# UNIVERSITY
# OF
# CALCUTTA

# SYLLABUS
## of
## Bachelor of Science (General)
## in
## Computer Science (CMSG)
## Choice Base Credit System (CBCS)
## 2018

**Semester-wise courses for B.Sc. (General)**

| | Sem-1 | Sem-2 | Sem-3 | Sem-4 | Sem-5 | Sem-6 |
|---|---|---|---|---|---|---|
| Core Course (CC) | CC-1 | CC-2 | CC-3 | CC-4 | | |
| AECC | AECC-1 | AECC-2 | | | | |
| Skill Enhancement course (SEC) | | | SEC-A | SEC-B | SEC-A | SEC-B |
| Total No. of Courses & marks | 4x100 =400 | 4x100 =400 | 4x100 =400 | 4x100 =400 | 4x100=400 | 4x100=400 |
| Total Credits | 20 | 20 | 20 | 20 | 20 | 20 |

# Computer Science General (CMSG) Syllabus

| Courses | Topics | Credit |
|---|---|---|
| CMS-G-CC-1-1-TH<br>Sem-1-Core Course-1 Theory | Computer Fundamentals and Digital Logic Design | 04 |
| CMS-G-CC-1-1-P<br>Sem-1-Core Course-1 Practical | Word Processing, Spreadsheet, Presentation and Web design by HTML/ PHP | 02 |
| CMS-G-CC-2-2-TH<br>Sem-2- Core Course-2Theory | Algorithm and Data Structure | 04 |
| CMS-G-CC-2-2-P<br>Sem-2-Core Course-2 Practical | Programming with C | 02 |
| CMS-G-CC-3-3-TH<br>Sem-3- Core Course-3 Theory | Computer Organization | 04 |
| CMS-G-CC-3-3-P<br>Sem-3-Core Course-3 Practical | Programming using PYTHON | 02 |
| CMS-G-CC-4-4-TH<br>Sem-4- Core Course-4 Theory | Operating System | 04 |
| CMS-G-CC-4-4-P<br>Sem-4-Core Course-4 Practical | Shell Programming (Unix/Linux) | 02 |
| Skill Enhancement Courses (SEC-A & B): Choices : Semesters-3 to 6 | | |
| CMS-G-SEC-A-X-1-TH | Communication, Computer Network andInternet | 02 |
| CMS-G-SEC-A-X-2-TH | Software Engineering | 02 |
| CMS-G-SEC-B-X-1-TH | Multimedia and its Applications | 02 |
| CMS-G-SEC-B-X-2-TH | Information Security | 02 |
| Discipline Specific Elective- A (DSE- A): Candidate has to opt any oneof the following topics | | |
| CMS-G-DSE-A-5-1-TH | Data base Management System (DBMS) | 04 |
| CMS-G-DSE-A-5-1-P | Database Design and Applications | 02 |
| CMS-G-DSE-A-5-2-TH | Object Oriented Programming | 04 |
| CMS-G-DSE-A-5-2-P | Object Oriented Programming by C++/ Java | 02 |
| CMS-G-DSE-A-5-3-TH | Sensor Network and IoT | 04 |
| CMS-G-DSE-A-5-3-P | Sensor Network and IoT Lab. | 02 |
| Discipline Specific Elective- B (DSE- B): Candidate has to opt any one of the following topics | | |
| CMS-G-DSE-B-6-1-TH | Embedded Systems | 04 |
| CMS-G-DSE-B-6-1-P | Embedded Systems Lab. | 02 |
| CMS-G-DSE-A-6-2-TH | Operation Research | 04 |
| CMS-G-DSE-A-6-2-P | Operation Research Lab. | 02 |
| CMS-G-DSE-A-6-3-TH | Computational Mathematics | 04 |
| CMS-G-DSE-A-6-3-P | Computational Mathematics Lab. | 02 |

# Semester –I

| Courses | Topics | Periods | Credit |
|---|---|---|---|
| CMS-G-CC-1-1-TH Sem-1-Core Course-1 Theory | Computer Fundamentals and Digital Logic Design | 60 hours | 04 |
| CMS-G-CC-1-P Sem-1-Core Course-1 Practical | Word Processing, Spreadsheet, Presentation and Web design by HTML/ PHP | 40 hours | 02 |

**CMS-G-CC-1-1-TH:  Computer Fundamentals and Digital Logic Design**
**Core Course- 1: Theory: 60 Hours**

**Group A: Computer Fundamentals** (20 hours)
**General Concepts:**
Introduction to Computer and Problem Solving: Information and Data
Hardware: CPU, Primary and Secondary storage, Cache Memory, I/O devices, Bus structure, BIOS
Software: Systems and Application.
Generation of Computers: Super, Mainframe, Mini and Personal Computer, Work stations, Parallel machines (concept only).
Introduction to Programming Languages: Machine Language, Assembly Language, High Level Language.
Problem Solving: Flow Charts, Decision Tables and Pseudo codes.
System Software: Classifications- Operating Systems (OS); Translators – Compilers and Interpreters, Preprocessors, Assemblers, Loaders, Linkers, Line and Screen Editors, other utilities.
Virus: Concept, Detection and Protection
Multimedia: Basic Concept, associated hardware and software
Object Oriented Paradigm: Basic characteristics, Definition, Brief comparison with other types of programming paradigms.

**Group B: Digital Logic Design**(40 hours)
Number Systems and Codes: (08 hours)
Number representation: Weighted Codes, Non-weighted codes, Positional, Binary, Octal, Hexadecimal, Binary Coded Decimal(BCD), Conversion of bases. Complement notions. Binary Arithmetic, Binary Codes: Gray, Alphanumeric, ASCII, EBCDIC; Single Error-Detecting and Correcting Codes, Hamming Codes, Fixed point, Floating point representation.

Boolean Algebra: (08 hours)
Fundamentals of Boolean Algebra, Switches and Inverters, Functionally Complete Gates (AND, OR, NOT), NAND. NOR, Switching function and Boolean Function. De Morgan's Theorem, Min-term, Max term, Truthtables and minimization of switching function upto four variables, Algebraic and K-map method of Logic circuit synthesis, two-level and multi-level.

**Digital Electronics:**                             (24hours)

*Combinational Circuits:* Realization of AND and OR Gates using diodes and NOT Gate using transistors, Standard Gate Assemblies, IC chips packaging nomenclature, Half and Full Adder(3 & 4 bit), Multi-bit adders – Ripple carry and Carry Look Ahead Adder, Adder/subtractor, BCD-Adder, Data selectors/multiplexers – expansions, reductions, function realization, universal function realization, multi-function realization, Decoders: function realization, De-multiplexer and function realization, Encoder, Priority Encoder, Parity bit Generator/checker, Gray Code Generator, Code Converters, Keyboard encoder, Seven segment display unit, Comparators.

Sequential Circuits: Model of Sequential computing, Difference between Combinational and Sequential circuit, RS-Latch: using NAND and NOR Gates, RS Latch as a Static RAM Cell, Problems of Basic Latch circuits, Digital Clock – Duty Cycle, Rising time, Falling time, Clocked Flip Flops - SR, JK, D, T, Level Trigger and Edge Trigger, Excitation Functions of each flip-flops, Flip-flops with Preset and Clear, Application of Flip-flops: Asynchronous Counter(UP/DOWN) upto 4 bit counter, Decade Counter, Mod – n Counter, Finite State machine Model – State Transition Diagram and Table, Synchronous Counters – different mod-n counters, Ring counter,  Registers: Registers with parallel load, Shift Registers.

**CMS-G-CC-1-1-P: Word Processing,Spreadsheet, Presentation and Web design by HTML/ PHP**
**Core Course- 1: Practical: 40 Hours**

**Word Processing:** (05 hours)
Document creation, saving, editing; Formatting text andparagraphs**;** header and footers**;** clipart, tables; tools, Inserting images, files; mail merge; margins; Hyphenation; page setups; OLE; index and references; comments; templates; macros.
**Spreadsheet:** (05 hours)
Workbook, worksheets, cell; address; entering, editing, formatting ,filtering, sorting worksheet data; printing; charts; functions and formulas; macros; importing , exporting files;
**Presentation**:                                               (05 hours)
Slides; formatting; wizard, layout; word art; animation.

**Web Design:**                     (25 hours)
Web page design can be taught in the laboratory classes by using HTML or PHP.

**Text/ Reference Books:**
1. Digital Circuits, Vol - I & II, D. Ray Chaudhuri, Platinum Publishers.
2. Digital Systems - Principle & Applications, Tocci&Widmer, EEE.
3. Digital Logic & State Machine Design, Comer, Oxford.
4. Digital Principle & Applications, Malvino& Leach, McGraw Hill.
5. Digital Design, Mano, PHI.
6. Computer Fundamentals, Anita Goel, Pearson Education.
7. Introduction to Computer Science, P.K.Sinha, P.Sinha, BPB Publication.

# Semester –II

| Courses | Topics | Periods | Credit |
|---|---|---|---|
| CMS-G-CC-2-2-TH Sem-2-Core Course-2 Theory | Algorithms and Data Structure | 60 hours | 04 |
| CMS-G-CC-2-2-P Sem-2-Core Course-2 Practical | Programming with C | 40 hours | 02 |

**CMS-G-CC-2-2-TH: Algorithms& Data Structure**
**Core Course- 2: Theory: 60 hours**

**Introduction:** Algorithms, ADT. (04 hours)

**Arrays:** (10 hours)
One dimensional and Two Dimensional Arrays, Row Major and Column MajorForms.

**Linked List:** (16 hours)
Singly and Doubly Linked List; Operations Like Insertion, Deletion. Searching.

**Stacks and Queues:** (16 hours)
Concepts of Stack and Queue; Insertion and Deletion of Elements;Array and Linked Representation: Prefix, Infix and Postfix Notation; Postfix Expression Evaluation, Infix to Postfix.

**Searching:** (04 hours)
Algorithm of Sequential, Binary Search Techniques.

**Sorting:** (10 hours)
Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort.

**CMS-G-CC-2-2-P: Programming with C**
**Core Course- 2: Practical: 40 hours**

**Basic Structure:** Character set, keywords, identifiers, constants, variables and type declaration. Sample programs, preprocessor.

**Operators:** Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, comma; operator precedence and associativity; arithmetic expression-evaluation and type conversion. Character I/O, Escape sequence and formatted I/O.

**Branching and Looping:** if, if-else, while, do-while, for.
**Arrays:** One-dimensional and 2-dimensional. Different types of uses. String handling with arrays – read and write, concatenation, comparison, string functions.

**User defined functions:** Need; Call by Reference and Call by value; return values and types; nesting of functions; recursion.

**Structures:** Initialization; arrays of a structure, arrays within structures, structure within structure, size of structures, Dynamic Storage Allocation.

**Pointers:**Declaration and initialization; operators; pointer arithmetics; accessing variables, pointer & arrays, strings, functions, Linked lists, concepts and use in C with different examples.

**File handling:**Opening & Closing, I/O.

**Other Features:**Bit level operations, macro definitions, union, command line arguments

**Text/ Reference Books:**
1. Data Structure ,Liptsuitz, S. Outline Series.
2. Data Structure, Ellis Horowitz and SartazSahani, Galgotia.
3. Data Structure using C, S.K.Bandyopadhyay and K.N.Dey, Pearson Education.
4. Data Structure and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education.
5. Programming in C. E. Balagurusamy, TMH.
6. Let us C, Y. Kanetkar, BPB Publication.

# Semester –III

| Courses | Topics | Periods | Credit |
|---------|--------|---------|--------|
| CMS-G-CC-3-3-TH<br>Sem-3-Core Course-3 Theory | Computer Organization | 60 hours | 04 |
| CMS-G-CC-3-3-P<br>Sem-3-Core Course-3 Practical | Programming using Python | 40 hours | 02 |

**CMS-G-CC-3-3-TH:Computer Organization**
**Core Course- 3: Theory: 60 hours**

**Basic Computer Organization:** (15 hours)
IAS Computer, Von Neumann Computer, System Bus. Instruction Cycle, Data Representation, Machine instruction and Assembly Language, CPU Organization: Arithmetic and Logic Unit, Control Unit, CPU Registers, Instruction Registers, Program Counter, Stack Pointer. CISC & RISC processors.

**Instruction:**                                                      (02 hours)
Operation Code and Operand. Zero, One, Two and Three address instruction. Instruction types. Addressing modes. Stack organization.

**Control Unit:**(05 hours)
Control Structure and Behaviour, Hardwired Control and Micro programmed Control : Basic Concept, Parallelism in Microinstruction.

**ALU:** (10 hours)
Basic Structure of ALU, Addressing mode, Instruction Formats, Handling of interrupts and subroutines, Combinational ALU, 2's Complement Addition, Subtraction Unit, Booth's Algorithm for multiplication and division.

**Memory:**(15 hours)
Types of Memory, RAM, ROM, EPROM, EEPROM, DRAM, SRAM, SAM, PLA. Different storage technology; Memory Hierarchy:CPU Register, Cache Memory, Primary Memory, Secondary Memory and Virtual Memory.

**I/O:**                                                      (08 hours)
Polling, Interrupts, DMA, I/O Bus and Protocol, Memory mapped I/O and I/O mapped I/O,I/O system organization and interfacing, Bus: SCSI, PCI, USB, Bus arbitration.

**Computer Peripherals:**                                    (05 hours)
VDU, Keyboard, Mouse, Printer, Scanner etc.

**Text/ Reference Books:**
1. Computer Architecture and Organizations, J.P.Hayes, TMH.
2. Computer System Architecture, M. Morris Mano, PHI.
3. Computer Organization and Architecture, William Stallings, Pearson Education.
4. Computer Architecture and Logic Design, Thomas C. Bartee, Mc. Graw Hill.

**CMS-G-CC-3-3-P:Programming using Python**
**Core Course- 3: Practical: 40 hours**
**Open Source Computer Programming Language Python**

**Planning the Computer Program:** (02 hours)
Concept of problem solving, Problem definition, Program design, Debugging, Documentation.

**Techniques of Problem Solving:** (02 hours)
Flowcharting, decision table, algorithms, Structured programming concepts, Programming methodologies viz. top-down and bottom-up programming.

**Overview of Programming:** (02 hours)
Structure of a Python Program, Elements of Python

**Introduction to Python:** (04 hours)
Python Interpreter, Using Python as calculator, Python shell,Indentation, Atoms, Identifiers and keywords, Literals, Strings, Operators(Arithmetic operator, Relational operator, Logical or Boolean operator))

**CreatingPython Programs:** (20 hours)
Input and Output Statements, Control statements(Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments.

**Iterationand Recursion:** (10 hours)
Conditional execution, Alternative execution, Nested conditionals, Return statement, Recursion, Stack diagrams for recursive functions, Multiple assignment, while statement, for statement.

**Strings and Lists:** (15 hours)
String as a compound data type, Length, Traversal and the forloop, String slices, String comparison, A find function, Looping and counting, List values, Accessing elements, List length, List membership, Lists and for loops, List operations, List deletion.

**Object Oriented Programming:** (05 hours)
Introduction to Classes, Objects and Methods.

**Text/ Reference Books :**
1.      John V. Guttag, "Introduction to Computation and Programming Using Python", MIT Press
2.      Allen Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly
3.      Mark Lutz, "Learning Python, 5th Edition", O'Reilly

# Semester –IV

| Courses | Topics | Periods | Credit |
|---|---|---|---|
| CMS-G-CC-4-4-TH<br>Sem-4-Core Course-4 Theory | Operating System | 60 hours | 04 |
| CMS-G-CC-4-4-P<br>Sem-4-Core Course-4 Practical | Shell Programming (Unix/ Linux) | 40 hours | 02 |

**CMS-G-CC-4-4-TH:Operating System**
**Core Course- 4: Theory: 60 hours**

**System Software:**(03 hours)
Introduction: Different System Softwares

**Introduction to Operating Systems:** (15 hours)
What is OS? User mode, Kernel mode, Mode Switching, Multiprogramming, Multitasking OS, Concepts of processes, Files, Shell, System calls, Time sharing systems, Types of operating systems: Operating systems for personal computers & workstations.

**Concepts of Synchronization:**(10 hours)
Critical Regions, Semaphores, Monitor Inter Process Communication Mechanism.

**Processor Management:**(07 hours)
Scheduling and its types, Priority Queue; Deadlock: Definition, Prevention, Avoidance,Detection, Recovery.

**I/O Management:**(08 hours)
Device and Device Controllers, Interrupt Handlers and Device drivers.

**Memory Management:**(10 hours)
Logical & Physical memory, Contiguous allocation, Paging, Segmentation, Swapping,Real andVirtual memory, Page Replacement Techniques.

**File Systems:**(07 hours)
Files and Directories, File Servers, Security and Protection.

**CMS-G-CC-4-4-P:Shell Programming (Unix/ Linux)**
**Core Course- 4: Practical: 40 hours**

**Shell Programming:**Concept and simple programming problems.
Linux system calls, IPC problems, use of semaphore for synchronization problems.

**Text/Reference Books:**
1. Operating Systems, H.M.Deitel, Pearson Education.
2. Operating System Concepts, A.Silberschatz, Peter B. Galvin, G.Gagne, John Wiley and sons.
3. Unix Shell Programming, Y. Kanetkar.
4. Your Unix The Ultimate guide, Sumitabha Das, Mc.Graw Hill.

# Semester –III to VI

**CMS-G-SEC-A-X-1-TH: Communication, Computer Network and Internet**
**Skill Enhancement Course – A (SEC-A-1): Choice-1: Theory: 40 hours**

**Communication and Network:** (30 hours)
**Introduction:** Components, Uses, Application
**Network Hierarchy:**LAN, MAN, WAN; Topology;
**Network Software:**Layered, Interface, Protocol, Connection Less and Connection Oriented Service.
Reference Model:ISO-OSI and TCP/IP; Functionalities of each layer, Comparison between two models.
**Data and Signals (Analog and Digital):**Periodic & Non-periodic signals, FDM, TDM, Bandwidth, Bit Rate, Baud Rate, Bit Length, and Composite Signal.
**Transmission Media:**Transmission Spectrum, Guided (Twisted Pair, Coaxial, Optical Fiber) and Unguided (Radio Wave, Microwave, Infrared, and Satellite Communication: Geostationary, Low Orbit and VSAT).
**Transmission Impairments:**Noise, Distortion and Attenuation.
**Digital Transmission:** Line Coding (NRZ, NRZ-L,NRZ-I, RZ, Manchester, Differential Manchester); Block Coding (Basic Idea); Code Modulation (PCM, DM), Concepts of ADSL Modem.
**Analog Transmission:**Shift Keying (ASK, FSK, PSK, QPSK, QAM);
**Multiplexing:**FDM, TDM, WDM.

**Internet:**(10 hours)
Bridges, Routers, Modem, Connectivity concept, DNS, URL, ISDN, WWW, Browser, IP Address, E-mail: Architecture and services, Voice and Video conferencing, Internet service providers, ADSL.

**Text/ Reference Books:**
1. Data Communication and Networking, B.A. Forouzan, TMH.
2. Data and Computer Communication, W. Stallings, Pearson Education.
3. Computer Network, Tanenbaum, Pearson Education.

**CMS-G-SEC-A-X-2-TH: Software Engineering**
**Skill Enhancement Course – A (SEC-A-2): Choice-2: Theory: 40 hours**

**Introduction:** (12 hours)

Defining System, open and closed system, modeling of system, Communication system, Software life cycle, Different Models: Classical and Iterative Waterfall Model; Spiral Model and its importance towards application for different system representations, Comparative Studies

**Software Requirement and Specification Analysis:**(08 hours)
Requirements Principles and its analysis principles; Specification Principles and its representations

**Software Design Analysis:** (08 hours)
Different levels of DFD Design, Physical and Logical DFD, Use and Conversions between them, Process Representation – Pseudo English, Tight English, Decision Tables and Trees, Structured analysis – Structure Chart Conversion from DFD: Transform Centric and Transaction Centric conversions algorithms, Coupling and Cohesion of the different modules

**Software Cost Estimation Modeling:** (06 hours)
Heuristic and Empirical Modeling; COCOMO

**Software Testing:** (04 hours)
Software Verification and Validation; Testing objectives, Testing Principles, Testability; Error and Faults; Unit Testing, White Box and Blank Box Testing, Test Case Design: Test Vector, Test Stub

**Software Quality Assurances:** (02 hours)
Concepts of Quality, Quality Control, Quality Assurance, SQA Activities, IEEE Standard for Statistical Software Quality Assurances (SSQA) criterions.

**Text/ Reference Books:**
1. Fundamentals of Software Engineering, Rajib Mall, PHI.
2. Software Engineering, Pressman.

**CMS-G-SEC-B-X-1-TH: Multimedia and its Applications**
**Skill Enhancement Course – B (SEC-B-1): Choice-1: Theory: 40 hours**

**Multimedia System:** (10 hours)
An overview of multimedia system and media streams, Source representation and compression techniques text, speech and audio, still image and video.

**Multi-modal Communication:** (10 hours)
Video conferencing, networking support.

**Multimedia OS:** (20 hours)
Synchronization and QoS, Multimedia Servers.

**Text/ Reference Books:**
1. Multimedia: Making it work,Tay Vaughan, TMH.
2.Multimedia: Computing, Communications Applications, R Steinmetz and K Naharstedt, Pearson.

**CMS-G-SEC-B-X-2-TH: Information Security**
**Skill Enhancement Course – B (SEC-B-2): Choice-2: Theory: 40 hours**

**Overview**                                                    (05 hours)
Overview of Security Parameters: Confidentiality, Integrity and availability-security violation, OSI security architecture.

**Cryptography**                                               (15 hours)
Mathematical Tools for Cryptography, Symmetric Encryption Algorithm, Theory of Block cipher design, Risk assessment, Network security management, Firewalls, Web and wireless security management, Computer security log management, IT security infrastructure, Operating system security, user security, program security

**Finite Field and Number Theory:**                            (05 hours)
Groups, Rings, Fields-Modular, Prime numbers, Fermat's and Euler's Theorem, Chinese remainder Theorem, Discrete Logarithm.

**Internet Firewalls for Trusted System:**                     (05 hours)
Roles of Firewalls, Firewall related terminology, Types of Firewalls, Firewall designs,

**E-Mail, IP & Web Security (Qualitative study)**              (10hours)
**E-mail Security:** Security Services for E-mail-attacks possible through E-mail, Pretty Good S/MIME.
**IP Security**: Overview of IPSec, IP Security Architecture, Authentication Header, Encapsulation Security Payload.
**Web Security:** Secure Socket Layer/Transport Layer Security, Basic Protocol, SSL Attacks, Secure Electronic Transaction (SET).

**Text/ Reference Books:**
1. M. Bishop, "Computer Security: Art and Science", Pearson Education, 2003.
2. M. Stamp, "Information Security: Principles and Practice", John Wiley & Sons, 2005.
3. Cryptography and Network Security, William Stallings, Eastern Economy Edition, PHI.

# Semester – V & VI

**Discipline Specific Elective Courses (DSE-A & B): Choices: Semesters-5&6**

| Semester-V: Discipline Specific Elective- A (DSE- A): Candidate has to opt any one from the following topics | | |
|---|---|---|
| CMS-G-DSE-A-5-1-TH | Data base Management System (DBMS) | 04 |
| CMS-G-DSE-A-5-1-P | Database Design and Applications | 02 |
| CMS-G-DSE-A-5-2-TH | Object Oriented Programming | 04 |
| CMS-G-DSE-A-5-2-P | Object Oriented Programming by C++/ Java | 02 |
| CMS-G-DSE-A-5-3-TH | Sensor Network and IoT | 04 |
| CMS-G-DSE-A-5-3-P | Sensor Network and IoT Lab. | 02 |
| Semester-VI: Discipline Specific Elective- B (DSE- B): Candidate has to opt any one from the following topics | | |
| CMS-G-DSE-B-6-1-TH | Embedded Systems | 04 |
| CMS-G-DSE-B-6-1-P | Embedded Systems Lab. | 02 |
| CMS-G-DSE-B-6-2-TH | Operation Research | 04 |
| CMS-G-DSE-B-6-2-P | Operation Research Lab. | 02 |
| CMS-G-DSE-B-6-3-TH | Computational Mathematics | 04 |
| CMS-G-DSE-B-6-3-P | Computational Mathematics Lab. | 02 |

**CMS-G-DSE-A-5-1-TH: Database Management System**
**Discipline Specific Elective Course – A (DSE-A-1): Choice-1: Theory: 60 hours**

**Introduction:**(10 hours)
Drawbacks of Legacy System; Advantages of DBMS; Layered Architecture of Database, Data Independence; Data Models; Schemas And Instances; Database Languages; Database

**ER Model:**      (10 hours)
Entity, Attributes and Relationship; Structural Constraints; Keys; ER Diagram of Some Example Database; Weak Entity Set; Symbolic Conventions; Specialization and Generalization; Constraints of Specialization and Generalization; Aggregation.

**Relational Model:**                                    (10 hours)
Basic Concepts of Relational Model; Relational Algebra; Tuple Relational Calculus; Domain Relational Calculus.

**Integrity Constraints:** (10 hours)
Domain Constraints, Referential Integrity, Assertions, Triggers.

**Relational Database Design:**                          (20 hours)
Problems of Un-Normalized Database; Functional Dependencies, Derivation Rules, Closure Of FD Set, Membership Of A Dependency, Canonical Cover; Decomposition to 1NF, 2NF, 3NF Or

BCNF Using FD; Lossless Join Decomposition Algorithm; Dependency preservation.

**CMS-G-DSE-A-5-1-P: Database Design and Application**
**Discipline Specific Elective Course – A (DSE-A-1): Choice-1: Practical: 40 hours**

**SQL:** Basic Structure, Data Definition, Constraints and Schema Changes; Basic SQL Queries (Selection, Insertion, Deletion, Update); Order by Clause; Complex Queries, Aggregate Function and Group by Clause; Nested Sub Queries; Correlated Sub Queries; Views (Insert-Able and Updatable), Joined Relations; Set Comparisons (All, Some); Derived Relations Etc; Grant and Revoke, Transaction in SQL.
**PHP Programming Lab**

**Text/ Reference Books:**

1. Fundamentals of Database Systems 6<sup>th</sup> Edition, R. Elmasri, S.B. Navathe, Pearson Education.
2. Database Management Systems, R. Ramakrishanan, J. Gehrke,3<sup>rd</sup> Edition, McGraw-Hill.
3. Database System Concepts 6<sup>th</sup> Edition, A. Silberschatz, H.F. Korth, S. Sudarshan, McGraw Hill.
4. Database Systems Models, Languages, Design and application Programming, R. Elmasri, S.B. Navathe, Pearson Education.

**CMS-G-DSE-A-5-2-TH: Object Oriented Programming**
**Discipline Specific Elective Course – A (DSE-A-2): Choice-2: Theory: 60 hours**

**Concepts:**                                             (20 hours)
Difference with procedure oriented programming, Data abstraction and Information Hiding: Objects, Classes and Methods, Encapsulation, Inheritance, Polymorphism,
**Object Oriented Programming through C++:**          (40 hours)
Input/ Output, Function and Operator Overloading, Constructors and Destructors, Copy Constructorsand Assignment Operator, Overloading, Single and Multiple Inheritance, Polymorphism and Virtual Functions.

**CMS-G-DSE-A-5-2-P: Object Oriented Programming by C++ / Java**
**Discipline Specific Elective Course – A (DSE-A-2): Choice-2: Practical: 40 hours**

Object Oriented Programming Lab. by using C++ / Java

**Text/ Reference Books:**
1. Object Oriented Programming with C++, Balagurusamy, TMH.
2. Effective Java by Joshua Bloch, Publisher: Addison-Wesley.

**CMS-G-DSE-A-5-3-TH: Sensor Network and IoT**
**Discipline Specific Elective Course – A (DSE-A-3): Choice-3: Theory: 60 hours**

**Introduction to Wireless sensor networks**                    (02 hours)
Definition and background, challenges and constrains.

**Node architecture** (10 hours)

Sensing subsystem, The processor subsystem, communication interface.


**Operating System** (05 hours)

Functional aspects, non-functional aspects.


**Basic Architectural framework**

**Physical Layer** (12 hours)

Basic components, source coding, channel encoding, Modulation and signal properties.


**Medium Access control** (08 hours)

Wireless MAC protocols, characteristics of MAC protocols in sensor networks, contention free MAC protocols.


**Network layer** (03 hours)

Data centric routing, proactive routing and on-demand routing, hierarchical routing, location based routing.


**Node and network Management** (10 hours)

**Power Management:** local power, Dynamic power, conceptual architecture. Time synchronization: clock and synchronization problem, Time synchronization & Protocols:


**Security** (qualitative discussion only.) (10 hours)

Fundamental of network security, challenges in wireless sensor networks, protocols and mechanisms in wireless sensor networks.

Introduction to IOT - Overview, IOT definition Evolution, IOT Architectures, Resource Management,, Data Management and Analytics, Communication Protocols, IOT Applications.

1. Wireless Sensor Network by Sohraby, Minoli and Znati, Wiley Publications.
2. Wireless Sensor Network: A network perspective by Zheng & Abbas, Wiley.
3. Building Wireless Sensor Network by Faludi, O'Reilly.
4. IOT fundamentals, David, Pearson Education.
5. Internet Of Things by Tripathy and Anuradha, CRC Press.



**CMS-G-DSE-B-6-1-TH: Embedded Systems**
**Discipline Specific Elective Course – B (DSE-B-1): Choice-1: Theory: 60 hours**

**Introduction to 8051:** (10 hours)

Overview of Microcontroller, Memory, I/O interface
Intel Microcontroller 8051: Architecture, Peripheral Interface Controller (PIC).


**Assembly Language Programming:** (10 hours)

Instruction set, Addressing Modes, Jump, Loop and Call instructions, I/O Manipulation, Serial communication, Arithmetic and logical instructions.


**Introduction to Embedded System Programming:** (20 hours)

Data types and time delays, I/O programming, Logic operations, Data conversions, Data serialization, Interrupt programming, LCD and Keyboard interfacing, ADC, DAC, sensors interfacing, interfacing 8255, I/O interfacing for 8051, interfacing 8255, 8257, 8259/ 8279, ADC, DAC.

**Hardware Description Language (VHDL):** (20 hours)
Basic Terminology, Entity Declaration, Architecture body, Configuration and package declaration, Package body, Model analysis and Simulation.

**CMS-A-DSE-B--6-1-P:Embedded Systems Lab.**
**DSE-A: Choice-3: Practical:  02 Credit:      40 hours**

**Practical:** Sample practical problems can be included related to theory.
1. Assembly Language Programming related to Microcontroller 8051.
2. VHDL programs for construction and simulation of various digital circuits.

**Text/ Reference Books:**
1. David E.Simon, "An Embedded software primer", Pearson Education.
2. Raj Kamal, "Embedded Systems:, TMH.
3. Raj Kamal, "Microcontroller", Pearson Education.
4. A VHDL Primer, J. Bhasker, Prentice Hall

**CMS-G-DSE-B-6-2-TH: Operation Research**
**Discipline Specific Elective Course – B (DSE-B-2): Choice-2: Theory: 60 hours**

**Introduction:** (05 hours)
Origin and development of operation research, Nature and characteristicfeatures, models in O.R.

**Linear Programming Problem:** (05 hours)
Introduction, mathematical formulation of the problem.

**Simplex Method:** (20 hours)
Introduction, computational procedure, artificial variable, problem ofdegeneracy.

**Duality:** (10 hours)
Concept, formulation of primal – dual, duality and simplex method, DualSimplex method.

**Transportation Problem** (05 hours)
Introduction, mathematical formulation, finding initial basicfeasible solution, optimality, degeneracy.

**Game Theory:** (10 hours)
Some basic terminology, Two-person Zero-sum Game, Game without Saddle Point – Mixed strategy, Algebraic method for $2 \times 2$ Game

**Network Scheduling** (05 hours)
Introduction, Critical Path Method (CPM).

**CMS-A-DSE-B-6-2-P:Operation Research (O.R.)Lab. using C/ Python**
**DSE-B: Choice-2: Practical:  02 Credit:     40 hours**

Lab sessions related to Theory.

**Text/ Reference Books:**
1.  Operations Research by KantiSwarup, P.K. Gupta, Man Mohan, Sultan Chand & Sons
2.  Schaum's Outline of Operations Research, Richard Bronson and GovindasamiNaadimuthu, McGraw-Hill Education
3.  Operations Research: An Introduction, Hamady.A.Taha, TMH


**CMS-G-DSE-B-6-3-TH: Computational Mathematics**
**Discipline Specific Elective Course – B (DSE-B-3): Choice-3: Theory: 60 hours**

**Errors:** (05 hours)
Introduction, Types of errors

**Interpolation:**                                          (05 hours)
Newton Forward and Backward Interpolation.

**System of Linear Equations**:                    (10 hours)
Properties: linear dependency, Rank, Singularity of coefficient matrix,
Solution methods: Gaussian Elimination, Gauss-Jordan Elimination.

**Solution of Non-linear Equations:**          (10 hours)
Bisection algorithm, Newton-Raphson method.

**Integration:**                                          (10 hours)
Trapezoidal and Simpson's $1/3^{rd}$ Rules and their composite forms

**Graph Theory: (concept only)**                (20 hours)
Basic Terminology, Models and Types, Multi graphs and Weighted graphs, Graph
Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits,
Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees.


**CMS-G-DSE-B-6-3-P:Computational Mathematics Lab.**
**Discipline Specific Elective Course – B (DSE-B-3): Choice-3: Practical: 40 hours**

Lab. based on the Graph theory and Numerical Methods using C/ Python.

**Text/ Reference Books:**
1.  Numerical Analysis and Computational Procedures by Mollah; New Central Book.
2.  Computer Oriented Numerical Methods, 3rd Edition, V Rajaraman, PHI
    3.  Graph Theory With Applications To Engineering And Computer Science by NarsinghDeo, PHI.
    4.  Introduction to Graph Theory by D B West, 2nd edition, Pearson Education