Design &amp; Analysis of Algorithm and Distributed Database Systems)</td>
<td>100</td>
</tr>
</tbody>
</table>

**Total Marks 600**
### 3rd Semester

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS-301</td>
<td>Advanced Software Engineering</td>
<td>100</td>
</tr>
<tr>
<td>MCS –302</td>
<td>System Software</td>
<td>100</td>
</tr>
<tr>
<td>MCS -303</td>
<td>Data Mining and Warehousing</td>
<td>100</td>
</tr>
<tr>
<td>MCS -304</td>
<td>Concept of Core and Advanced Java</td>
<td>100</td>
</tr>
<tr>
<td>MCS –305</td>
<td>Network Programming</td>
<td>100</td>
</tr>
<tr>
<td>MCS –306P</td>
<td>Programming Laboratory - III</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(Based on Advanced Java and Network Programming)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Marks</strong></td>
<td><strong>600</strong></td>
</tr>
</tbody>
</table>

### 4th Semester

<table>
<thead>
<tr>
<th>Paper</th>
<th>Subject</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCS-401</td>
<td>Advanced Web Technologies using ASP.NET</td>
<td>100</td>
</tr>
<tr>
<td>MCS - 402</td>
<td>Microprocessor and Its Applications</td>
<td>100</td>
</tr>
<tr>
<td>MCS -403</td>
<td>Object Oriented Modeling, Analysis and Design</td>
<td>100</td>
</tr>
<tr>
<td>MCS -404P</td>
<td>Programming Laboratory – IV</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>(Based on Advanced Web Technologies using ASP.NET)</td>
<td></td>
</tr>
<tr>
<td>MCS –405P</td>
<td>Project Work</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td><strong>Total Marks</strong></td>
<td><strong>600</strong></td>
</tr>
</tbody>
</table>
MCS-101: Advanced Data Structures

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Review of algorithm analysis, Binary search trees, balanced binary search trees (red-black trees), B-trees, AVL Trees, 2-3 trees, 2-3-4 trees.

Binary heaps, heap operations, specifications, implementation and applications. Advanced heap structures, priority queue operations, and double-ended priority queues.

Dictionaries, binomial heaps, Fibonacci heaps. Data structures for disjoint sets, tables and table operations.

Amortized analysis, string matching, and graph algorithms.

External data structures - external storage, external files, external sorting searching indexing files, external hashing.

References:
MCS-102: Advanced Computer Architecture

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Paradigms of Computing: Synchronous – Vector/Array, SIMD, Systolic

Asynchronous – MIMD, reduction Paradigm, Hardware taxonomy: Flynn’s classification, Software taxonomy: Kung’s taxonomy, SPMD.

Parallel Computing Models

Parallelism in Uniprocessor Systems: Trends in parallel processing, Basic Uniprocessor Architecture, Parallel Processing Mechanism.

Parallel Computer Structures: Pipeline Computers, Array Computers, Multiprocessor Systems
Architectural Classification Schemes: Multiplicity of Instruction-Data Streams, Serial versus Parallel Processing, Parallelism versus Pipelining

Pipelining: An overlapped Parallelism, Principles of Linear Pipelining, Classification of Pipeline Processors, General Pipelines and Reservation Tables

References

Requirements, planning, & choosing technology: System requirements, traffic sizing characteristics time & delay consideration.

Traffic engineering and capacity planning: Throughput calculation traffic characteristics & source models, traditional traffic engineering, queued data & packet switched traffic modeling, designing for peaks, delay or latency

Network performance modeling- Creating traffic matrix, design tools, components of design tools, types of design projects.

Technology Comparisons- Generic packet switching networks characteristics, private vs. public networking, Business aspects of packet, frame and cell switching services, High speed LAN protocols comparison, Application performance needs, Throughput, burstiness, response time and delay tolerance, selecting service provider, vendor, service levels etc.

Access Network Design- N/W design layers, Access N/W design, access n/w capacity, Backbone n/w design, Backbone segments, backbone capacity, topologies, Tuning the network, securing the network, Design for network security.

Documentation and network management- Documentation, network management, SNMP, RMON

Network Optimization- Network optimization theory: Goals of network optimization, measurements for network optimization, optimization tools, optimization techniques.

References:
MCS-104
Discrete Structures

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Graph Theory: Graph - Directed and undirected Eulerian chains and cycles. Hamiltonian chains and cycles Trees, Chromatic number Connectivity and other graphical parameter. Application.

Combinatorial Mathematics: Basic counting principles Permutations and combinations Inclusion and Exclusion Principle Recurrence relations, generating Function, Application.

Sets and Functions : Sets relations functions operations equivalence relations, relation of partial order partitions binary relations.

Monoids and Groups: Groups Semigroups and monoids Cyclic semigraphs and submonoids, Subgroups and Cosets. Congruence relations in semigroups. Morphisms. Normal subgroups. Structure of Cyclic groups permutation groups, dihedral groups Elementary applications in coding theory.

Rings and Boolean algebra : Rings Subrings morphism of rings ideals and quotient rings. Euclidean domains Integral domains and fields Boolean Algebra direct product morphisms Boolean sub-algebra Boolean Rings Application of Boolean algebra in logic circuits and switching functions.

References :
M.Sc. (Computer Science) (Semester-I)

MCS-105
Soft Computing

Time: 3 Hrs. Max. Marks: 100

Note:

(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Neural Networks

Introduction to neural networks, working of an artificial neuron, linear separability, perceptron, perceptron training algorithm, back propagation algorithm, adalines and madalines.

Supervised and unsupervised learning, counter-propagation networks, adoptive resonance theory, neocognitron and bidirectional associative memory.

Fuzzy Logic

Introduction to fuzzy logic and fuzzy sets, fuzzy relations, fuzzy graphs, fuzzy arithmetic and fuzzy if-then rules.

Applications of fuzzy logic, neuro-fuzzy systems and genetic algorithm.

Probabilistic Reasoning

Introduction to probability theory, conditional probability, Baye’s theorem, random variables and expectations.

Probability distributions, various types of probability distributions like joint distributions, normal distributions etc., fuzzy logic and its relationship with probability theory.

References:
M.Sc. (Computer Science) (Semester-I)

MCS-106 P
Programming Laboratory - I

Time: 3 Hrs.          Max. Marks: 100

Programs based on Advanced Data Structures using C/C++
Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.


Unrestricted Languages: Normal form and Derivation Graph, Automata and their Languages: Finite Automata, Push down Automata and Turing Machines, The Equivalence of the Automata and the appropriate grammars.

Syntax Analysis: Ambiguity and the formal power Series, Formal Properties of LL(k) and L.R.(k) Grammars.

Derivation Languages: Rewriting Systems, Algebraic properties, Canonical Derivations, Context Sensitivity.


References:
MSc. (Computer Science) (Semester-II)

MCS-202: Image Processing

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Background: Introduction to electronic systems for image transmission and storage, computer processing and recognition of pictorial data, overview of practical applications.

Fundamentals: Mathematical and perceptual preliminaries, human visual system model, image signal representation, imaging system specification building image quality, role of computers, image data formats.

Image Processing Techniques: Image enhancement, image restoration, image feature extraction, image data compression and statistical pattern recognition. Hardware architecture for image processing: Distributed processing of image data, role of array processing, standard image processor chips (as example).

Techniques of Colour Image Processing: Colour image signal representation, colour system transformations, extension of processing techniques to colour domain.

Applications of Image Processing: Picture data archival, machine vision, medical image processing.

References:
M.Sc. (Computer Science) (Semester-II)

MCS-203
Design & Analysis of Algorithms

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.
(ii) The student can use only Non-programmable & Non-storage type calculator.

Introduction: Concept of Algorithm, Algorithm Specification, Performance Analysis (Time and space complexities), Asymptotic Notations.

Divide and Conquer: General Method, Binary Search, Finding the Maximum and Minimum, Quick Sort, Selection.
Greedy Method: General Method, Knapsack Problem, Minimum Cost Spanning Trees (Prim’s Algorithm, Kruskal’s Algorithm) and Single-Source Shortest Path.

Backtracking: General Method, 8-Queens Problem, Graph Coloring and Hamiltonian Cycles.

Search and Traversal Technique: Techniques for Binary Trees, Techniques for Graphs.

NP-Hard Problems: Basic Concepts, Nondeterministic Algorithms, Classes \( NP \)-Hard and \( NP \)-Complete, \( NP \)-Hard Graph Problems (CNDP, DHC, TSP and AOG).
References:
Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Specification of Sequential Programs: Pre-post conditions Partial and total correctness, First Order Logic, Abstract data types and data type refinement. Case study of specification languages.


Dijkstra’s weakest pre-condition semantics. Extension of Hoare Logic to deal with Languages involving advanced constructs like procedures with parameters, non-determinism, concurrency, communication and fairness.


References:
M.Sc. (Computer Science) (Semester-II)

MCS-205
Distributed Database Systems

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Introduction to distributed databases, comparison of distributed and centralized systems, DDBMS, global relations, fragment and physical image, types of schemas, methods of fragmentation of a relation, levels of transparency in a distributed system, integrity constraints.

Representation of database operation in form of a query, operation in form of a query, operations on a query, unary and binary tree in a query, converting a global query into fragment query, join and union operations involving a query, aggregate functions, and parametric queries.

Introduction to query optimization, estimation of profiles of algebraic operations, optimization graphs, reduction of relation using semi-join and join operation.

Properties and goals of transaction management, distributed transactions, recovery mechanism in case of transaction failures, log based recovery, check pointing, and communication and site failures in case of a transaction and methods to handle them, serializability and timestamp in distributed databases.

Introduction to distributed deadlocks, local and global wait for graphs, deadlock detection using centralized and hierarchical controllers, prevention of deadlocks, 2 and 3 phase locking and commitment protocols, reliability in commitment and locking protocols, reliability and concurrency control, reliability and removal of inconsistency.

Distributed database administration, authorization and protection in distributed databases, distributed database design, heterogeneous database system.

References:
2. Distributed Database Systems by David Bell, Jame Grimson, Addison-Wesley, 1992.
Implementations based on Design & Analysis of Algorithms and Distributed Database Systems.
M.Sc. (Computer Science) (Semester-III)

MCS-301
Advanced Software Engineering

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.


Software Re-engineering: Introduction Re-engineering, Restructuring and Reverse Engineering, Re-engineering existing systems, Data Re-engineering and migration, Software Reuse and Re-engineering.

Object-Oriented (OO) Measurements: Introduction, Why metrics ?, Classification of OO metrics, Study of Design Metrics- method size, method internals, class size, class inheritance, Method inheritance, class intervals and class externals.


Software Agents: Definition, Applications, Types and Classes, Multi-Agent systems, characteristics & Properties Agents.

References:

1. Software project management, Walker Royce, Pearson Education Inc.
3. Object Oriented Software Metrics, Lorenz and Kidd.
M.Sc. (Computer Science) (Semester-III)

MCS-302
System Software

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.


Assemblers: Overview of assembly process, design of one pass and two assemblers.

Macroprocessors: Macro definition and expansion, concatenation of macro parameters, generations of unique labels, conditional macro expansion, Recursive macro expansion.

Compilers: Phases of compilation process, logical analysis, parsing, storage management optimisation. Incremental compilers, cross compilers, P code compilers.

Loaders and Linkage Editors: Basic loader functions. Relocation, program linking, linkage, editors, dynamic linking bootstrap loaders.

Other System Software: Operating system, DBMS, text editors, Interactive debugging systems.

References:
Data Warehousing:
Concepts of Data Warehousing, Difference between operational database systems and Data warehousing, Need of a separate Data Warehouse. Multidimensional Data Model.

Data Warehousing Architecture:
Steps for Design and Construction of Data-Warehouses, Three-Tier Data Warehouse Architecture, Characteristics of Data Warehousing Data, Data Marts, Types of OLAP Servers: ROLAP, MOLAP, HOLAP; Difference between Online Transaction Processing and Online Analytical Processing

Data Warehouse Implementation:
Efficient Computation of Data Cubes, Indexing OLAP Data, Efficient Processing of OLAP Queries, Metadata Repository, Data Warehouse Back-End Tools and Utilities

Data Mining
Basic Concepts;
Data Mining Techniques: Predictive Modeling, Database Segmentation, Link Analysis, Deviation Detection in details.
Data Mining Query Languages, Applications and Trends in Data Mining.

References:

1. Han, Kamber “Data Mining: Concepts and Techniques” Morgan Kaufmann.
M.Sc. (Computer Science) (Semester-III)

MCS-304
Concept of Core and Advanced Java

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Java Fundamentals: Features, Objects Oriented Basis, Java Virtual Machine

Character Set, Operators, Data Types, Control Structures

Classes, Inheritance, Polymorphism, Packages & Interfaces, Stream IO Classes, Exception Handling

Multithreading: Java Thread model, Thread Priorities, Synchronization, Interthread communication, Suspending, resuming & stopping thread.


Telnet, FTP, Web Server and their implementation in Java.

References:

M.Sc. (Computer Science) (Semester-III)

MCS-305
Network Programming

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Sockets and Socket Address structures, Concept of Zombies, Daemon Processes, Super servers, Concurrent versus Iterative servers, Protocol Independence, Error Handling : Wrapper functions, OSI Model, Unix standards.

TCP Connection establishment & Termination, Port Numbers and Concurrent Servers, Protocol Usage by common Internet Applications.

UDP Communication Semantics, UDP Echo Server, Echo Client working, Protocol Usage by Common Internet Applications.

Sockets Address Structures, Byte ordering & Manipulation Functions, TCP Socket System Calls, TCP Client-Server E.g., I/O Multiplexing, Signal Handling in Concurrent Servers.

Socket Options, Elementary Names Address Conversions, Ipv4 and Ipv6 Interoperability.

References:

Programming Laboratory based on Advanced Java and Network Programming
M.S.C. (Computer Science) (Semester-IV)

MCS-401
Advanced Web Technologies using ASP.NET

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will
be required to attempt any five questions out of these eight questions. All
questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Standard Controls: Display information, Accepting user input, Submitting form data, Displaying
images, Using the panel control, Using the hyperlink control.

Validation Controls: Using the required field validator control, Using the range validator control
using the compare validator control, Using the regular expression validator control, Using the
custom validator control, Using the validation summary controls.

Rich Controls: Accepting file uploads, Displaying a calendar, Displaying advertisement,
Displaying different page views, Displaying a wizard.

Designing Website with Master Pages: Creating master pages, Modifying master page content,
Loading master page dynamically.

SQL Data Source Control: Creating database connections, Executing database commands, Using
ASP.NET parameters with the SQL data source controls, Programmatically executing SQL data
source commands, Cashing database data with the SQL data Source controls.

List Controls: Dropdown list control, Radio button list controls, list box controls, bulleted list
controls, custom list controls.

Grid View Controls: Grid view control fundamentals, Using field with the grid view control,
Working with grid view control events extending the grid view control.

Building Data Access Components with ADO.NET: Connected the data access, Disconnected
data access, Executing a synchronous database commands, Building data base objects with the
.NET framework.


Caching Application Pages and Data: page output caching, partial page caching, data source
 caching, data caching, SQL cache dependences.

Reference:

ASP.NET 3.5: Stephen Walther, Pearson Education, 2005
Introduction: Introduction to Microprocessor, General Architecture of Microcomputer System. Microprocessor Units, Input unit, Output unit, Memory unit and auxiliary storage unit.

Architecture of 8086/8088 Microprocessor: Description of various pins, configuring the 8086/8088 microprocessor for minimum and maximum mode systems, Internal architecture of the 8086/8088 microprocessor, system clock, Bus cycle, Instruction execution sequence.

Memory Interface of 8086/8088 Microprocessor: Address space and data organization, generating memory addresses hardware organization of memory address space, memory bus status code, memory control signals, read/write bus cycles, program and data storage memory, dynamic RAM system.

Input/Output Interface of the 8086/8088 Microprocessor: I/O interface, I/O address space and data transfer, I/O instructions, I/O bus cycles, Output ports, 8255A Programmable Peripheral Interface (PPI), Serial communication interface (USART and UART) – the RS-232 C interface.

Interrupt Interface of 8086/8088 Microprocessor, Types of Interrupt, Interrupt Vector Table (IVT).

References:

M.Sc. (Computer Science) (Semester-IV)

MCS-403
Object Oriented Modeling, Analysis and Design

Time: 3 Hrs.          Max. Marks: 100

Note:
(i) The paper setter is required to set eight questions in all and the candidates will be required to attempt any five questions out of these eight questions. All questions will carry equal marks.

(ii) The student can use only Non-programmable & Non-storage type calculator.

Object Orientation, OMT Methodology, Object and Class, Link and Association Generalization, Aggregation Multiple Inheritance, Packages,

Object Meta Modeling, Metadata and Metamodels, Functional Modeling Pseudocode with the Object navigation Notation, ONN Constructs, Combining ONN Constructs.


System Design:- Devising an Architecture, Database Management Paradigm, Object Model, Elaborating the functional Model, Evaluating the Quality of Design Model.

Reference:

Object Oriented Modeling and Design By Michael Blaha, William Premerlani, and Prentice Hall.
M.Sc. (Computer Science) (Semester-IV)

MCS-404 P
Programming Laboratory – IV

Time: 3 Hrs.          Max. Marks: 100

Programming Laboratory based on Advanced Web Technologies using ASP.NET
The Project is to be prepared based on sum current problems from industry / business / academic domain using some currently available technology / platform.

**Note:** 1. The end semester project work evaluation is to be conducted by following panel of examiners:-
   a. Internal Examiner
   b. External Examiner (to be appointed by GND University, Amritsar)
   c. Head/Head’s nominee (where Head means Head, DCSE, GND University, Amritsar.)
2. The Project are to be submitted as per the common ordinances for P.G. courses under semester system.