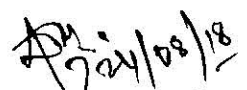# UNIVERSITY OF CALCUTTA

Notification No. CSR/ 82 /18

It is notified for information of all concerned that the Syndicate in its meeting held on 13.07.2018 (vide Item No. 11) approved the Syllabus of M. Sc. Course of Study in Computer and Information Science (1st & 2nd semester) under CBCS in the Post Graduate Departments of the University and in the affiliated Colleges offering Post Graduate Courses under this University, as laid down in the accompanying pamphlet.

The above shall be effective from the academic session 2018-2019.

SENATE HOUSE
KOLKATA-700073
The 24th August, 2018

(Debabrata Manna)
Deputy Registrar(Acting)

M.Sc. (Computer & Information Science) under CBCS
(1st & 2nd Semester)

FIRST SEMESTER			
Code	**Subject**	**Marks**	**Credits**
THEORETICAL			
CISM101	Advanced Computer Architecture	100	4
CISM102	Database Management System	100	4
CISM103	Data Structure	100	4
CISM104	Data Communication	100	4
PRACTICAL			
CISM105(P)	Data Structure Laboratory	100	3
CISM106(P)	Database Laboratory	100	3

SECOND SEMESTER			
Code	**Subject**	**Marks**	**Credits**
THEORETICAL			
CISM201	Computer Network	100	4
CISM202	Design and Analysis of Algorithms	100	4
CISM203	Computer Graphics and Image Processing	100	4
CISM204	Software Engineering	100	4
PRACTICAL			
CISM205(P)	Graphics Laboratory	100	3
CISM206(P)	Software Engineering Laboratory	100	3

First Semester

CISM101: 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

CISM 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.

CISM 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.

CISM 104: DATA COMMUNICATION   Full Marks: 100

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

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

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

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

Transmission Media: Guided and Unguided: Architecture, Transmission characteristics and application

Switched Networks: Circuit switching and Packet Switching, Circuit Switching principle and the Modems used in a Telephone network, Connection oriented and Connection-less approach in packet switching network

Information Theory: Measure of Information, Entropy, Discrete and Continious channel, Shannon's encoding algorithms

CISM 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.

CISM 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

CISM 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.

CISM 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.

CISM 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..

Introduction to 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.
Image Transforms:-
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:-

Image understanding and recognition:-
Matching by templates, classifiers models (statistical and neural network base Recognition
techniques
Information Theory & compression techniques:-
Basics, Entropy and data compression, lossless and lossy, various error-free compression techniques, lossy compression techniques, Image compression standards.
Image segmentation:-
Edge detection, line detection, curve detection, Edge linking and boundary extraction, boundary
representation, region representation and segmentation, morphology – dilation.

CISM 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.

Practical

CISM 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.

CISM 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