ANNEXURE-II

Syllabus of B.Tech, M.Sc. & M.Tech

NOTIFICATION NO.: CSR/84/07 (FOR 1ST-2ND)

NOTIFICATION NO.: CSR/30/08 (FOR 3RD-6TH)

REVISED COURSE STRUCTURE

B.Tech. (Computer Science & Engineering)

(6 Semesters)

FIRST SEMESTER					
THEORETICAL		**L**	**T**	**P**	**C**
CSEB101	COMPUTATIONAL MATHEMATICS –I	2	1	0	3
CSEB102	BASIC ELECTRONICS	2	0	0	2
CSEB103	DATA STRUCTURE	3	1	0	4
CSEB104	COMMUNICATION SKILL	2	0	0	2
CSEB105	SYSTEMS PROGRAMMING	2	1	0	3
CSEB106	DIGITAL LOGIC	2	1	0	3
PRACTICAL					
CSEB107(P)	**GROUP A** : ENGINEERING DRAWING & WORKSHOP	0	0	3	2
CSEB107(P)	**GROUP B** : SYSTEM PROGRAMMING LABORATORY	0	0	2	2
CSEB108(P)	BASIC ELECTRONICS LABORATORY	0	0	3	2
CSEB109(P)	DATA STRUCTURE LABORATORY	0	0	3	2
CSEB110(P)	DIGITAL LOGIC LABORATORY	0	0	3	2
					27
SECOND SEMESTER					
THEORETICAL					
CSEB201	COMPUTATIONAL MATHEMATICS – II	2	1	0	3
CSEB202	COMPUTER ORGANIZATION	2	1	0	3
CSEB203	DATA COMMUNICATIONS	2	1	0	3
CSEB204	OPERATING SYSTEMS	3	1	0	4
CSEB205	MICROPROCESSOR & MICROCONTROLLER	2	1	0	3
CSEB206	FORMAL LANGUAGE & AUTOMATA THEORY	2	1	0	3
PRACTICAL					
CSEB207(P)	OPERATING SYSTEM LABORATORY	0	0	3	2
CSEB208(P)	MICROPROCESSOR LABORATORY	0	0	3	2
CSEB209(P)	DATA COMMUNICATIONS LABORATORY	0	0	3	2
CSEB210(P)	SOFTWARE LABORATORY	0	0	3	2
					27
THIRD SEMESTER					
THEORETICAL					
CSEB301	SOFTWARE ENGINEERING –I	3	1	0	4
CSEB302	COMPUTER ARCHITECTURE	3	1	0	4
CSEB303	COMPILER DESIGN	2	1	0	3
CSEB304	DESIGN & ANALYSIS OF ALGORITHMS	3	1	0	4
CSEB305	DATABASE MANAGEMENT SYSTEMS	3	1	0	4
CSEB306	OBJECT ORIENTED SYSTEM	2	1	0	3
PRACTICAL					
CSEB307(P)	SOFTWARE ENGINEERING LABORATORY	0	0	3	2
CSEB308(P)	SYSTEM DESIGN LABORATORY	0	0	3	2
CSEB309(P)	OBJECT ORIENTED SYSTEM LABORATORY	0	0	3	2
CSEB310(P)	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	3	2
					30

FOURTH SEMESTER					
THEORETICAL					
CSEB401	SOFTWARE ENGINEERING II	3	1	0	4
CSEB402	COMPUTER NETWORKS	3	1	0	4
CSEB403	ARTIFICIAL INTELLIGENCE	2	1	0	3
CSEB404	OPTIMIZATION TECHNIQUES	2	1	0	3
CSEB405	COMPUTER GRAPHICS	3	0	0	3
CSEB406	ECONOMICS	2	0	0	2
PRACTICAL					
CSEB407(P)	SOFTWARE ENGINEERING LABORATORY – II	0	0	3	2
CSEB408(P)	COMPUTER NETWORKS LABORATORY	0	0	3	2
CSEB409(P)	ARTIFICIAL INTELLIGENCE LABORATORY	0	0	3	2
CSEB410(P)	COMPUTER GRAPHICS LABORATORY	0	0	3	2
					27
FIFTH SEMESTER					
THEORETICAL					
CSEB501	BUSINESS PROCESS LOGIC	2	0	0	2
CSEB502	MULTIMEDIA TECHNOLOGY	2	0	0	2
CSEB503	INTERNET TECHNOLOGY	3	0	0	3
CSEB504	VLSI TECHNOLOGY	3	1	0	4
CSEB505	SOFT COMPUTING	3	1	0	4
CSEB506	ELECTIVE –I	3	0	0	3
PRACTICAL					
CSEB507(P)	MULTIMEDIA TECHNOLOGY LABORATORY	0	0	3	2
CSEB508(P)	INTERNET TECHNOLOGY LABORATORY	0	0	6	4
CSEB509(P)	SOFT COMPUTING LABORATORY	0	0	3	2
CSEB510(P)	TERM PAPER –I	0	2	0	2
					26
SIXTH SEMESTER					
THEORETICAL					
CSEB601	INDUSTRIAL MANAGEMENT	2	0	0	2
CSEB602	DIGITAL SIGNAL PROCESSING	3	1	0	4
CSEB603	ELECTIVE-II	3	0	0	3
CSEB604	ELECTIVE-III	3	0	0	3
PRACTICAL					
CSEB605(P)	TERM PAPER-II	0	2	0	2
CSEB606(P)	GENERAL VIVA	0	2	0	2
CSEB607(P)	PROJECT WORK	0	0	16	8
					24

Set of Elective Papers: (B.Tech.)

Elective-I:

1. Distributed Systems
2. Cryptography
3. Fuzzy Systems
4. Principles of Programming Language

Elective-II:

1. Embedded System
2. Coding & Information Theory
3. Neural Networks
4. Modeling and Simulation

Elective –III:

1. Parallel Computing
2. Cognitive Computing
3. Information Security
4. Computational Geometry

REGULATIONS 3-YEAR (6-SEMESTER) B.TECH.
COMPUTER SCIENCE & ENGINEERING
UNIVERSITY OF CALCUTTA

<table>
<tr><td>1.</td><td>The minimum qualification for 3-year B. Tech. Course in Computer Science & Engineering of Calcutta University is a 3-year B.Sc. degree (with Honours in Physics / Mathematics / Statistics / Computer Science) of Calcutta University or an equivalent degree.</td></tr>
<tr><td>2.</td><td>The duration of the Course will be divided into 6 Semesters each of 6 months' duration and the total credit of the examination for the B.Tech. degree in Computer Science and Engineering would be as follows:
<table>
<tr><th>Examination</th><th>Duration</th><th>Total Credits</th></tr>
<tr><td>B.Tech. Semester-I</td><td>6 months</td><td>27</td></tr>
<tr><td>B.Tech. Semester-II</td><td>6 months</td><td>27</td></tr>
<tr><td>B.Tech. Semester-III</td><td>6 months</td><td>30</td></tr>
<tr><td>B.Tech. Semester-IV</td><td>6 months</td><td>27</td></tr>
<tr><td>B.Tech. Semester-V</td><td>6 months</td><td>27</td></tr>
<tr><td>B.Tech. Semester-VI</td><td>6 months</td><td>24</td></tr>
</table>
The schedule of papers and distribution of credits for the B.Tech. Semesters I, II, III, IV, V, & VI examinations in Computer Science and Engineering is given in Appendix-I.</td></tr>
<tr><td>3.</td><td>One credit theory paper means three lecture hours or two lecture-hours and one tutorial-hour or zero tutorial-hour per week while one practical paper means at least three compact hours in the laboratory per week. For project-work, there will be 16 contact-hours per week and for general, Term Paper-I and Term Paper-II, no contract hours will be provided.</td></tr>
<tr><td>4.</td><td>Each Theoretical/Practical paper and Tutorial will carry "CREDIT" according to the number of periods devoted per week as indicated in the following table.
<table>
<tr><th>Item</th><th>No. of periods/week</th><th>Credit assigned</th></tr>
<tr><td>Theoretical</td><td>1</td><td>1</td></tr>
<tr><td>Tutorial</td><td>1</td><td>1</td></tr>
<tr><td>Practical</td><td>3</td><td>2</td></tr>
</table></td></tr>
<tr><td>5.</td><td>The number of lecture periods/week devoted to each Compulsory/Elective paper and Tutorial, and the Credit thereof will be determined from the Course Structure in conjunction with the Table in Item 4.</td></tr>
<tr><td>6.</td><td>The total credit to be earned to complete the B. Tech. course will be 161.</td></tr>
<tr><td>7.</td><td>The examinations for the B. Tech. Course shall be held in 6 parts. At the end of each Semester, an examination of the Papers covered in that Semester will be held. This examination will be referred to as the B.Tech. Semester Examination. 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. The schedule of a Semester examination and the credit to be earned will be according to the course structure given below. A student earns the credit assigned to a Theoretical/Practical paper or to a Tutorial or to Term paper or to Project Work or to General Viva Voce, when he/she satisfies the performance criteria stated below in Item 9.</td></tr>
<tr><td>8.</td><td>(a) Examination of a Theoretical paper carrying of 3-hour duration.
(b) Paper Setters and Examiners for Theoretical papers will be appointed from a Board of Examiners consisting of a11 the faculty members.
(c) Evaluation of performance in a Practical paper will be based on Sessional work in that paper and an end-semester viva voce. On completion of all the experiments in a Practical paper, a student will be given marks, out of notional full marks, according to the following divisions:
1. 50% for experiments performed in the lab - the Sessional work to be evaluated by the Teacher under whom the laboratory will be assigned.
2. 40% for viva voce on the experiments to be conducted by a Board consisting of the Faculty members of the Department and/or External Examiner(s).
3. 10% for Lab Report to be evaluated by the Viva Voce Board.
(d) Evaluation of performance in a Tutorial will be through assignments handed out by the Teacher concerned.</td></tr>
</table>

	(e) Evaluation of the performance in a Term paper will be evaluated by a board of examiners.
9.	(a) The performance of a student in a paper (Theoretical/ Practical), Tutorial, Project work and General Viva Voce will be evaluated in terms of '**Grades**', and '**Grade Points**' earned by the student. The equivalence between 'Grade', 'Grade Point' and the Percent Marks (out of notional full marks) is tabulated below.

Percentage of Marks	Grade	Explanation	Grade-Point(P)
>=90	O	Outstanding	10
>=80 - <90	A	Excellent	9
>=70 - <80	B	Very Good	8
>=60 - <70	C	Good	7
>=50 - <60	D	Satisfactory	6
>=40 - <50	E	Fair	5
<40	F	Fail or Absent in any end-paper	0

Grade 'F' also implies failure to earn the corresponding credit. Grades higher than 'F' and Grade Points ≥5 indicate successful clearing of a unit that will earn the student the corresponding Grade Point (P) and the Credit (C) assigned to that unit.

(b) The overall performance of a candidate in a particular (j th, j=1,2,3,4,5,6) Semester examination, who earns all the credit of that Semester in one chance, will be assessed by the **Semester Grade Point Average (SGPA) 'S' to** be computed from

$$SGPA = \frac{\sum_i P_i^{(j)} C_i^{(j)}}{\sum_i C_i^{(j)}} \quad \textbf{(I)}$$

where the summations are over the Grade Points and Credit earned in the examination of the jth Semester. Cj may be the credit associated with a Theoretical or a Tutorial or a Practical paper or Project Work or General Viva Voce and Pi would be the corresponding Grade Point earned. $\sum_i C_i^{(j)}$ is the total credit of the jth Semester and $\sum_i P_i^{(j)} C_i^{(j)}$ is the weighted sum of the Grade Points earned in the jth Semester.

(c) On completion of the B. Tech. course (when 161 credits have been earned as per regulations), the combined result of a candidate will be shown through the **Consolidated Grade Point Average(CGPA).** CGPA will be computed from

$$CGPA = \frac{\sum_{j=1}^{6} \sum_i P_i^{(j)} C_i^{(j)}}{\sum_{j=1}^{6} \sum_i C_i^{(j)}} = \frac{\sum_{j=1}^{6} \sum_i P_i^{(j)} C_i^{(j)}}{161} \quad \textbf{(II)}$$

for a student who earns the total credit of the course in single chance (6 consecutive semesters without any back credit); and from

$$CGPA = \frac{\sum_K P_K C_K}{\sum_K C_K} \quad \textbf{(III)}$$

for a student who completes the B.Tech. course in 6 Semesters but with back credit or in more than 6 Semesters as per regulations, where P_K is the Grade Point earned in a unit carrying C_K credit and the summation is over all the Theoretical/Practical papers, Tutorials, Project Works and General Viva Voce of the B. Tech. course.

10.	(a) Each student will be allotted the topic of the Project Work at the beginning of the 5th Semester. He/She will have to carry out the Project Work under i) the supervision of a Faculty member of the Department, Or ii) the joint supervision of more than one Faculty members of the Department, Or iii) the joint supervision of one or more Faculty members of the Department and an External Supervisor belonging to another institution/organization. (b) At the end of the 6th Semester, a student will have to submit, through the respective Supervisor(s), a dissertation on the Project Work (Final) carrying 6 credit to a Board of Examiners consisting of the

	Faculty members of the Department, External Supervisor(s) and External Examiner(s). (c) For Project Work, 50% of the notional full marks will be set aside for the Sessional Works and 50% for the Viva Voce and the Report. (d) At the end of the 6th Semester, a student will have to appear at a General Viva Voce carrying 2 credit to be conducted by Boards of Examiners consisting of the Faculty members of the Department and External Examiner(s).
11.	(a) The 2nd to 6th Semester classes will begin immediately after the completion of the previous Semester Examinations. (b) A student who fails to earn the total credit of a Semester (1st to 4th) in the Semester examination, will be allowed to continue in the next semester, provided he/she earns at least 15 credit in the Semester examination. (c) A student who earns at least 15 credit in the 5-th-Semester examination will be allowed to continue in the 6-th Semester. (d) If a student earns less than 15 credit in a Semester examination (Semester 1-5), he/she will be deemed to have failed in that Semester examination. (e) In order to pass in the 6-th Semester examination, a student will have to earn the total 10 credit of the Semester in a single chance. (f) The due-to-earn or 'back' credit of a Semester will have to be earned during the examination of the next Semester. The candidate will have two such additional chances to earn the due credit. (g) For a student who fails to earn the total credit of a Semester but gets promoted to the next Semester by virtue of earning at least 15 credit (clauses 1 l(b), (c)), it would be necessary that the total 'back' credit carried by the student at any stage does not exceed 15. If at the end of a Semester, the accumulated back credit of a student exceeds 15, the student will not be permitted to pursue the course further. (h) A student who fails in a Semester examination (clause 11(d)) will not be allowed to continue in the next Semester and will have to revert to the same Semester in the next academic session. i. In order to complete the B.Tech. course, a student will have to utilize all the allowed chances within 4 years or 4 consecutive academic sessions from the date of the first admission. ii. A student who fails to earn the total credit of the B.Tech. course within the allowed chances, will not be permitted to continue the course.
12.	At the end of each Semester examination, the University will publish lists of successful candidates as per this regulation.
13.	In order to be able to appear in a Semester examination, a candidate shall have to pursue a regular course of studies in the Semester and attend at least 65% of the total Theoretical (including Tutorial) and total Practical classes (including the supporting theoretical classes, if any) separately in the Semester. A candidate who fails to earn the total credit of a Semester but gets promoted to the next Semester by virtue of earning at least 20 credit (clauses 1 l(b), (c)), will not have to attend classes in the paper(s) corresponding to the back credit.

APPENDIX-I

REVISED (DETAILED) SYLLABUS FOR 3-YR. B.TECH. 6 SEMESTERS EACH OF 6 MONTHS DURATION IN COMPUTER SCIENCE & ENGINEERING --- UNIVERSITY OF CALCUTTA

NOTIFICATION NO.: CSR/84/07 (FOR 1ST- 2ND)

B.Tech. 1st Semester

THEORETICAL

CSEB 101: COMPUTATIONAL MATHEMATICS – I (2L + 1T + 0P) (3 Cr) Full Marks – 100

Set Theory: Set and subsets, Empty set and power set, Equality of sets, operations on sets Cartesian Product of sets, Relations ,Domain and Range of a Relation, Equivalence relation, Equivalence classes, Functions, Special type of Functions (Injective, Surjective and Bijective), Identity function, composite Functions, Invertible Functions, Groups, Semi Group and Monoid, Subgroup, More characterizations of a Group, Rings, Some Special classes of Ring, Subring, Algebra of Subrings, Ideals and quotient rings, Properties of integral domains, Fields, Field of Fractions.
Combinatorics: Mathematical induction, Recurrence Relations, The Characteristic Polynomial, Generating Functions, The Principle of Inclusion-Exclusion, The Addition and Multiplication Rules, The Pigeon-Hole Principle, Permutations and Combinations.
Mathematical Logic: Propositions, Connectives, Truth Table, Propositional Equivalence, Logical Equivalence, Tautologies, Predicates and Quantifiers, Negations.
Linear Algebra*:* Characteristic Equations, Eigen Values and Eigen Vectors, Properties of Eigen Values, Cayley-Hamilton Theorem, Reduction to Diagonal form, Canonical forms.

CSEB102: BASIC ELECTRONICS (2L + 0T + 0P) (2Cr) Full Marks – 100

Physics of Semiconductor Devices: Conductivity, mobility, carrier lifetime, E-B diagram, Fermi level, effective mass, classification of semiconductors,
P-N junction: Structure, operations and V-I characteristics built-in potential, forward and reverse biasing, different junction capacitances, different types of breakdown-Avalanche breakdown and Zener breakdown.
Bipolar Junction Transistors (BJTs): Structures, mode of operation, different methods of biasing, h-parameter analysis of transistors, amplifiers and oscillators circuit using BJTs.
Field Effect Transistors (FETs): Structures of JFET and MOSFET, V-I characteristics, equivalent circuits, CMOS, MOS capacitors,
Operational Amplifiers (Op-Amp): Basic building block, equivalent circuit, modes of operation, use of op-amp in inverting and non-invertible modes. gain-frequency response, use of op-amp in analog computation, 555 timer circuit and Schmitt trigger using op-amp, Design of astable and monostable multivibrator.
Multivibrator circuits: Monostable, bistable and astable and their applications.
Power Supply: Basic building block of a power supply, Regulated fixed and variable voltage supply, UPS, SMPS. Design of dc regulated power supply using op-amp
Electronic Measuring Equipment: Analog & digital multimeters, Cathode Ray Oscilloscope (CRO), signal generators.

CSEB 103: DATA STRUCTURE (3L + 1T + 0P) (3 Cr) Full Marks – 100

Data Structure and algorithm preliminaries: Definitions; Time and Space analysis of Algorithms; Time and space trade-off, Recursion, ADT
Array: Definitions of Arrays and Lists; Stacks; Queues; Strings; Row/Column major representation of Arrays; Sparse matrix.
Linked List: Singly linked list; circular linked list; doubly linked list, operations on linked list.
Stack: Push; Pop; Applications of Stack; stack representation using array and linked list.
Queue: Representation using array and linked list; Insertion and deletion operations; circular queue; priority queue.
Graph Algorithms: Representation and Traversal, Basic Algorithms Minimal Spanning Tree, Shortest Path, All pairs Shortest Path, Transitive Closer
Searching and Sorting Methods: Various Searching and Sorting algorithms with complexity analysis.
Tree: Definition; Generalised tree representation; Binary tree - definitions and properties; binary tree traversal algorithms with and without recursion.
Binary Search Tree - creation, insertion and deletion operations, Threaded tree (One way and Two way); AVL tree balancing; B-tree; Application of trees.

CSEB 104: COMMUNICATION SKILL (2L + 0T + 0P) (2 Cr) Full Marks – 100

Basic Skills Development using English as medium; Listening skill: narrations and descriptions, taking notes, appropriate response. Speaking: Intelligent and Fluent way of making statements, reporting events. Reading texts. Writing sentences. Creative articles. Translation skills. Preparation of Presentation materials.
Reference to modern day technological terminologies. Grammar: Familiarity with different types of sentences
Preposition and their uses. Familiarity with Tenses Familiarity with degrees of objectives – Positive, Comparative, Superlative. Familiarity with Common English idioms and everyday expressions. Common English group verbs and everyday expressions. Agreement of the subject with the verb. Salutations: Good Morning, Good day, Good Evening etc. and Modes of Address: e.g., Sir, Madam, Your Excellency, Tour Honour, Your Grace etc. Expression of a composite subject in one word e.g., An 'Entrepreneur' is a person who starts or organizes some 'Business'. Correction of sentences. Conversation with –Bus driver, taxi drivers etc. At a telephone booth, railway station, airport, etc. With a shop-keeper or a Chemist. With a doctor or with officials in a Bank. Mock interview for a Job. Mock Interview. Overall Revision.

CSEB 105: SYSTEMS PROGRAMMING (2L + 1T + 0P) (3 Cr) Full Marks – 100

System Hardware and Software: interaction
Language Issues: Types and levels of languages; Interpretation and Translation; Translation of Low Level Languages and High Level Languages.: Characteristics and differences
Assemblers: Algorithm; Pseudo operations; Expressions.
Debuggers, Word Processors, Editors.
Tools: LEX and YACC/JavaCC
Macro Processors; Recursive and nested macros.
Linking and Loading
Compilers: introduction.

CSEB 106: DIGITAL LOGIC (2L + 1T + 0P) (3 Cr) Full Marks – 100

Switching algebra and its applications, Boolean algebra vs. Switching algebra, Switching functions, Gate concepts, Minimization of switching functions, Universal logic module.
Synthesis and Analysis of Logic Circuits, Two level and multilevel realizations, Propagation delay, Noise margin and Power dissipation, Switch and Inverter as functionally complete elements, Gates. Registers and Processor level design of Digital Systems, Structure and behavior components, Finite state model for Sequential circuits. Flip Flops, Synthesis of Sequential machines, Counters and Registers, Decompositions,

Unitness and Symmetric Boolean functions. Threshold functions, Logic families, Static and Dynamic memories, Flash memories, PLA and PROM.

PRACTICAL

CSEB 107(P) GR-A: ENGINEERING DRAWING AND WORKSHOP PRACTICE
(0L + 0T + 3P) (2 Cr) Full Marks-50

Working on different machines. To be based on assignments. Use of AutoCAD.

CSEB 107(P) GR-B: SYSTEM PROGRAMMING LAB (0L + 0T +2P) (2 Cr) Full Marks-50

Installation & Configuration of Operating Systems.
Design and implementation of Assemblers.
Text Editors, linkers
Use of Lex, YACC, JavaCC
Lexical Analyzers
Parsers

CSEB 108(P): BASIC ELECTRONICS LAB (0L + 0T + 3P) (3 Cr) Full Marks – 100

Clipping and Clamping circuits with diodes and transistors
Use of op amp as:
Inverting amplifier
Non-inverting amplifier
AC amplifier
Integrator and frequency response (Bode* Amplitude plot)
Elimination determination of frequency response
Regulated DC Voltage and current sources using op amps- regulation characteristics with load.
Study of 555 timer chips and testing of
Astable multi-vibrator (Clock generator) (ii) monostable multi-vibrator.

CSEB 109: DATA STRUCTURE LAB (0L + 0T + 3P) (2 Cr) Full Marks – 100

Programming with C: Fundamentals of C programming, 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.
Separate class/tutorial hours should be included for teaching.

CSEB 110: DIGITAL LAB (0L + 0T + 3P) (2 Cr) Full Marks – 100

Prerequisites
Documentations Standards, Transfers characteristics, Universal Gate set operations, concept of propagation delay, Fan in, Fan out, Noise margin.
Digital System
Combinational Logic Design Practices
Decoder, Cascading, VHDL, Seven Segment Decoder.
Encoders – priority encoder and keyboard displays, encoders in VHDL.
Three State devices – standard SSI and MSI. Buffers 74125, 74126 and 74541.

Multiplexers – standard MSI Multiplexer, expanding Multiplexer, MUX as Universal logic module, VHDL description.
Exclusive OR gates and Priority circuits, the 74280 9-bit priority generator.
Comparator Iterative circuits standard MSI comparator.
Adder, Subtractor, and ALU.
Multiplication by repeated addition shift and all multiplication.
Sequential Logic Design Examples
Latches and Flip flops.
Counters universal 74193.
Shift Registers universal 74194
Simulation: Multisym, PSpice and other simulator available are to be used for chip level simulation.

B.Tech. 2nd Semester

THEORETICAL

CSEB 201: COMPUTATIONAL MATHEMATICS II (2L + 1T + 0P) (3 Cr) Full Marks – 100

Probability and Statistics- Mean, Median, Mode, Standard deviation, Sample Space & Events, Conditional Probabilities and Expectations, Independent Events, Bayes' Formula, Discrete and Continuous Random Variables, Expectation of a Random Variable (Both Discrete & Continuous case), Independent Random Variables, Correlation and Regression, Distribution (Binomial, Poisson, Normal, Exponential, Uniform, Gamma, Geometric), Limit Theorem, Strong Law of large Numbers, Central Limit Theorem, Stochastic Processes, Markov (Chains & Processes), Poisson Process, Counting Processes, Birth & Death Process, Queuing Theory and application to Performance evaluation and modeling.
Transforms- Fourier Transforms, Laplace Transforms, Z Transform.
Numerical Methods- Errors, Solution of Algebraic and Transcendental equations: Solution of Linear Simultaneous Equations, Numerical Integration, Interpolation, Solution of Differential Equations, Solution of Partial Differential Equations

CSEB202: COMPUTER ORGANIZATION (2L + 1T +0P) (3 Cr) Full Marks – 100

CPU Organization: Fundamentals, Fixed and Floating point numbers, Instruction Set formats, modes, types and programming. Datapath Design Fixed and Floating point arithmetic. ALU pipeline programming. Control Design .Hardware control, Microprogramed control and Pipeline control. Memory Organization: Technology, RAM and SAM. Multilevel Memory, Virtual memory and Cache memory. System Organization: Bus control, Arbitration., Program I/O, DMA and Interrupt I/O programming

CSEB 203: DATA COMMUNICATION (2L + 1T + 0P) (3 Cr) Full Marks – 100

Introduction to communication systems, Data, signal and Transmission: Analog and Digital, Transmission modes, Transmission Impairments, Performance criteria of a communication system Goals of computer Network, Networks: Classification, Components and Topology, Layered architecture of a Network software, OSI and TCP/IP model
Encoding: Line coding and Block coding, Error detection codes, Modulation: Digital to Analog and Analog to Analog conversion techniques
Bandwidth utilization techniques: Multiplexing: Frequency division, Time division and Wave division multiplexing, Spread spectrum concepts
Transmission Media: Guided and Unguided: Architecture, Transmission characteristics and application Switched Networks: Circuit switching and Packet Switching, Circuit Switching principle and the Modems used in a Telephone network, Connection oriented and Connection-less approach in packet switching network Information Theory: Measure of Information, Entropy, Discrete and Continuous channel, Shannon's encoding algorithms

CSEB 204: OPERATING SYSTEMS (3L+ 1T + 0P) (4Cr) Full Marks – 100

Introduction- Role of OS, Evolution of OS, Structural Overview, Concept of Process, Threads, Process Control Block, Process Management & Scheduling, Hardware Requirements, Protection, Content switching, Privileged mode
Process Synchronization, Critical Section Problem, Hardware Mechanism for synchronization, Semaphores and Mutex objects, Classical Problems (producer consumer, dining philosophers etc.),
Deadlocks and Detection, Prevention and Avoidance Mechanisms.
Memory Management, Virtual Memory - Dynamic Linking, Segmentation, Paging Protection, Demand paging, Page Replacement Polices-Thrashing, Pre-paging and other issues, Swapping
File and Directories - File Organization in directories, File attributes, Operation on file, Directory attributes and operations on directories, File protections.
File System Implementation, Concepts of mounting, Allocation mechanisms, Contiguous, Linked and indexed allocations. Free Space management.
Device Drivers - Storage management, Disk Scheduling, Disk Management
Security and Protection Mechanism - Password based protection, Encryption and Decryption, System Threats – Viruses, Wormholes, Trojan horses etc.

CSEB 205: MICROPROCESSOR & MICROCONTROLLER (2L + 1T + 0P) (3 Cr) Full Marks – 100

Introduction to microprocessors and microcomputers: Function of microprocessors- architecture of 8086- pin configuration and functions – tristate bus concept - generation of control signals - bus timings – de-multiplexing – flags - memory decoding - interfacing of RAM and EPROM - I/O addressing - I/O mapped I/O - and memory mapped I/O schemes - instruction execution - fetch/execute cycle - instruction timings and operation status.
Memory organization - program memory - data memory - direct & indirect addressing area - Program status word - register banks - addressing modes - instruction set – arithmetic - logical and data transfer instructions - Boolean instructions - program branching instructions - Programming examples.
Machine cycles – interrupts - interrupt sources - interrupt enable register - interrupt priority - interrupt control system - interrupt handling - single step operation - port bit latches and buffers - port structures and operation - accessing external memory – programming examples.
Timer0 & Timer1 - TMOD SFR - mode0, mode1, mode2, mode3 - TCON SFR - serial interface - SCON SFR - mode0, mode1, mode2, mode3- block schematics- baud rates- power on reset circuit- ONCE mode- on chip oscillator- external program & data memory timing diagrams- I/O port timings – programming examples.
Microcontroller 8051 – Architecture - pin configurations - internal block schematic - PORT0, PORT1, PORT2, PORT3, idle & power down mode - power control register - program protection modes - flash programming & verification. I/O interfaces with microcontroller, Real Time Control Issues, Embedded Systems, Programming Examples

CSEB 206: FORMAL LANGUAGES AND AUTOMATA THEORY (2L +1T+0P) (3Cr) Full Marks – 100

Introduction and Review of Finite State Machines: Deterministic, Nondeterministic M/cs, Minimization of FSM, Inverse FSM.
Finite Automata (FA) & Regular Expression: Definition, Deterministic & Nondeterministic FA, FA null string, Regular Expression, two-way FA, Linear Bound Automata, Applications
Regular Set: Definition, Properties, Pumping Lemma, Decision Algorithm, Minimization
Grammar: Introduction, Definition, 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, Acceptance of Strings, Alternative Forms of PDA

Turing Machine: Introduction, Turing Machine Model, Computable Languages & Function, Church's Hypothesis
Undecidability: Introduction, Recursive and Recursively Enumerable Languages, Recursive Function Theory and its Application

PRACTICAL

CSEB 207(P): OPERATING SYSTEM LAB (0L + 0T + 3P) (3 Cr) Full Marks – 100

UNIX: -
File System, Utilities, Editor, Process, Communication, Filters, Shell Programming, System Administration.
C-Programming using UNIX System Calls relating File Structure, Process, Inter Process Communication.
DOS and Windows: Commands, Utilities and Tools.
Familiarities with SUN-Solaris: Commands and Utilities.

CSEB 208(P): MICROPROCESSOR LAB (0L + 0T + 3P) (3 Cr) Full Marks – 100

Assembly language programming to explore instruction set of 8085 / 8086
Design and implementation of basic interface circuits
Programming of microcontroller 8051
Interfacing with 8051

CSEB 209(P): DATA COMMUNICATION LAB (0L + 0T + 3P) (3 Cr) Full Marks – 100
Familiarity with Networking equipment, Setting up and configuration of a Network;
Experiments on communication- Encoding, modulation, multiplexing.

CSEB 210(P): SOFTWARE LABORATORY (0L + 0T + 3P) (3 Cr) Full Marks – 100

Scripting and Front-end Languages
Familiarity with Editing, Presentation, Multimedia, Desktop Publishing Software with suitable application
System security concepts, configuration and implementation

NOTIFICATION NO.: CSR/30/08

B.Tech. 3rd Semester

THEORETICAL

CSEB301: SOFTWARE ENGINEERING I (Full Marks – 100)

Software Engineering- Objectives, Definitions. Software Process Models- Waterfall, Prototyping, RAD; Evolutionary Models: Incremental, Spiral. Structured Analysis, Data Flow Diagrams -Physical and Logical DFDs. Data Modelling- Entity Relationships. Software Requirements Specification – Characteristics, Components, SRS Document. Design Aspects- Structure Charts. Transform and Transaction Analysis. Module Relationship: Coupling and Cohesion. Structured Programming. Coding Standards. Software Testing – Whitebox and Blackbox testing Module Testing, Integration Testing. System Testing. Program Verification. Software Project Planning- Effort Estimation models-COCOMO, Project Scheduling. Software Maintenance. CASE tools.

CSEB302: COMPUTER ARCHITECTURE (Full Marks – 100)

Introduction: Computer Architecture & Organization, Basic Parallel Processing Architecture, Taxonomy-SISD, MISD, SIMD, MIMD Structures. Serial, Parallel & Concurrent Computation, CISC versus RISC, Structure of Instruction Sets and Desirable Attributes. Pipelining: Basic Concepts of Pipelining, Instruction Pipeline, Hazards, Reservation Tables, Collision, Latency, Dynamic Pipeline, Vector Processing and Vector Processors. Memory system: Cache Memory & Virtual Memory: Structure, Analysis and Design. I/O Systems: Design Issues, Performance Measures Multiprocessor Architecture: Loosely Coupled & Tightly Coupled Systems, Concurrency & Synchronization, Scalability, Models of Consistency, Application of SIMD Structures Interconnection Network: Definition, Types of Interconnection Networks, Examples of Baseline, Benes, Shuffle-Exchange, Omega, Cube. Comparison and Application. Systolic Architecture: Mapping of Algorithm to Array Structures, Systolic Processors: Mapping, Design and Optimization, Wave front Array Processor Data Flow Architecture: Data Flow Graphs, Petri Nets, Static & Dynamic DFA Programming Environment: Different Models, Languages, Compilers, Dependence Analysis, Message Passing, Program Mapping to Multiprocessors, Synchronization. Symbolic Architecture: Basic features. Function Based Computing. Logic Based Computing. Stack Architecture: Basic Features, B5700 & HP30U0 Processor Characteristics Case Study

CSEB 303: Compiler Design (Full Marks – 100)

Introduction; Compiler, Structure, Analysis-synthesis model of Compilation, Various phases of a Compiler and Overview.
Lexical Analysis: Regular language, finite automata, regular expression, Scanner generator, tokens, Difficulties in lexical analysis, Error reporting, Implementation, Regular definition, Transition diagrams, LEX. Syntax analysis.
Parsing: Top down parsing, Recursive descent parsing, Transformation on the grammars, Predictive parsing, Bottom up parsing, LR parsers, SLR, LALR, LR, YACC.
Syntax Directed Definitions: Inherited and Synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes.
Type Checking: Type system, Type expressions, Structural and name equivalence of types, Type conversion, Overloaded functions and operators, Polymorphic functions, Type checking in OO languages.
Run Time Organizations: Storage organization, Activation tree, Activation record, Parameter passing, Symbol Table, Dynamic Storage allocation, Garbage collection, Intermediate code generation.
Code Generation and Instruction Selection: Issues, Basic blocks and flow graphs, Register allocation, Code generation, DAG representation of programs, Code generation from DAG.
Code Optimization: Introduction to Code optimization, Data-flow analysis, Code improvement, Local optimization, Global optimization, Loop optimization, Peephole optimization, Architecture dependent code improvement. Register allocation and target code generation.

CSEB 304: DESIGN & ANALYSIS OF ALGORITHMS (Full Marks – 100)

Review: Mathematical Induction, Probability, Recurrence Relations.
Algorithms: Efficiency, Analysis, Time-complexity. Case-complexities. Order and their properties. Use of limits. Divide and Conquer: Quicksort, Strassen's Matrix Multiplication Algorithm, Arithmetic with Large integers. Dynamic Programming, Travelling Salesman Problem, Chained Matrix Multiplication., Optimal Binary Search trees. Greedy Algorithm: Minimum Spanning trees. Prim's Algorithm, Kruskal Algorithm. Computational Complexity and intractability: Polynomial reducibility, P and NP, NP-hard and NP-complete problems. Satisfiability problem. Reductions. Approximation Algorithms. Amortised analysis. Parallel Algorithms.

CSEB 305: DATABASE MANAGEMENT SYSTEMS (Full Marks – 100)

Database System Concepts & Architecture - Data Models, DBMS Architecture, DB Languages.
Data Modeling Using the K-R Model - Basic Concepts, Mapping Constraints, E-R Diagram Relational Model. SOL. Integrity Constraints Relational Database Design - Decomposition, Normalization, Different Normal

Forms Query Processing, Optimization Transaction, Concurrency Control, Recovery System Object Oriented Database; Distributed Database, Data Warehousing, Data Mining. Spatial and Geographic Databases, Multimedia Databases, Data Analysis, OLAP.

CSEB 306: OBJECT ORIENTED SYSTEM (Full Marks – 100)

Object Model - Abstraction, Encapsulation, Modularity, Links and Association, Generalization, Inheritance, Aggregation, Polymorphism, using Instantiation, Metadata & Metaclass, Typing, Concurrency, Persistence;
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 Languages and Programming- 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.
Distributed Object Oriented System - CORBA

PRACTICAL

CSEB 307(P): SOFTWARE ENGINEERING LAB (Full Marks – 100)

CASE tools: Familiarities with tools for System Analysis for preparing DFD, E-R Diagrams, Use of tools for relational database design such as relational designer. Application Development tools: Use of tools in developing application software including interactive data entry screens, transaction processing, report generations.

CSEB 308(P): SYSTEM DESIGN LAB (Full Marks – 100)

Kernel level Programming:
File system, Interprocess Communication, Device Driver, Kernel Building and Modules, Networking, Security
Application System Development in: Open Source Platform, .Net Platform
Requisite set of Open Source Tools, Installation, Compilation/binding, Portability, Language References

CSEB 309(P): OBJECT ORIENTED SYSTEM LAB (Full Marks – 100)

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

CSEB 310(P): DATABASE MANAGEMENT SYSTEM LAB (Full Marks – 100)

Study of features of a Standard Commercial database, DBMS Configuration DBA Mode: Start-up, shut down, User Creation, User Maintenance User Mode Creating Table space and Maintenance of Table space. Application Design. Familiarities with SQL. and PI. / SQL, Form Design, Use of Cursors, Triggers, Report Generation. Bach-up and Restore of a Database. Some Sample Applications on database design.

B.Tech. 4th Semester

THEORETICAL

CSEB 401: SOFTWARE ENGINEERING-II (Full Marks – 100)

Software Quality – Quality factors, Quality Models- Fixed Model, Own Model, Quality Assurance, FTRs. Software Configuration Management – Process, version control, Change control, SCM standards. Software Risk Management- Concepts, Strategies, Identification and Projection. Software Architecture- Role, Component and Connector View, Styles. Software Reliability – Basics, Time-dependent and Time-independent Models. Software Metric – Software Science, Cyclomatic Complexity, Function Points, Zipf's Law Quality Measures. Defect Density, Bang Metric, Maintainability Measures.
Object-oriented Software Engineering –Concepts and Principles, Analysis, Design, Testing. UML views and notations: - Class diagrams, use case, object, interaction, sequence, collaboration diagrams, case study.

CSEB 402: COMPUTER NETWORKS (Full Marks – 100)

Foundation of Networking: Network Categories. Devices, Layered Network Architecture, Protocols and Standards, Network Operating Systems, Security, Performance of Network.
Data Link Control: Line Discipline. Flow Control. Data Link Protocols. Character Oriented and Bit Oriented Protocols.
Local Area Networks: IEEE LAN Standards, LLC, MAC Protocols: Ethernet, Token Bus^Token Ring, High Speed LAN Protocols, Bridges.
Switching and Routing in Networks: Circuit Switching: Space Division Switches, Time Division Switches, Space and Time Division Switching Combinations.
Packet Switching: Virtual Circuit and Datagram Approach
Routing: Shortest Path Routing, Distance Vector Routing, Link State Routing, Routing for Broadcasting and Multicasting, Routing for Mobile Hosts. Congestion Control Algorithms. The X.25 and. TCP/IP Standard and Supporting Protocols Frame Relay Layer and Operations End to End Protocols: Addressing, Reliable Delivery, Flow Control, Connection Establishment and Termination
Application Layer Protocols: DNS, TELNET, SMTP, SNMP, HTTP

CSEB 403: ARTIFICIAL INTELLIGENCE (Full Marks – 100)

Introduction to Artificial Intelligence: Importance of Al, Scope of Al, Goals of AI, AI and Related fields,
State-Space Search: State-Space Graphs, Implicit and Explicit Graphs, Production Systems, Formulating the State-Space; Uniformed search: Depth-first Search, Breadth-first Search; Uniform Cost algorithm;
Heuristic Search: Use of Heuristics, A* Algorithm, Admissibility of A*; Analysis and comparison of Search algorithms;
Adversarial Search: Two-agent games, AND/OR Graphs, Minimax Procedure, α-β pruning procedure, Learning evaluation functions;
Expert Systems: Introduction to ES, Knowledge-Based systems, Knowledge Representation: Rule-Based approach: Forward and Backward Chaining, Semantic-Nets Based approach, Frame Based approach;
Constrained Satisfaction Search: Introduction to Constrained Satisfaction Problems(CSP), Applications, Algorithms to CSPs, Symbolic constraints & Propagation;
Logic Programming: Introduction to programming in logic. Declarative and Procedural Meaning, Data Objects, Lists, Operators, Controlled Backtracking

CSEB 404: OPTIMIZATION TECHNIQUES (Full Marks – 100)

Linear Programming-Simplex Method, Duality. Integer Programming- Gomory's Technique, Branch and Bound Method. Assignment and Transportation Models. Nonlinear Programming, Kuhn-Tucker condition, Dynamic Programming. Graph optimization, Combinatorial optimization.

CSEB 405: COMPUTER GRAPHICS (Full Marks – 100)

Introduction: Information handling mechanisms and Computer Graphics, Interactive input Devices, Coordinate systems, Graphics Software, Area of Application.
Display Devices: Raster Scan Display & Systems, Flat-Panel Displays, Frame Buffer, Random-scan Display & Systems, Three Dimensional Viewing Devices, Graphics Monitors, Workstations, Video Controller,
Display processor Line Drawing Algorithms: Points & Lines, DDA Algorithm, Bresenham's Line Algorithms. Circle Generating Algorithms: Midpoint Circle. Algorithm, Ellipse and other
Curve Generating Algorithms Area Filling: Scan-Line polygon Filling Algorithm. Boundary Fill Algorithm
Basic Transformations: Translation, Rotation, Scaling, matrix Representation & Homogeneous Coordinates, Composite Transformations, Rotation about an Arbitrary Point, Inverse Transformation.
Other Transformations: Reflections, Shear. Transformations between Coordinate Systems.
Windowing and Clipping: The Viewing Transformation, Clipping Operations, Line Clipping, Polygon Clipping, Curve Clipping, Text Clipping. Exterior clipping.
Three Dimensions: 3D Geometry 3D Transformations-Rotation about an arbitrary axis, other transformations. Parallel Projection. Perspective Projection. Viewing Parameters Hidden Lines and Surfaces: Back Face Removal, 7. Buffers. Scan-Line Algorithms, The Painter's Algorithm. Hidden Lines Methods, Binary Space Partition. Light and Shading: Illumination. Shading Algorithms. Surface Approximation.
Texture Mapping. Half Toning Curves and Fractals: Curve Generation, Interpolation, B Splines. Beizer Curves. Fractals: Fractal Lines and Surfaces Computer Animation: Key-Frame Systems, Application

CSEB 406: ECONOMICS (**) (Full Marks – 100)

Economics of Industrial Investment, profit, monopolistic practice. Organization Inceptive & Efficiency. Finance & Production cost. Demand & pricing & Policies. Science, Engineering and Technology and their relationship with Economic Development - Basic Economic Concepts – Economic Goods, Value, Price, Cost. Wealth, Capital – Demand, Supply, Elasticity of Demand & Supply – Concept of Profit and Revenue

PRACTICAL

CSEB 407(P): SOFTWARE ENGINEERING LABORATORY-II (Full Marks – 100)

Design and development of Software- Application and System Software.
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

CSEB 408(P): COMPUTER NETWORK LABORATORY (Full Marks – 100)

Familiarity with different components. Network cards, hubs, switches, routers,
repeaters, modems, fibre optic cables and connectivity. ISDN, leased lines.
Characteristics and uses of a Network OS (Peer to peer and Client Server connectivity)
Establishing a small LAN including hardware and software. (Coax/UTP, Optical fibers)
Socket Programming and Device drivers.
Proxy Servers / IP masquerading.
Error detection and correction, trouble shooting
Setting up mail servers, data-base servers, firewalls

CSEB 409(P): ARTIFICIAL INTELLIGENCE LABORATORY (Full Marks – 100)

Introduction to Prolog: Using clauses, Facts, rules, recursion, examples with structures, Declarative and procedural meaning;

Prolog in use: Order of clauses and goals, List, Operations on lists, Arithmetic in prolog, examples on backtracking;
Sorting through Prolog: Permutation sort, Insert sort, Partition-exchange sort, Merging sorted lists.
Controlled Backtracking: uses of cut (!) and fail, Puzzle solution;

CSEB 410(P): COMPUTER 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.

B.Tech. 5th Semester

THEORETICAL

CSEB 501: BUSINESS PROCESS LOGIC (Full Marks – 100)

Concepts of Business Processes - Analysis, Skills - Business Process Reengineering (BPR) – Innovation, Change – Functional coupling -Business Process Modelling – Analysis, Architecture, Design, Instance – Support/Subsidiary Business Processes – Case Studies
Role of Information Systems - IT as an Enabler - Workflow Model – Workflow System Engine – Difference between Process and Workflow – Embedded Control System - Tool- Business Process Execution Language - XML Business Process Language - Case Studies
Service Oriented Architecture – IT Infrastructure – Embedded Business Logic within communicative networks –Service Oriented Business Approaches – Development – Interpretation of Process and Data – Use of web services – Case Studies
Enterprise Architecture Shared Business Semantics – Collaborative Business Semantics – Community Process – Event based Business Process – Buy-Sell Process – Enterprise Analytics - activity-center view of a Process – iteration of activities – Case Studies
Value Chain – Primary Activities -– Inbound Logistics – Operations – Outbound Logistics – Marketing and Sales – Service – Support activities – Procurement - – Technology Development – Human Resource Management - Firm Infrastructure - Supply Chain – Difference – Value Chain Analysis
Quality – Meaning & Definition –Quality Control Systems – Quality assurance – Planning for Quality - – Total Quality Management (TQM) –Implementation of TQM in service and manufacturing industries – National and International Standards - Case Studies
Business Intelligence, Business, Analytics,
Overview of Information Systems – Manger's View of Information Systems – Introduction to Systems and Organizations – System Approach to problem solving - Strategic Uses of Information Technology - Business Process Engineering and Information Technology. Management Information Systems
Accounting and Financial Information Systems – Marketing Information System –Operational Production Information Systems – Human Resource Information Systems - Applications of Tactical and Strategic Information Systems - Case Studies
Introduction to Decision Support Systems (DSS) Characteristics of Decision-Making Process– Important Features of DSS – Components of DSS – Tools of DSS: what if analysis, sensitivity analysis, goal seek analysis, optimization analysis, data mining for decision support – DSS Lifecycle – Group Decision Support Systems (GDSS) – Benefits of DSS – Case Studies

CSEB 502: MULTIMEDIA TECHNOLOGY (Full Marks – 100)

Perceptual and cognitive psychology related to visual and auditory perception. Methods of data sampling and digitization relative to different formats of audio and video media: frequency- and spatial-based sampling., vector-based and sampling-based media representations, audio and video files including AVI and WAV, uses and application of XML, media data compression. HTML and Java script language for interactive multimedia representation. Macromedia Director, Macromedia Dreamweaver, and Adobe Premier.

CSEB 503: INTERNET TECHNOLOGY (Full Marks – 100)

Basics: Internet Client/Server Computing: What is C/S Computing, Middleware, Fat client VS Fat Servers, N-tiered Software Architecture.
Markup Languages and Their Grammars: SGML, DTD Resource; HTML, CSS; XML, XSL, Query
Web Browser: Browser Architecture
Web Server: Web Server Architecture, Server Features, Configuration of Apache and IIS Protocols: HTTP, FTP, SMTP, POP; Search Engines; Web Database Connectivity; Web Security: S-HTTP, Fire Walls, Proxy Servers.

CSEB 504: VLSI TECHNOLOGY (Full Marks – 100)

Overview of VLSI Technology, Hierarchical Design of VLSI, Behavioral Description, RTL, Logic Circuit, Gate Circuits, Device, Process, Circuit Topology, Wafer Preparation.
Integrated Circuit Manufacturing, Layout Design Rules, Circuit Characterization and Performance Estimation, Delay Estimation, Transistor Sizing, Power Disruption, Interconnect, Design Margin, Reliability, Scaling.
CMOS Technology, IC Design Techniques, MOS Transistors, CMOS Processing Technology, Design of nMOS and CMOS Inverter, Stick Diagrams, Colour and Monochrome Codes in Stick Diagrams and Mask Layouts, Pull-up to Pull-down Ratio for nMOS Inverter, Correspondence of Design Parameters with Specifications, Mask Layout Designs for nMOS/CMOS NAND and NOR Gates.
Design Methodologies, Custom and Semi-Custom Designs, Standard Cell, Gate Array, FPGA, PLDs. CAD VLSI Tools, Simulators for Logic, Timing, Circuit, Device and Process Optimization, Layout Design, Assignment, Partitioning, Floor-Planning, Placement, Routing, Compaction, and Verification Algorithms.
Hardware Description Languages for VLSI design, VHDL and Verilog, Programming and Subsystem Design Concepts, Design of Multiplexer, Parity Generator, Adder, Subtractor, Multiplier, ALU, Datapaths and Control Unit Design.
Trends and Issues in High Performance VLSI Design, Interconnect as Key Limiting Factor, Wire Modeling, Clock Distribution of High Speed System, Power Distribution, Crosstalk and Power Distribution Noise, High Speed Circuit Design Techniques, Low Power Design Issues, High Density and High Speed Memory Design, ASIC Design.

CSEB 505: SOFT COMPUTING (Full Marks – 100)

Fuzzy Systems: Fuzzy sets, Fuzzy logic. Fuzzy relations, Approximate Reasoning, Fuzzy logic control systems Applications of Fuzzy Theory: Fuzzy Pattern Recognition. Fuzzy Database Human Matching 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 & Control Genetic Algorithm (GA): Evolutionary Computing. Basics of Genetic Algorithms Reproduction, Crossover Mutation, Schemata, Fitness function. Optimization problems with Constraints, Stochastic models

Applications or GA: 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

CSEB 506: ELECTIVE-I (Full Marks – 100)

1. Distributed Systems

Characterization of Distributed Systems, Design issues and user requirements. Interprocess Communication-Synchronous and Asynchronous, Client-server communication, Group communication. Remote procedure Call-Design issues & Implementation. Distributed S-Design issues & Implementation. File Services Design issues, Implementations and case studies. Name Service-Design issues and case studies. Time and Co-ordination Physical & Logical Clocks, Distributed Co-ordination. Replication issues and implementations. Shared data and Transactions, Distributed transactions, concurrency control. Recovery and Fault Tolerance. Security-Design issues and case studies.

2. Cryptography

Introduction to Number Theory: Fermat's Little Theorem, Euler's Phi-Function, Wilson's Theorem, The Legendre symbol and its properties, Quadratic Reciprocity, Euclidean Algorithm, Chinese Remainder Theorem, Primitive roots and discrete logarithms.
Introduction to some simple Classical Cryptography: Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Permutation Cipher, Cryptanalysis, Elementary Probability Theory, Perfect Security, Product Cryptosystem, entropy and perfect security.
Symmetric-Key encryption: Overview of Block and Stream Ciphers, Product ciphers and Feistel ciphers, DES. Asymmetric-Key encryption: Public Key Cryptography, RSA Cryptosystem, Some Attacks on RSA, E1Gamal Cryptosystem.
An overview of Secret Sharing Schemes: Threshold schemes, general access structures, simple example of a secret sharing scheme using basic group theory.

3. Fuzzy Systems

Introduction. Fuzzy Sets, Fuzzy Logic. Fuzzy Relations, Set-Theoretic Operators, Membership Functions-Formulation and Parametrization, Fuzzy Unions, Intersection and Complement, Fuzzy rules and Fuzzy Reasoning, Fuzzy Inference Systems. Fuzzy logic in Database Systems, Fuzzy Pattern Recognition. Fuzzy Neural Systems. Fuzzy Control.

4. Principles of Programming Language

Introduction to different paradigms of programming: Imperative, Object-Oriented, Functional, Logic Programming. Imperative Languages: Types, Type checking, Block Structures, Scope Rules, parameter passing. Coroutines, Tasks. Object-oriented Programming: class, Information hiding, Data Abstraction, polymorphism. Functional Programming: concepts, Referential Transparency, Types, Type Systems, Recursive functions, polymorphic functions, High order functions. Logic Programming: Logic languages, predicate logic, clause form logic, logic as a programming language, Unification Algorithm, SLD resolution

PRACTICAL

CSEB 507: MULTIMEDIA TECHNOLOGY LAB (Full Marks – 100)

Bit map and Vector Graphics:
Prepare one image using Adobe Photoshop modifying a given image.
Prepare one image using Adobe Illustrator by scaling a given image in vector graphics format.

Prepare a multimedia presentation (2-3) pages using Dreamweaver.
Concepts and usage of Macromedia Director, a multimedia authoring tool.
Using the Adobe Premiere program for editing and rendering digital video.
Concepts and usage of HTML and Dreamweaver
Javascript with Dreamweaver

CSEB 508: INTERNET TECHNOLOGY LAB (Full Marks – 100)

Java programming: manipulating strings, variables and operators. Control structures. Abstract classes, inheritance and interface.
Handling exceptions, getting input from user, reading from files and writing into files.
HTML, Using Java Applet and Servlet, CGI programming, JDBC.

CSEB 509(P): SOFT COMPUTING LABORATORY (Full Marks – 100)

Computational Methods for data analysis, Non-linear Optimization, Problem-solving by Soft Computing Techniques- Fuzzy Logic, Genetic Algorithms, Neural Networks.

CSEB 510(P): TERM PAPER-I (Full Marks – 100)

B.Tech. 6th Semester

THEORETICAL

CSEB 601: INDUSTRIAL MANAGEMENT (Full Marks – 100)

Concept of management – Administration, Organization – Functions of management, evolution of management thought – Organization – Forms of Business Organization –Types of Business Organization – Features of proprietary, partnership and joint stock companies – Public Sector enterprises – features and problems – objectives – company Promotion and Documentation - Organization charts – Managerial objectives and social responsibilities – Cooperate planning – mission, objectives, programs, goals, environmental scanning – SWOT – strategy formation and implementation
Industrial Structures- Public, Private, Joint and Cooperative Sectors - Size of Industrial unit – Optimum size- Different Optima – Representation Firm
Planning and Organisation – meaning – importance and steps in planning - Types, meanings and forms – Authority and Power – Distinction - Delegation
Human Resources Management – Manpower Planning – Selection & Training - Job Evaluation – Performance Appraisal – Communication – Definition, Elements, Principles – Oral and written Communication
Financial Management – Concept – Financial Accounting – Cost accounting –Sources of Industrial finance – Short Term – Long Term - Stock Exchanges – Functions and Services Working of Stock Exchanges in individual Mutual funds – Role of SEBI in regulating Capital Market - Management of Sale & Advertisement – Management & Productivity
Productivity – Batch and mass production – Work study – Basic Meaning – Basic Procedure Involved in Methods, Study and Work Measurement
Network Analysis to Project Management – PERT/CPM – Application of Network technique to problems
Markets – Competitive structures- Price output determination under perfect competition and monopoly – Marketing functions – Channels of Distribution – Market Research
Quality Management – Concept, Importance – Total Quality Management (TQM) – ISO 9000 - Patents – Patents Procedure
Factor affecting Industrialisation – Industrial Policy – Liberalisation and Consequences – Globalisation – Privatisation – Role of MNC in Industrial Development – SSI –Definition – Problems and Prospects of SSI

Industrial Act – Introduction – Pollution Control, Factories Act - Industrial Safety – Accident Prevention Techniques & related Legal Provisions
Structure and Features of Indian economy – Industrialization of India – Economics of Small and Large-Scale industries –Growth of Public Sector in India – Trends in Labour Movement on India – Role of Agriculture in Indian Economy – Problems of Indian Agriculture and Modernization of Indian Agriculture and also Globalisation

CSEB602: DIGITAL SIGNAL PROCESSING (Full Marks – 100)

Introduction: Signals: Analog & Digital Signals, Classification and Characterization, Typical Signal Processing Applications. Why DSP? Discrete Time Signals (in Time domain & Transform Domain): Discrete Time Signals and System, Sequence and its representation, Sampling Process, Random Signals, Correlation of Signals, Analysis & Modeling of Random Signals Fourier Transform, Transfer Function, Discrete Fourier, Transform & Discrete Time Fourier Transform and their relationship, Z- Transform. Inverse Z- Transform and its Applications, Discrete Cosine Transform, Frequency Response. Simple Digital and Analog Filters, Complementary Transform Functions. Digital Signal Processing and Continuous Time Signals: Sampling of Continuous signals. Sampling Theorem, Power Spectral Density, Design and Analysis of Analog High pass and Band Pass Filters, A/d, D/A Circuits, Sample/Hold Circuits Digital Filter Structure and Design: Block Diagram Representation, Equivalent Structure, Realization of Basic Structures, Computational Complexity, Different Filter Design: 1R Filter, Truncation, Windowing, FIR Filter, Impulse lnvariance. Bilinear Transformation
DSP Algorithms and Application: Basic Concepts and issues. Structure Simulation, Number Representation, Arithmetic Operations. Overflow, Function Approximation, Engineering Applications Speech, Music, RADR, Two Dimensional Digital Signal Processing in Picture Processing and Pattern Recognition

CSEB603: ELECTIVE-II (Full Marks – 100)

1. 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 and D/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

2. Coding & Information Theory

Introduction to Coding Theory. Maximum Likelihood Decoding, Error-detecting codes, Linear Codes, Parity Check, Equivalent codes, Perfect Codes, Hamming Codes, Information Measure, Entropy, Properties of Entropy function, Channel Capacity, Efficiency and Redundancy, Shannon's Theorem

3. Neural Networks

Introduction. Fundamental concepts. Neuron models-Mcculloch-Pitts model, nearest-neighbour model, radial basis function model. Neural network Models- multilayer perceptron. Nearest neighbour based

multilayer perceptron, Back propagation algorithm, Self-organizational learning, evolutionary learning, Applications- Character Recognition, Signal Restoration

4. Modelling and Simulation

System, Types of System- Deterministic, Stochastic, Continuous and Discrete Systems. System Simulation. Statistical tools- pseudorandom numbers, Sampling and Estimation. Discrete Event Simulation- Approaches. Queueing models- Single and multiserver queues, Steady state behaviour of queues, GPSS, SIMSCRIPT. Continuous System Simulation -Open and closed loop systems, System Dynamics- Growth and decay models, CSMP. Virtual Reality modeling VRML. Modelling and Performance Evaluation of Computer Systems, Use of VHDL.

CSEB604: ELECTIVE-III (Full Marks – 100)

1. Parallel Computing

Parallelism and Computing. Parallel Machine Model, Parallel Programming Model, Designing Parallel Algorithms, Performance Analysis. Parallel Processing Models-message passing, Grid Computing, Vector Computing. Parallel Programming – Master Slave programming, Multithreaded programming, Scheduling, Concurrency.

2. Cognitive Computing

Introduction, Intelligence –Characteristics, Measure. Artificial Intelligence. Vocabularies. Formal Systems as Models. Representational Scheme-
Network and Structure-based, Logic-based Reasoning, Search Strategies, Machine Learning, Connectionist Networks, Learning Models, Language Representation and Processing. Use of PROLOG as representation language. Meta-interpreters

3. Information Security

Security- Definition, Assessment, Terminologies, Structure. Cryptography-Applications. Information Security-Minimum Privileges, Compartmentalization, Dual Controls, Security Perimeters, Trustworthy systems, Security Models, Kerberos Authentication, Denial of Service Attacks, Vulnerability and Security Attack models in ATM, IP and mobile wireless networks. Security protocols- Digital signature, Digital Cash, Secure contract signing, Secure voting.

4. Computational Geometry

Data structures; Interval tree; Segment tree; DECL; Algorithmic paradigms; Line sweep; Incremental design; Geometric searching; Algorithms for range searching and point location. Convex hulls; Lower bounds; Algorithms for two dimensional and higher dimensional. Proximity; Lower bounds; Closest pair; Vornoi diagrams; Planar triangulations. Intersections; Hidden line and hidden surface problem; Intersection of polygons. line segments; Algorithms related to rectangles. Motion planning; Piano mover's problem; Motion of a point, rod, disc; Motion of objects with restricted degrees of freedom; Configuration space approach; Cell decomposition and retraction; Motion of linked arms; Motion planning amidst moving obstacles, movable obstacles and unknown environment. Visibility problems; Art gallery problems.

CSEB605(P): TERM PAPER-II (Full Marks – 100)

CSEB606(P): GENERAL VIVA (Full Marks – 100)

CSEB607(P): PROJECT WORK (Full Marks – 200)

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

FIRST SEMESTER		
THEORETICAL		
CISM101	ADVANCED COMPUTER ARCHITECTURE	100
CISM102	DATABASE MANAGEMENT SYSTEM	100
CISM103	DATA STRUCTURE	100
CISM104	DATA COMMUNICATION	100
PRACTICAL		
CISM105(P)	DATA STRUCTURE LABORATORY	100
CISM106(P)	DATABASE LABORATORY	100
SECOND SEMESTER		
THEORETICAL		
CISM201	COMPUTER NETWORK	100
CISM202	DESIGN AND ANALYSIS OF ALGORITHMS	100
CISM203	COMPUTER GRAPHICS AND IMAGE PROCESSING	100
CISM204	SOFTWARE ENGINEERING	100
PRACTICAL		
CISM205(P)	GRAPHICS LABORATORY	100
CISM206(P)	SOFTWARE ENGINEERING LABORATORY	100
THIRD SEMESTER		
THEORETICAL		
CISM301	OBJECT ORIENTED SYSTEM	100
CISM302	AUTOMATA THEORY & COMPILER DESIGN	100
CISM303	INTERNET AND MULTIMEDIA TECHNOLOGY	100
CISM304	ADVANCED OPERATING SYSTEM	100
PRACTICAL		
CISM305(P)	OPERATING SYSTEM AND OBJECT ORIENTED SYSTEM LABORATORY	100
CISM306(P)	MULTIMEDIA LABORATORY	100
FOURTH SEMESTER		
THEORETICAL		
CISM401	ELECTIVE I	100
CISM402	ELECTIVE II	100
PRACTICAL		
CISM403(P)	TERM PAPER	100
CISM404(P)	GRAND VIV-VOCE	100
CISM405(P)	PROJECT WORK	200

Set of Elective Papers: (M.Sc.)

Elective-I:

1. Distributed system
2. Cryptography
3. Soft Computing
4. Modeling and Simulation
5. Embedded System
6. Artificial Intelligence.

Elective-II:

1. Parallel Computing
2. Information Security
3. Cognitive Computing
4. Computational Geometry
5. Principles of Programming Language
6. VLSI Design.

REGULATIONS FOR
TWO-YEAR M.SC. COURSE IN COMPUTER & INFORMATION SCIENCE.

1. The Department of Computer Science, University of Calcutta shall provide instructions leading to 2-year, 4 Semester M.Sc. Degree in Computer & Information Science.

2. A candidate who has passed 3-year B.Sc. Examination with Honours in Computer Science from University of Calcutta can apply for admission to the M.Sc. course. Admission for candidates from other Universities/Colleges will be governed according to the university rules.

3. The examinations for the M.Sc. course shall be held in 4 Semesters. At the end of each semester, an examination of the papers covered in that semester would be held. This examination will be referred to as the M.Sc. examination of that semester. In any semester, the study break between the completion of regular classes and the commencement of the Semester Examination will generally be a maximum of 10 calendar days.

4.1 The total marks for the 2 year (4 semester) course in Computer & Information Science will be 2400. The distribution of marks for each semester examination is as follows:-

	1st Semester	2nd Semester	3rd Semester	4th Semester
Theoretical	4 X 100	4 X 100	4 X 100	2 X 100
Practical	2 X 100	2 X 100	2 X 100	
Project Work	-	-	-	200
Term Paper	-	-	-	100
Grand Viva-Voce	-	-	-	100

4.2 Examination of a Theoretical Paper is of 3-hour duration and will usually carry 70 marks. 30 marks for each paper will be set aside for continuous assessments to be evaluated by the teacher(s) assigned for that class.

4.3 For Theoretical papers, paper setters and examiners will be appointed from a Board of Examiners considering of all the faculty members.

4.4 Evaluation of performance in a Practical paper will be based on Sessional work in that paper and on end-semester viva-voce. The distribution of marks for each Practical Paper would be as follows: -

i) 50% for experiments performed in the laboratory – the Sessional Work to be evaluated by the Teachers assigned for that course.

ii) 40% for viva-voce on the experiments to be conducted by a Board consisting of the faculty members and / or External examiners.

iii) 10% for Lab report to be evaluated by the viva-voce Board.

Only the total marks are to be shown in the mark-sheet.

4.5 In order to pass a semester examination, a candidate will have to score minimum of 40% of the total marks of theoretical papers and 50% in each practical papers a candidate must appear in each theoretical and practical papers. Pass marks for project, grand viva-voce and term paper will be 50% as for practical paper. Pass mark for each theoretical paper is 35%.

4.6 Each student will have to undertake a project work at the beginning of the 4th 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).

4.7 Each candidate will have to complete a term paper assignment. He / She will have to deliver a lecture and submit a report on the topic of the term paper.

4.8 Evaluation of the performance in a Term paper will be done by a board of examiners.

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 where in the next academic session immediately after publication of the result. However, the candidate failing in a paper in the previous semester has to clear the paper(s) as per 5.4.

5.4 A candidate will get a maximum of three consecutive chances including the first one in his / her regular year in order to pass each of the Semester Examinations.

6. The final result (combining all the Semester results) will be determined by adding marks for all theoretical and practical papers separately. A candidate obtaining 40% in theoretical paper (i.e., 560 of 1400) and 50% in each of practical examination will be declared as passed with Second Class. A candidate scoring 60% marks in the total aggregate of all the Semester examinations will be placed in the First Class.

7. The course structure is as given in Appendix – I.

Appendix – I.

REVISED (DETAILED) SYLLABUS FOR 2-YR. M.Sc. 4 SEMESTERS EACH OF 6 MONTHS DURATION IN COMPUTER AND INFORMATION SCIENCE UNIVERSITY OF CALCUTTA

First Semester

THEORETICAL

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 Continuous channel, Shannon's encoding algorithms

PRACTICAL

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

THEORETICAL

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 Software- Application and System Software.
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

THEORETICAL

CISM 301: OBJECT ORIENTED SYSTEM (Full Marks – 100)

Object Model - Abstraction, Encapsulation, Modularity, Links and Association, Generalization, Inheritance, Aggregation, Polymorphism, using Instantiation, Metadata & Metaclass, Typing, Concurrency, Persistence;
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 Languages and Programming- 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
Distributed Object Oriented System - CORBA – A

CISM 302: AUTOMATA THEORY AND COMPILER DESIGN (Full Marks – 100)

Introduction and Review of Finite State Machines: Deterministic, Nondeterministic M/cs, Minimization of FSM, Inverse FSM.
Regular Expression, properties applications: Definition, Regular Expression, two-way FA, Linear Bound Automata, Applications
Regular Set: Definition, Properties, Pumping Lemma, Decision Algorithm, Minimization
Grammar, Different types, Derivation Tree, Different Normal Forms, Ambiguous Grammar and its implications, Chomsky hierarchy, Context Sensitive Languages, Different Classes of Languages, Deterministic Context Free Language and its Properties
Pushdown Automata: Definition, PDA and CFL, Alternative Forms of PDA
Turing Machine: Introduction, Turing Machine Model, Church's Hypothesis
Compiler design, various phases; lexical analyzer, token, lexeme, and patterns. Regular definitions, Transition Diagrams, Syntax Analysis, ambiguity, 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. Runtime systems, Activation tree, Activation record, Basic Blocks, Dataflow analysis, Code optimization and code generation.

CISM 303: INTERNET AND MULTIMEDIA TECHNOLOGY (Full Marks – 100)

Internet –introduction, addressing schemes, IPv4 and IPv6; World Wide Web. Protocols; HTTP, Telnet.
FTP and other Net utilities; Web mail. Netiquette.
Searching: portals, search engines, concepts of crawlers, web mining.
Web site design: HTML, XML and XHTML-Web authoring, Document Structure, Tags and Page Composition; multimedia elements- colour, graphics, photographs and image maps, Cascading Style Sheets (CSS) & Dynamic HTML (DHTML); Page editors.
Scripting language: client side and server side, applets, servlets, JSP, Common Gateway Interface (CGI); database connectivity.
Multimedia: definition, characteristics- interactive and non-interactive; local (standalone CD, DVD) and networked (videoconferencing, web video broadcasting, multimedia Email); large data volume, real-time property, continuous display, delay requirement. Various media types: captured and. synthesized; discrete (space dimension) and continuous (space and time dimension); text- plain and rich; graphics (revisable) and images (not revisable); video (captured or synthesized); animation; sound -speech and non-speech, natural and structured. File formats- text (doc, RTF, PDF): audio (WAV, MIDI).
Data compression and coding: entropy coding, lossy and lossless; text (run length; Huffman, arithmetic, vector, LZ, LZW); audio (Dolby), image and video standards- JPEG and. MPEG techniques.

CISM 304: ADVANCED OPERATING SYSTEM (Full Marks – 100)

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

PRACTICAL

CISM 305(P): OPERATING SYSTEM AND OBJECT ORIENTED SYSTEM (Full Marks – 100)

Operating System Lab
UNIX
File System, Utilities, Editor, Process, Communication, Simple Filter, Advance Filter, Advanced Shell Programming, System Administration
C-Programming using UNIX system calls
UNIX Model

File Structure, I/O, File and Directory maintenance, UNIX environment, Terminal Processes and Signals Threads

Inter Process Communication

Locking, Pipes, Semaphore, Message Queue, Shared memory

Familiarities with SUN Solaris

Command & Utilities

Object Oriented System Lab

Programming with OOL: 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:-Datatypes, Operators, Statements, Methods, Class declaration, Java Programming, Objects, Inheritance, Argument Passing, Arrays and Strings, I/O to Text Files,

CISM 306(P): MULTIMEDIA LAB

Bit map and Vector Graphics:
Prepare one image using Adobe Photoshop modifying a given image.
Prepare one image using Adobe Illustrator by scaling a given image in vector graphics format.
Prepare a multimedia presentation (2-3) pages using Dreamweaver.
Concepts and usage of Macromedia Director, a multimedia authoring tool.
Using the Adobe Premiere program for editing and rendering digital video.
Concepts and usage of HTML and Dreamweaver
Javascript with Dreamweaver

Forth Semester

THEORETICAL

CISM 401: ELECTIVE-I (Full Marks – 100)

1. Distributed system

Characterization of Distributed Systems, Design issues and user requirements. Interprocess Communication-Synchronous and Asynchronous, Client-server communication, Group communication. Remote procedure Call-Design issues & Implementation. Distributed S-Design issues & Implementation. File Services Design issues, Implementations and case studies. Name Service-Design issues and case studies. Time and Co-ordination Physical & Logical Clocks, Distributed Co-ordination. Replication issues and implementations. Shared data and Transactions, Distributed transactions, concurrency control. Recovery and Fault Tolerance. Security- Design issues and case studies.

2. Cryptography

Mathematical preliminaries: Number theory, Modulo arithmetic, Euclidean algorithm, Chinese remainder theorem, Discrete logarithm.
Classical Cryptography: Classification of attacks, Cryptanalysis, Basic Cipher Techniques.
Symmetric Cryptography: Shannon's theorem, Block & Stream Cipher, Algorithmic modes, Fiestel Structure, Symmetric Key Cryptographic algorithms: DES & AES. Diffie-Hellman Key exchange algorithm. Elliptic-curve Cryptography.
Asymmetric Cryptography: RSA, El-gamal Crypto system.
Authentication: Hash & MAC function, Needham-Schroder algorithm, Kerberos.

3. 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 Matching Interactions

Artificial Neural Networks: Feedforward Networks and Supervised Learning Perception learning rules, Adaline, Back propagation. Associative Memories, Hopfield networks, Unsupervised Learning Networks, Self-organizing feature map. Adaptive Resonance Theory, Radial Basis function. Recurrent Neural, Networks Reinforcement Learning

Applications of Neural Networks Sensor processing. Communication. System Identification and Control Genetic Algorithm (GA): Evolutionary Computing. Basics of Genetic Algorithms Reproduction, Crossover Mutation, Schemata, Fitness function. Optimization problems with Constraints, Stochastic models Applications or GA: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

4. Modelling and Simulation

System -Types of System- Deterministic, Stochastic, Continuous and Discrete Systems. System Simulation. Statistical tools- pseudorandom numbers, Sampling and Estimation. Discrete Event Simulation- Approaches. Queuing models- for Single and multiserver queues, Steady state behaviour of queues, GPSS, SIMSCRIPT. Continues System Simulation -Open and closed loop systems,

System Dynamics- Growth and decay models, CSMP. Virtual Reality modeling VRML. Modelling and Performance Evaluation of Computer Systems, Use of VHDL.

5. 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

6. Artificial Intelligence

Introduction to Artificial Intelligence: Importance of Al, Scope of Al, Goals of AI, AI and Related fields,

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

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

Adversarial Search: Two-agent games, AND/OR Graphs, Minimax Procedure, α-β pruning procedure, Learning evaluation functions;

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

Constrained Satisfaction Search: Introduction to Constrained Satisfaction Problems(CSP), Applications, Algorithms to CSPs, Symbolic constraints & Propagation;
Logic Programming: Introduction to programming in logic. Declarative and Procedural Meaning, Data Objects, Lists, Operators, Controlled Backtracking

CISM402: ELECTIVE-II (Full Marks – 100)

1. Parallel Computing

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.

2. Information Security

Security- Definition, Assessment, Terminologies, Structure. Cryptography-Applications. Information Security-Minimum Privileges, Compartmentalization, Dual Controls, Security Perimeters, Trustworthy systems, Security Models, Kerberos Authentication, Denial of Service Attacks, Vulnerability and Security Attack models in ATM, IP and mobile wireless networks. Security protocols- Digital signature, Digital Cash, Secure contract signing, Secure voting.

3. Cognitive Computing

Introduction, Intelligence –Characteristics, Measure. Artificial Intelligence. Vocabularies. Formal Systems as Models. Representational Scheme-
Network and Structure-based, Logic-based Reasoning, Search Strategies, Machine Learning, Connectionist Networks, Learning Models, Language Representation and Processing. Use of PROLOG as representation language. Meta-interpreters.

4. Computational Geometry

Data structures; Interval tree; Segment tree; DECL; Algorithmic paradigms; Line sweep; Incremental design; Geometric searching; Algorithms for range searching and point location. Convex hulls; Lower bounds; Algorithms for two dimensional and higher dimensional. Proximity; Lower bounds; Closest pair; Vornoi diagrams; Planar triangulations. Intersections; Hidden line and hidden surface problem; Intersection of polygons. line segments; Algorithms related to rectangles. Motion planning; Piano mover's problem; Motion of a point, rod, disc; Motion of objects with restricted degrees of freedom; Configuration space approach; Cell decomposition and retraction; Motion of linked arms; Motion planning amidst moving obstacles, movable obstacles and unknown environment. Visibility problems; Art gallery problems.

5. Principles of Programming Languages

Introduction to different paradigms of programming: Imperative, Object-Oriented, Functional, Logic Programming. Imperative Languages: Types, Type checking, Block Structures, Scope Rules, parameter passing. Coroutines, Tasks. Object-oriented Programming: class, Information hiding, Data Abstraction, polymorphism. Functional Programming: concepts, Referential Transparency, Types, Type Systems,

Recursive functions, polymorphic functions, High order functions. Logic Programming: Logic languages, predicate logic, clause form logic, logic as a programming language, Unification Algorithm, SLD resolution.

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.

CISM 403: TERM PAPER (Full Marks – 100)
CISM 404: GRAND VIVA-VOCE (Full Marks – 100)
CISM 405: PROJECT WORK (Full Marks – 100)

M.Tech.

Regulations:

1. **Title of the Course:**

   The Course shall be termed as Master of Technology (M.Tech.) Course in Computer Science & Engineering, of the University of Calcutta under the Faculty Council for Post Graduate studies of Engineering & Technology.

2. **Minimum qualifications for admission:**

   B.Tech. / B.E. in Computer Science / Computer Science & Engineering / Computer Science & Technology, MCA (with B.Sc. Honours in Phys / Maths / Stats / Comp. Sc. / Electronics Sc.) or M.Sc. in Computer and Information Science (with B.Sc. (Hons) in Computer Science from University of Calcutta) or equivalent degree in computer Science from other University.

3. **Duration:**

   Duration of the course will be of 2 academic years consisting of 4 semesters, each of six months' duration. At the end of each semester an examination of the courses covered in the semester will be held. This examination will be referred to as M.Tech. Examination of that semester.

4. **Course work:**

   The course work that each student will have to complete in each semester is as follows. Each course will be covered in approximately 40 lecture hours.

   Semester – I

Course	Pds/wk.	Marks
CSE101 Algorithms and Algorithmic Complexity	3	100
CSE102 Cryptography and Network Security	3	100
CSE103 Advanced Database Systems	3	100
CSE104 Elective-I	3	100
CSE105(P) System Design Lab-I		100

- **Elective-I**: ***(Any one)***

a) Distributed Systems
b) Bioinformatics.
c) Soft Computing
d) Multimedia Systems

Semester – II

Course		Pds/wk.	Marks
CSE201	VLSI Design	3	100
CSE202	Gr A – Image processing		50
	Gr B – Embedded Systems		50
CSE203	Mobile & Wireless Computing	3	100
CSE204	Elective-II	3	100
CSE205(P)	System Design Lab-II		

- **Elective-II:** ***(Any one)***

a) Real-time Systems

b) Advanced Software Engineering
c) Cluster & Grid Computing.
d) Natural Language Processing.

Semester – III

Course	**Marks**
Project-I#	200
Seminar*	100
General Viva-Voce	100

Semester – IV

Course	**Marks**
Project-II#	400

Notes:

* Seminar : Each student will be allotted a topic of seminar at the beginning of the current semester. The student will have to submit a written presentation & give a seminar on that topic on a date and time to be announced subsequently.

Project-I : Each student will have to undertake a project work under a supervisor. The work will have to be carried out during the 3rd semester of study. The student will have to submit a typewritten or printed report on the work done by him/her according to a schedule to be announced by the department. The project-report should be duly approved by the supervisor concerned and should embody results of research/development work carried out by the student. A project work is to be carried out within department under the guidance of the thesis supervisor who must be a faculty member of the department.

Project-II : Each student will have to undertake a project work under a supervisor. The work will have to be carried out during the 4th semester of study. The student will have to submit typewritten or printed report on the work done by him/her according to a schedule to be announced by the department. The project-report should be duly approved by the supervisor concerned and should embody results of research/development work carried out by the student. A project work may be carried out within department or in any other academic / research / industrial / commercial organization under the guidance of the thesis supervisor who must be a faculty member of the department or under a joint supervision including at least one such faculty member.

5. Requirement for the M.Tech. Degree:

To qualify for M.Tech. degree in Computer Science & Engineering a student will have to complete the total requirement as follows:

Total Marks

a) In first semester, a course work consisting of 4-courses each of 100-marks together with a practical paper of 100-marks.	400 (Theory) 100 (Practical)
b) In second semester a course work consisting of 4-courses each of 100-marks together with a practical paper of 100-marks.	400 (Theory) 100 (Practical)

c)	In third semester a project work of 200-marks,	100 (Seminar)
	a seminar of 100-marks, and a general	200 (Project)
	viva-voce of 100 marks	100 (General viva-voce)
d)	In fourth semester a project work of 400-marks	400 (Project)
	Grand Total (for M.Tech. Course)	1800 Marks

6. Examination:

An examination will be held at the end of each semester.

a)	Course Work	:	For each theoretical paper there will be a theoretical examination of 4-hour duration at the end of the semester.
b)	Seminar	:	At the end of 3rd semester each student will have to deliver a seminar lecture on the topic assigned to him/her. Assessment will be made by a set of examiners which should consist of at least two faculty members.
c)	Project Work-I	:	At the end of the third semester, assessment of the project work of each student will be made by the board of examiners including supervisors on the basis of a viva-voce examination and the report submitted by the student.
d)	General Viva-voce	:	At the end of 3rd semester, all the students will have to appear at a General Viva-voce test to be conducted by a board of examiners consisting of the faculty members of the department and external examiners.
e)	Project Work-II	:	At the end of 4th semester, the thesis work of all students will be assessed by a board of examiners consisting of supervisors and external examiners.
f)	Practical Paper	:	Assessment of performance in the practical papers will be made as follows – 50% marks will be set apart for the sessional work and laboratory report and the rest 50 % marks will be for viva voce test/examinations which will be conducted by a board of examiners appointed from the faculty members of the department.

7. Minimum Requirements for the M.Tech. Degree:

To pass an examination a student will have to earn at least the following marks.

a)	For each theoretical course work -	50 marks
b)	For Seminar -	50 ″
c)	For Project I work (3rd Semester) -	100 ″
d)	For each Practical paper -	50 ″
e)	For General viva-voce -	50 ″
f)	For project work (4th Semester) -	200 ″

The 2nd, 3rd, and 4th Semesters will begin immediately after the completion of the respective previous Semester examination.

8. Attendance

In order to be eligible for appearing at a Semester examination a candidate shall have to pursue a regular course of studies in the subject and attend at least 65% of the theoretical and practical classes separately

during the academic session. Candidates who fail in any paper and appear for the same at subsequent chances need not attend classes.

9. Additional Chances:

i) A student failing in a course work or seminar or project will have a chance to reappear** at an examination for that course/ /seminar/project of the next corresponding semester examination. Marks in course/ seminar/project in which he/she have passed will be considered at the time of computation of his/her final result and it is not necessary to reappear at the other examinations. For reappearing at a course examination it will not be necessary to attend lectures.
ii) A student failing or absent in more than two paper in a semester, will be declared to have failed in that semester. He/She will have to appear afresh from that particular semester in the next academic session.
iii) A student failing in project work will have to complete a new project work. Examination will be held as per rules.
iv) ##To complete a course/seminar/project work a student will have at most two consecutive chances in next two corresponding examinations after the first examination in which he/she was registered or was eligible to appear as a regular student.

10. Award of Degree:

i) A student will complete the minimum requirements in both the parts will be declared to have passed the M Tech examination in Computer Science & Engineering of the University of Calcutta.
ii) A student who will earn in aggregate 50% or above but less than 66% of the grand total will be declared to have passed M Tech examination with second class and a student who will earn in aggregate 66% and above of the grand total will be declared to have passed M.Tech. examination with first class.
iii) The student passing the examination as in (i) and (ii) above will be awarded degree of Master of Technology (M Tech) in Computer Science & Engineering, University of Calcutta and be placed in First/Second Class (as the case may be) as per rules of University of Calcutta, the University would publish a list of successful candidates in order of merit.

REVISED (DETAILED) SYLLABUS FOR 2-YR. M.TECH. 4 SEMESTERS EACH OF 6 MONTH DURATION IN COMPUTER SCIENCE & ENGINEERING UNIVERSITY OF CALCUTTA

1ST SEMESTER:

CSE101: ALGORITHMS AND ALGORITHMIC COMPLEXITY (Full Marks – 100)

Review: Fundamentals of Mathematics: Linear Algebra, Combinatorics, Boolean Functions, Number Theory. Fundamentals of Algorithmic: Classification of Problems, Complexity, Asymptotic Notations. Recurrences: Master Theorem Probabilistic Analysis: Sort, Search, Random Binary Search trees, Red-black trees,
Priority Queues, Bipartite Matching, Common Subsequence Problem, Flow Networks, Ford-Fulkerson Method, Fast Fourier Transforms, Knuth-Morris-Pratt Algorithm, Convex Hull, Point Location, Combinatorial Algorithms: Generating Permutations, Generating Partitions.
Approximation Algorithms: Concept, Design, Applications. Inapproximability. Number -Theoretic Algorithms. Randomized Algorithms, Primality Testing, Constrained and Unconstrained Optimization, Evolutionary Algorithms.

Books:

1. Introduction to Algorithms - T. H. Cormen, et al. (PHI, 1990)
2. Algorithms for Hard Problems - J. Hromkovic (Springer)
3. Analysis of Algorithms & Data Structures - L. Banachowski, et al. (International Computer & Addison. Wesley)

CSE 102: CRYPTOGRAPHY AND NETWORK SECURITY (Full Marks – 100)

Principles of Security, Basic Cryptographic techniques, Classification of attacks, Virus, Worm, Trojan Horse, Spam etc.
Symmetric Key Cryptography: Algorithm types and modes, Cryptographic Algorithms
Asymmetric Key Cryptographic Algorithms, Digital Signature
Digital Envelope, Message Authentication Code, Message Digest
Public-Key Infrastructure (PKI)
Authentication: Classifications, Mutual authentication Algorithms, Kerberos
Security in layers and domains: IPsec, Secure Socket Layer (SSL), E-mail Security
Electronic transactions

Books:

1. Cryptography and Network Security: Atul Kahate, TMH
2. Cryptography and Network Security: Principles & Practices: William Stallings, 4th Edition Pearson & Prentice Hall
3. Network Security: Kaufman, Perlman, Speciner, Pearson Education

Digital Signature Scheme: A framework for Digital Signature mechanisms, RSA and related signature scheme, possible attacks on RSA signatures, signature with additional functionality. (7 hours)
Secret Sharing Scheme: Perfectly secure secret sharing scheme, Shamir's secret sharing scheme, secret sharing for general access structure, Visual cryptography for threshold and general access structure for black and white images. (7 hours)
Complexity theoretic functions: pseudo-randomness, one-way function, proof system, zero knowledge proofs. (3 hours)

Primality Tests and factorization: Lucas sequence, Primality Test based on. Lucas sequence. Pseudo primes, more primality tests, relation of testing of primes with complexity theory, The integer factorization problem, Trial division, Fermat factorization method. Pollard's rho factoring algorithm, Pollard's p-1 factoring algorithm, random square factoring method. (7 hours)
Overview of Elliptic curve cryptosystem, Hash functions, key agreement protocols. (6 hours)

Assignments using C Programming Language:

1. Implementation of RSA signature scheme;
2. Implementation of a Visual Cryptographic shame.

Books:

1. Primality and Cryptography. E. Kranakis. Wieley. Chichester.!986.
2. A. J. Menezes, P. C. Van Oorschot, S. A. Vanstone, Handbook of Applied Cryptography, CRC Press, 1997.
3. I. Niven, S. H. Zuckerman and L. H. Mongomery, An Introduction to the Theory of Numbers, John Wiley, 1991.
4. D.R. Stinson, Cryptography: Theory and practice, CRC Press Company, 2002.
5. M. R. Adhikari and Avishek Adhikari, Introduction to Linear Algebra with Application to Basic Cryptography, Asian Books Pvt. Ltd, 2007.
6. O. Goldeich, Foundations of Cryptography, Fragments of a Book, ECCC Report, Cambridge, Univ. Press, London 2000.
7. N. Koblitz, Introduction to Elliptic Curves and Modular Forms 2nd ed., Springer, Berlin, 1993.

CSE 103: ADVANCED DATABASE MANAGEMENT SYSTEMS (Full Marks – 100)

Distributed Database: Distributed database architecture, levels of distribution transparency, DDB design, Translation of global queries, Query optimization for DDB, Concurrency control for DDB
Object Oriented Database: OO paradigm, OO data models: Object identifiers, Relationship and Integrity, ER Diagramming model for OO relationships, Object relational data models
Data Warehousing: Components, Building a data warehouse, Data extraction, cleanup and transformation, OLAP
Future Trends in data models: Semantic data models, DM for loosely structured data items, Multimedia database.

Books:

1. Alex Berson, Stephen J Smith; "Data Warehousing, Data Mining, and OLAP"; Tata McGraw-Hill Publishing Company Limited, 1997, ISBN 0-07-058741-8
2. S Ceri, G Pelagatti; ""Distributed Databases: Principles and Systems"; Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-066215-0
3. M Tamer Ozsu, P Valduriez; "Principles of Distributed Database Systems"; Pearson Education Pvt. Ltd., 2005, ISBN 81-7808-375-2.
4. J. L. Harrington; "Object Oriented Database Design Clearly Explained"; Morgan Kaufmann Publishers, 2001, ISBN 0-12-326428-6.
5. A K Majumder, P Bhattacharya; "Database Management Systems"; Tata McGraw-Hill Publishing Company Limited, 2004, ISBN 0-07-462239-0

CSE 104: ELECTIVE-I (Full **Marks – 100**)

CSE 104(a): DISTRIBUTED SYSTEMS

Introduction: definition, characteristics and challenges of distributed systems, Architectural models (client-server).
Time: Physical and logical time, Event ordering, Clock Synchronization, Message delivery ordering.
Inter-process communication (sockets, UDP/TCP), Overview of middleware, Web services, RPC.
Operating system support - Mutual exclusion, termination detection, deadlock, process migration, replication management, threads, multi-threaded client/server.
Distributed file service (design options, file sharing, access control).
Distributed transactions (flat/nested, one/two phase commit).
Security - main threats and techniques for ensuring security (secure channels, firewalls).
Fault-tolerance and availability (passive/active replication, gossip architectures).
Applications. Pervasive computing environments: active office, home and city, Events, composite events, mobility and location-tracking, Electronic health, police and transport services.

CSE 104(b): BIOINFORMATICS

Basic Biology: What is life? The unity and the diversity of living things. Prokaryotes and Eukaryotes, Yeast and People, Evolutionary time and relatedness, Living parts: Tissues, cells, compartments and organelles, Central dogma of molecular biology, Concept of DNA, RNA, Protein and metabolic pathway. What is Bioinformatics? Recent challenges in Bioinformatics.
Biological databases: Their needs and challenges. Example of different biological databases – sequence, structure, function, microarrray, pathway, etc.
Sequence Analysis: Theory and Tools: Pairwise alignment – Different local and global search alignment, Heuristic searches (like BLAST) applicable to search against database, Multiple alignment algorithms, Whole genome comparison.
Walk through the genome – Prediction of regulatory motifs, Operon, Gene, splice site, etc.
Markov models: Hidden Markov models – The evaluation, decoding and estimation problem and the algorithms. Application in sequence analysis.
Molecular phylogeny – maximum Parsimony, distance Matrix and maximum likelihood methods. Concepts of adaptive evolution.
Application of graph theory in Biology – Biochemical Pathway, Protein-protein interaction network, Regulatory network and their analysis.

Books:

1. Bioinformatics: David Mount
2. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic acids: R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison.

CSE 104(c): SOFT COMPUTING

Soft Computing: Introduction, requirement, different tools and techniques, usefulness and applications.
Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.
Artificial Neural Network: Introduction, basic models, Hebb's learning, Adaline, Perceptron, Multilayer feedforward network, Backpropagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Recurrent Networks, RBF Network, Different Design issues, Applications.

Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Hypothesis of building blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.
Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.
Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Books:

1. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.
2. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI, 1997.
3. Neural Networks, S. Haykin, Pearson Education, 2ed, 2001.
4. Genetic Algorithms in Search and Optimization, and Machine Learning, D. E. Goldberg, Addison-Wesley, 1989.
5. Neural Networks, Fuzzy logic, and Genetic Algorithms, S. Rajasekaran & G. A. V. Pai, PHI.
6. Neuro-Fuzzy and Soft Computing, Jang, Sun, & Mizutani, PHI
7. Learning and Soft Computing, V. Kecman, MIT Press, 2001.
8. Rough Sets, Z. Pawlak, Kluwer Academic Publisher, 1991.
9. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997.

CSE 104(d): MULTIMEDIA SYSTEMS

Concept of Multimedia Data; Various File Formats; Multimedia data Model e.g. RMDM
Compression & Decompression:
Binary Image compression: Various CCITT standards Color Image compression : JPEG Methodology, DCT, MPEG Methodology
Storage & Retrieval Methods: Magnetic Media Technology, RAID Technology, Optical Media, Hierarchical Storage Management; Cache Management;
Architectural Issues: Specialized processor, Memory System, LAN-WAN connectivity, Client-Server approach; Distributed Multimedia System: various components;
Multimedia Authoring; Authoring Tools and their design issues, Hypermedia Application Design issues;
User Interface: Hypermedia Interface Design Issues;

Books:

1. R. S. Tannenbaum, Theoretical Foundations of Multimedia. W.H. Freeman & Co.
2. S. McGloughlin, Multimedia: Concepts and Practice.
3. Andleigh and Thakrar, Multimedia Systems Design, Prentice Hall PTR

CSE 105(P): SYSTEN DESIGN LAB (Full Marks – 100)

a) Hardware-oriented Application Lab
b) Software-oriented Application Lab.

2ND SEMESTER:

CSE201: VLSI DESIGN (Full Marks – 100)

Technology: Bi-Polar and CMOS, Features, CMOS Downscaling, Process Technology, Nanotechnology Devices, VLSI / ULSI
ASIC: Introduction, Advantages, Examples, Classification, VLSI Design style and Design Flow, Economics of ASIC.

Simulation: Types of Simulation, Logic Simulation, Circuit Simulation, Gate level Simulation, Switch Simulation.
Physical Design Automation: Partitioning – Iterative and Constructive Algorithms.
Floorplanning: Rectangular Dual and Hierarchical Method.
Placement: Force-directed, Simulated Annealing and Genetic Algorithms.
Routing: Area Routing, Channel Routing, Switchbox Routing, Performance Driven, Placement and Routing, Clock Routing., Design Rule Verification., Layout Compaction.
FPGA: Architecture, Physical Design.
VHDL: Introduction, Composite Data Type, Processes, Subprograms, Behavioral & Structural VHDL, Packages, Libraries, VHDL in Simulation – Test Bench, VHDL for Combinational, Sequential logic & FMS.
Case Studies: Arithmetic Logic Unit, Digital Filter VHDL for testing.
System Level Design using VHDL, Verilog, MATLAB, System and FPGA Synthesis of the systems.
Logic Synthesis:-Design Methodology, PLA Based synthesis, Two and Multilevel combinational circuit – OBDD, Synthesis, Delay, Testability.
SOC Design: ASIC and SOC, IP-Reuse & Integration, Design Factors, Design Flow, Verification, Low Power Design – Algorithm, Architecture, Optimization.
Application: DSP and Audio-Video Processor.

Books:

1. An Introduction to Physical Design – Surrafzadeh, Wong, TMH Inc.
2. Algorithms for VLSI Physical Design Automation – Naveed Sherwani – Kellwer Academic Publisher.
3. Application Specific Integrated Circuit – by Sebastian Smith – Pearson Education Asia.
4. VHDL & FPLD in Digital System Design – by Salcic Zoran – Kellwar Academic Publisher.
5. Logic Synthesis – S. Devadas, A. Ghosh, K. Kellwar, McGrawHill Inc.
6. Logic Design Theory – N. N. Biswas, PHI.
7. FPGA Architecture and CAD tools – by V. Metz & J. Rose, Addison Weseley.
8. Reuse Methodology Manual for System on Chip Designs – Kellwar Academic Publishers.
9. Surviving the SOC Revolution – A Guide to Platform based Design – H. Chang, L. Cooke, M. Hunt, G. Martin, A. McNelly and L. Todd, Norwell, MA: Kellwar Academic Publisher.

CSE 202: GR. A: IMAGE PROCESSING (Full Marks – 50)

Introduction: 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.
Applications: Automatic visual system in part inspection, forensic and security system, entertainment – multimedia, scientific and medical investigation.

Books:

1. Digital Image Processing – Gonzalez and Woods. (2nd Edition), Prentice Hall.
2. Image Processing & Analysis – Tony F. Chan, SIAM Publications.
3. Digital Image Processing- Kenneth R. Castleman, Academic Press.

CSE 202: GR. B: EMBEDDED SYSTEMS (Full Marks – 100)

Introduction to Embedded Systems: Definition of Embedded Systems, Difference between General Purpose Computers and Embedded Systems, Categories of Embedded Systems, Requirements of Embedded Systems.
Embedded Hardware: The Von-Neumann Model and the Embedded Board, Embedded Processors - Architecture Models, Internal Design, Performance; Memory Systems - ROM, RAM, Auxiliary Memory, Memory Management of External Memory, Board Memory and Performance; Board Input/output - Serial and Parallel I/O, Interfacing the I/O Components, Performance; Buses - Arbitration and Timing, Integration with other Board Components, Performance, Design Examples.
Embedded Software: Program Design and Analysis, Design Patterns, Models, Assembling and Linking, Compilation Techniques, Interpreters, JIT compilers, Analysis and Optimization - Execution Time, Energy and Power, Program Size; Validation and Testing, Safety-Critical System, Design Examples.
Process and Operating Systems: Real-Time Operating Systems (RTOS) and Embedded Operating Systems (EOS), RTOS Kernel Architecture, Scheduling Algorithms - Priority Based, Shortest Job First, Round Robin, FIFO, etc.; Task Synchronization - Mutual Exclusion, Semaphores; Timers, EOS, Porting RTOS or EOS on a Hardware Platform.
Embedded Application Development with 8051 Microcontroller: The 8051 Microcontroller, 8051 Assembly Language Programming, I/O Port Programming, 8051 Addressing Modes, 8051 Programming in C, 8051 Timer Programming in Assembly and C, 8051 Serial Port Programming, Interrupts Programming, Display and Keyboard Interfacing, 8051 Interfacing to External Memory, Design Examples.

Books:

1. W. Wolf, Computers as Components: Principles of Embedded Computing System Design, Harcourt India Pvt. Ltd. (Morgan Kaufmann Publishers), 2001.
2. T. Noergaard, Embedded Systems Architecture, Newnes (Elsevier), 2005.
3. S. Heath, Embedded Systems Design, 2nd Edition, Newnes (Elsevier), 2005.
4. O. Bailey, Embedded Systems Design, Dreamtech Press, 2005.
5. R. Kamal, Embedded Systems Architecture, Programming and Design, TMH, 2005.
6. M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay, the 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Edition, Pearson Education, 2007.

CSE203: MOBILE & WIRELESS COMPUTING (Full Marks – 100)

Introduction- Historical Evolution, Physical and Technological Constraints, Impacts on Computing Science
Wireless communication - Radio Propagation & Media Access, Wireless Communication Systems, Cellular Radio and Personal Communications
Wireless Networking -Packet Radio Network, Wireless LAN/WAN, Personal Communication Services
Cellular Wireless (Single-hop) Networks- Network Architecture, Mobility and Traffic Models, Radio Resource Management, Location Management, GSM, GPRS, 3G/4G systems
Mobile Ad-hoc (Multi-hop) Networks- Architectural Overview, Medium Access Protocols, Routing: Unicast & Multicast, Bluetooth, IEEE 801.11x systems
Mobile Wireless Protocols- Mobile IP, Wireless TCP, Session Mobility
Mobile Computing- Data Dissemination and Broadcast Models, Mobile Database and Mobile Transaction, Naming, Locating, and Routing, Location Awareness and Environmental Discovery
Mobile Applications and Services- Mobile Agents, Transcoding and Proxy Architecture
WAP and mobile web services,
Wireless Mobile Security- Authentication Privacy, Protocols such as WTLS, IEEE 802.11g
Pervasive/Ubiquitous Computing- Sensor Networks & Smart Environments, Power Management and Energy-Awareness Computing, Human-Computer Interactions, Wearable Computing

Books:

1. "Wireless Communications Principals and Practice", by T. S. Rappaport, 2nd ed., Prentice Hall PTR.
2. "Location Management and Routing in Mobile Wireless Networks" by A. Mukherjee, S. Bandyopadhyay, and D. Saha, 1st ed., Artech House, 2003.
3. "Networking Infrastructure for Pervasive Computing Enabling Technologies and Systems", by D. Saha, A, Mukherjee, and S. Bandyopadhyay, 1st ed., Kluwer Academic Publishers, Boston, USA, 2002.
4. "Transmission Systems Design Handbook for Wireless Networks", by H. Lehpamer, 1st ed., Artech House
5. "WLAN Systems and Wireless IP for Next Generation Communications", by N. Prasad, and A Prasad, 1st ed., Artech House.
6. "Bluetooth Revealed", by B. A. Miller, C. Bisdikian, 1st ed., Pearson Education Asia.
7. "Third Generation Systems and Intelligent Wireless Networking Smart Antennas and Adaptive Modulations", by J. S. Blogh, and L. Hanzo, 1st ed., J. W. Wiley

CSE 204: ELECTIVE-II (Full Marks – 100)

CSE 204(a): REAL-TIME SYSTEMS

\Introduction to real-time systems: Misconceptions About Real-Time Computing, Example real-time applications, Hard vs. soft real time, Reference model.
Classic uniprocessor scheduling results: Static scheduling, Dynamic scheduling, Dynamic-priority scheduling, Optimality of EDF and LLF, Utilization-based schedulability test for EDF, Non-preemptive EDF, Static-priority scheduling, Optimality of RM and DM, Utilization-based schedulability test for RM, Demand-based scheduling conditions for static-priority systems, Timing analysis
Fairness: Proportional-share scheduling, Pair scheduling.
Resource sharing: Priority inheritance and priority ceiling protocols, Stack resource protocol, Resource sharing under EDF, Lock-free approach
Mixing real-time and non-real-time: Introduction, Deferrable servers, Sporadic servers, Constant utilization and total bandwidth servers, Weighted fair queuing
Multiprocessors and distributed systems: Multiprocessor priority ceiling protocol, End-to-end scheduling.
Case Study: Basic operating-system functions needed for real-time computing, Brief survey of commercial real-time operating systems.

Books:

1. Real-time Systems, Jane Liu, Prentice Hall, 2000.
2. Real-Time Systems, C.M. Krishna and K.G. Shin, McGraw Hill,

CSE 204(b): ADVANCED SOFTWARE ENGINEERING

Agile Software Development: Principles behind agile methods — the Agile Manifesto, Comparison of Agile methodology with other methods, Suitability of Agile methods, Agile Requirements modeling, Agile artifacts, Agile methodologies: XP, FDD, AUP, Scrum, Post-Agilism.
Object Modeling using UML & Object Oriented Software Engineering: Basic Ideas on UML, Use Case Model, Class and Interaction Diagrams, Activity and State Chart Diagram, Object-Oriented Software Design Patterns, Domain Modeling
Software Risk Management - Risk Management Paradigm, Risk Taxonomy, Software Risk Evaluation (SRE), Continuous Risk Management (CRM), Team Risk Management (TRM), Methodological Framework for Software Risk Management (SRM).
Software Reliability and Quality Management: Software Reliability Issues, Statistical Testing, Software quality assurance, Process vs. product metrics, Software inspections and walkthroughs, Quality management systems, Key features of a quality management system, Standards for quality management systems, Use of ISO standards for software quality management, Software Capability Maturity Model (CMM).

Computer Aided Software Engineering: Basic Ideas on CASE Tools, Characteristics of CASE Tools, categories of CASE tools, CASE versus case tools

Books:

1. Handbook of Software Quality Assurance, 3rd Edition; Edited by G. Gordon Schulmeyer and James McManus; Prentice Hall PTR, Upper Saddle River, NJ, 1999.

CSE 204(d): CLUSTER AND GRID COMPUTING

Cluster Computing and Parallel Programming Techniques Introduction to high performance computing brief overview of state-of-the-art parallel architectures Clusters, Hardware technologies for cluster computing, Software for cluster computing Configuring and Tuning Clusters Setting up Clusters Introduction to Message Passing Interface (MPI), MPI process creation, MPI basics and illustrative examples Introduction to Grid Computing What is Grid computing? - Virtual organizations; Cluster versus Grid; Middleware
Protection and Security in Virtual Organizations Public key cryptography; Authentication; SSL Handshake; Digital signatures; RSA; Certificates Grid Security Infrastructure Enterprise authentication systems
Web Services and Grid Services Web Services technologies- XML; SOAP/WSDL Web Services hosting environments - Apache/Tomcat Web Services Open Grid Service Architecture; Globus Toolkit Writing a Grid Service and Grid Services development
High Level Globus Toolkit Components Information Services Resource Management Schedulers and resource brokers Data Management
Grids in the Real World Some Existing Grid systems and their applications

Books:

1. High Performance Cluster Computing: Architectures and Systems, Volume 1, edited by Rajkumar Buyya
2. Foster, I., Kesselman, C., and Tuecke, S. "The Anatomy of the Grid: Enabling Scalable Virtual Organizations," Int. J. Supercomputer Applications, 2001. http://www.globus.org/research/papers/anatomy.pdf
3. http://www.globus.org/security/overview.html
4. http://www-unix.globus.org/toolkit/docs/3.2/gsi/index.html
5. Introduction to XML, http://www-106.ibm.com/developerworks/edu/x-dw-xmlintro-i.html
6. Introduction to Web Services and the WSDK v1.5, http://www.106.ibm.com/developerworks/edu/ws-dw-ws-intwsdk51-i.html
7. Publishing with UDDI, https://www6.software.ibm.com/developerworks/education/ws-psuddi51/index.html
8. "Introduction to Grid Computing with Globus" by L. Ferreira et al, IBM Redbooks, Sept 2003. (Notice Globus section is on GT2.2), http://www.redbooks.ibm.com/redbooks/pdfs/sg246895.pdf
9. "Globus Toolkit 3.0 Quick Start" by L. Ferreira et al, IBM Redbooks, Sept 2003. http://www.redbooks.ibm.com/redpapers/pdfs/redp3697.pdf
10. "The Physiology of the Grid: An Open Grid Services Architecture for Distributed Systems Integration," I. Foster, C. Kesselman, J. M. Nick, and S. Tuecke. http://www.globus.org/research/papers/ogsa.pdf

CSE 204(e): NATURAL LANGUAGE PROCESSING

Introduction and Course Overview; Natural Language and Formal Language: Regular Expressions and Finite State Automata; Words and Their Parts: Morphology; Word Construction and Analysis: Morphological Parsing; Words: Tokenization and Spelling; N-grams and Language Models; Word Classes and POS Tagging; Machine Learning Approaches to NLP and Introduction to Weka; Context-Free Grammars; Parsing with Context Free Grammars; Probabilistic and Lexicalized Parsing; Semantic Analysis ; Lexical Semantics: Word Sense Disambiguation; Lexical Semantics: Word Relations; Lexical Semantics: Semantic Roles; Robust Semantics and Information Extraction; Pronouns and Reference Resolution;

Algorithms for Reference Resolution; Machine Translation; Text Coherence and Discourse Structure; Dialogue Systems; Natural Language Generation: Story Generation

Books:

1. Speech and Language Processing: Daniel Jurafsky and James H. Martin, Pearson Education

CSE 205(P): SYSTEM DESIGN LAB (Full Marks – 100)

a) Hardware-oriented Application Lab
b) Software-oriented Application Lab