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 Sem-1-Core Course-1 Theory	Computer Fundamentals and Digital Logic Design	04
CMS-G-CC-1-1-P Sem-1-Core Course-1 Practical	Word Processing, Spreadsheet, Presentation and Web design by HTML	02
CMS-G-CC-2-2-TH Sem-2- Core Course-2 Theory	Algorithm and Data Structure	04
CMS-G-CC-2-2-P Sem-2-Core Course-2 Practical	Programming with C	02
CMS-G-CC-3-3-TH Sem-3- Core Course-3 Theory	Computer Organization	04
CMS-G-CC-3-3-P Sem-3-Core Course-3 Practical	Programming using PYTHON	02
CMS-G-CC-4-4-TH Sem-4- Core Course-4 Theory	Operating Systems	04
CMS-G-CC-4-4-P Sem-4-Core Course-4 Practical	Shell Programming (Linux)	02
Skill Enhancement Courses (SEC-A & B): Any one topic to be opted from SECA either in Semester-3 or in Semester-5. Any one topic to be opted from SECB either in Semester-4 or in Semester-6.		
CMS-G-SEC-A-X-1-TH	Communication, Computer Network and Internet	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 2 of the following topics		
CMS-G-DSE-A-5-1-TH	Data base Management System (DBMS)	04
CMS-G-DSE-A-5-1-P	DBMS Lab using SQL	02
CMS-G-DSE-A-5-2-TH	Operation Research	04
CMS-G-DSE-A-5-2-P	Operation Research Lab using C	02
CMS-G-DSE-A-5-3-TH	Computer Graphics	04
CMS-G-DSE-A-5-3-P	Computer Graphics Lab using C	02
Discipline Specific Elective- B (DSE- B): Candidate has to opt any 2 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	Object Oriented Programming	04
CMS-G-DSE-A-6-2-P	Object Oriented Programming by Java	02
CMS-G-DSE-A-6-3-TH	Computational Mathematics	04
CMS-G-DSE-A-6-3-P	Computational Mathematics Lab using C	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	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

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: 1's complement, 2's complement, 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, Boolean Function. De Morgan's Theorem, Min-term, Max term, Truth tables and minimization of Logic expression up to four variables, Boolean Algebraic and K-map methods of Logic circuit synthesis, two-level and multi-level.

Digital Electronics: (24 hours)

Combinational Circuits: Realization of AND and OR Gates using diodes and NOT Gate using transistors, Half adder 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, 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) up to 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
Core Course- 1: Practical: 40 Hours

Word Processing: (05 hours)
Document creation, saving, editing; Formatting text and paragraphs**;** 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 formula; 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.
Basic Tags and Document structure, HTML Tags, Head Tags, Title Tags, Introduction to HTML and Web design, How to create simple Web page, How to format text, Create Table, Adding Web link and Images, Forms, Adding styles and classes to web pages, Borders and Background, Adding Video and Graphics.

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: (8 hours)
One dimensional and Two Dimensional Arrays, Row Major and Column Major Forms.

Linked List: (10 hours)
Singly, Circular and Doubly Linked List; Operations Like Insertion, Deletion, Searching.

Stacks and Queues: (14 hours)
Concepts of Stack and Queue; Insertion and Deletion of Elements; Array and Linked Representation: Prefix, Infix and Postfix Notation; Postfix and Prefix Expression Evaluation using stack, Infix to Postfix conversion using stack.

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

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

Tree: (10 hours)
Binary tree; Pre-order, In-order and Post-order traversal; Binary Search Tree (BST): Creation, Insertion and Deletion

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 associatively; 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 Two-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.

Pointers: Declaration and initialization; operators; pointer arithmetics; accessing variables, pointer & arrays, strings, functions.

File handling: Opening & Closing, I/O.

Examples:

1. WAP to print the sum and product of digits of an integer.
2. WAP to reverse a number.
3. WAP to compute the sum of the first n terms of the following series,
S=1+1/2+1/3+1/4+……
4. WAP to compute the sum of the first n terms of the following series, S =1-2+3-4+5…….
5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
7. WAP to compute the factors of a given number.
8. Write a macro that swaps two numbers. WAP to use it.
9. WAP to print a triangle of stars as follows (take number of lines from user):

```
*
***
*****
*******
*********
```

10. WAP to perform following actions on an array entered by the user :

- **i)** Print the even-valued elements
- **ii)** Print the odd-valued elements
- **iii)** Calculate and print the sum and average of the elements of array
- **iv)** Print the maximum and minimum element of array
- **v)** Remove the duplicates from the array
- **vi)** Print the array in reverse order

The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.

11. WAP that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
12. Write a program that swaps two numbers using pointers.

13. Write a program in which a function is passed address of two variables and then alter its contents.
14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc() / calloc() functions or new operator.
16. Write a menu driven program to perform following operations on strings:
    a) Show address of each character in string
    b) Concatenate two strings without using strcat function.
    c) Concatenate two strings using strcat function.
    d) Compare two strings
    e) Calculate length of the string (use pointers)
    f) Convert all lowercase characters to uppercase
    g) Convert all uppercase characters to lowercase
    h) Calculate number of vowels
    i) Reverse the string
17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
18. WAP to display Fibonacci series (i) using recursion, (ii) using iteration.
19. WAP to calculate Factorial of a number (i) using recursion, (ii) using iteration.
20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion.
21. Write a menu-driven program to perform following Matrix operations (2-D array implementation): a) Sum b) Difference c) Product d) Transpose
22. Copy the contents of one text file to another file, after removing all whitespaces.
23. Write a function that reverses the elements of an array in place. The function must accept only one pointer value and return void.
24. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.
25. Add two distances in meter kilometer system using structure.
26. Add two complex numbers using structures.
27. Calculate the difference between two time periods using structures.

These are only examples; more can be included related to the theory. Use open source C compiler.

Text/ Reference Books:

1. Data Structure , Liptsuitz, S. Outline Series.
2. Data Structure, Ellis Horowitz and Sartaz Sahani, 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 Sem-3-Core Course-3 Theory	Computer Organization	60 hours	04
CMS-G-CC-3-3-P 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 cycle, 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, One, Two and Three address instruction. Instruction types.

Control Unit: (05 hours)
Control Structure, Hardwired Control and Micro programmed Control: Basic Concept, Parallelism in Micro-instruction.

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: Primary and Secondary; RAM, ROM, EPROM, EEPROM, DRAM, SRAM, PLA. Different storage technology; Memory Hierarchy: CPU Register, Cache 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 3

Introduction to the Python: (2 hours)
Interpreted v. compiled languages. The importance of whitespace.Variables and the assignment operator, the binding of names to objects, and aliasing. Keywords and their significance.

Ordered Datatypes - Strings, Lists and Tuples: **(**6 hours)
Strings: definition, declaration, and immutability, string constants, declaration, and the equivalence of single and double quotes. Multi-line strings. Raw strings. String formatting using the format function and the % operator. f-strings in Python 3.6+. Built-in functions: count, find, replace, upper, lower, strip, etc. Time and space complexities of the functions and operations.

Lists: definition, declaration, and mutability. Nested lists. Indexing and slicing: same as strings. List comprehensions. The split and join methods. Built-in list functions – append, extend, count, find, index, etc. Time and space complexities of the functions and operations.

Tuples**:** definition, declaration, and immutability. Packing and unpacking lists and tuples.

The + and * operators on strings, lists, and tuples. Indexing and slicing strings, lists, and tuples.

Conditionals and Iterators: (12 hours)
Conditionals: If, elif, and else statements. Nested conditionals. Containment checking in containers using the in keyword.

Looping constructs: while and for loops. Flow control using break, continue, and pass. Nested loops.

User-defined Functions and Recursion (10 hours)
Functions: definition, function signature, positional, default, and keyword arguments. Documentation strings.

Recursion: basic idea, implementing recursion, sharing variables across the recursion stack, modifying the size of the recursion stack.

File Handling and Exception Handling (5 hours)
File handling: open and close methods, the different read and write modes. Using the with open approach to files. read, readline, readlines functions.

Exception handling: the popular errors- NameError, ValueError, SyntaxError, KeyError, AttributeError, etc, and their cause and effects. Using try-except blocks for graceful handling of exceptions.

Unordered data types - Sets and Dictionaries (5 hours)
Basic concepts of hashing: hash functions, open chain, closed chain, advantages and disadvantages compared to conventional ordered data types. The hash() function in Python.

Sets and frozensets: definition, declaration, mutability, and advantages over lists / tuples. Insertion, deletion, union, intersection, and other built-in operations. Time and space complexities of the functions and operations.

Dictionaries: Concept of keys and values. Immutability requirement for keys. Basic operations on dictionaries. Iterating over the keys and key, value pairs of a dictionary. Dictionary inversions.

Suggested lab exercises

Use Python 3.6 or above. Use a text editor sensitive to whitespace like Notepad++, gedit, vim, Sublime Text, and NOT Notepad / WordPad.

1. The Interpreter as a calculator. Basic arithmetic operations. Introduction to the simple numeric data types – integers, floating point numbers, Boolean, complex numbers. Interconversion of datatypes.
    a. Use the Python prompt as a basic calculator. Explore the order of operations using parentheses.
    b. Explore the various functions in the math module. Eg: find GCD of two numbers, area and perimeter of circle using math.pi, etc.
    c. Exploring the complex data type and their operations, eg: finding the modulus and phase angle of a complex number.
    d. The print function – Printing values. Repeat the previous experiments now using the print function
2. Basic user interactions using the print() and input() functions.
    a. Write a simple python script using the print function in a text editor, save it with the extension ".py". Run it in the terminal / command prompt.
    b. Take input two strings from the user, and print the first one twice, and the other one thrice.
    c. Ask the user to enter two numbers, and output the sum, product, difference, and the GCD.
    d. More programs that test concepts learned in week 1 which involves the usage of the print and input functions.
3. Strings, List, Tuples, the re (regular expression) module
    a. Ask the user for two strings, print a new string where the first string is reversed, and the second string is converted to upper case. Sample strings: "Pets", "party", output: "steP PARTY". Only use string slicing and + operators.
    b. From a list of words, join all the words in the odd and even indices to form two strings. Use list slicing and join methods.
    c. Simulate a stack and a queue using lists. Note that the queue deletion operation won't run in O(1) time.
4. Conditionals, looping constructs, and generators
    a. Use list comprehension to find all the odd numbers and numbers divisible by 3 from a list of numbers.
    b. Using while loops to do Gaussian addition on a list having an even number of numbers. Print each partial sum. Eg: if the list is [1, 2, 3, 4, 5, 6], the program should output "1 + 6", "2 + 5", and "3+4" in separate lines, and the result of the addition "21". Extend it to handle lists of odd length.
    c. Primality testing using for and while loops.
    d. Use (c) to generate a list of primes within a user-given range.
5. User defined functions

a. Implement popular sorting algorithms like quicksort and merge sort to sort lists of numbers.
b. Implement the Pascal's triangle.
c. Three positive integers a, b, and c are Pythagorean triples if $a^2 + b^2 = c^2$. Write a function to generate all Pythagorean triples in a certain range.
d. Write two functions that simulates the toss of a fair coin, and the roll of an unbiased 'n' sided die using the random module.
e. Like (d), but now the coin and the die are not fair, with each outcome having a given probability.

6. File handling, sys, pickle and csv modules
    a. Basic file operations. Explore the different file modes.
    b. Emulate the unix 'cp', 'grep', 'cat' programs in Python. In each case, the user should pass the arguments to the program as command line arguments.
7. Sets and dictionaries
    a. Use sets to de-duplicate a list of numbers, and a string such that they contain only the unique elements
    b. Use the set union and intersection operations to implement the Jaccard and Cosine similarity of two sets.
    c. Use dictionaries to count the word and letter occurrences in a long string of text.
    d. Invert a dictionary such the previous keys become values and values keys. Eg: if the initial and inverted dictionaries are d1 and d2, where d1 = {1: 'a', 2: 'b', 3: 120}, then d2 = {'a': 1, 2: 'b', 120: 3}.
    e. What if the values in (d) are not immutable? Use frozensets. For repeated values, use lists. Eg: if d1 = {1: 'a', 2: 'a', 4: [1, 2]}, then d2 = {'a': [1, 2], frozenset([1, 2]): 4}.
    f. Write a function to generate the Fibonacci numbers in (a) exponential time using the naïve algorithm, and (b) in linear time using dynamic programming (memoization) with a dictionary.

References

1. Guttag, John V. *Introduction to Computation and Programming Using Python: With Application to Understanding Data*. MIT Press, 2016. (2nd edition)

2. Shaw, Zed A. *Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code*. Addison-Wesley Professional, 2017.

3. Downey, Allen B. *Think Python 2e*. Green Tea Books, 2015. (2nd edition)

4. Gries, Paul, Jennifer Campbell, and Jason Montojo. *Practical Programming: An Introduction to Computer Science Using Python 3.6*. Pragmatic Bookshelf, 2017.

Semester –IV

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

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

System Software: (04 hours)
Introduction: Different System Softwares

Introduction (08 hours)
Basic OS functions, types of operating systems- batch processing, multiprogramming, time sharing, multiprocessing, distributed and real time systems.

Operating System Organization (02 hours)
Processor and user modes, kernels, system calls and system programs.

Process (18 hours)
System view of the process and resources, process control block, I/O and CPU bound process, process hierarchy, concept of threads, Process Scheduling: Preemptive and non-preemptive scheduling, Long term scheduling, short term/CPU scheduling (FCFS, SJF, SRJF, RR and priority) and medium term scheduling
Process Synchronization: Concurrent processes, critical section, semaphores and application, methods for inter-process communication;

Deadlock: (09 hours)
Definition, Prevention, Avoidance, Detection, Recovery.

Memory Management (14 hours)
Physical and logical address space; memory allocation strategies –fixed and variable partitions, paging, segmentation, virtual memory

File and I/O Management (05 hours)
Directory structure, file operations, file allocation methods, disk management.

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

1. Write a shell script to convert the content of a file from lower case to upper case.
2. Write a shell script to count the words, lines and characters of a given file. File name should be provided at run time.
3. Write a shell script that take a word from user and find out the frequency of the word in a given file.
4. Write a shell script that gets executed at the moment of user login and it displays Good Morning, Good afternoon, Good Evening, Good Night, depending upon the time at which the user logs on.

5. Write a shell script to print Pascal diamond.
6. Write a shell script to find a number using sequential search method.
7. Write a shell script to find a number using binary search technique.
8. Write a shell script to sort a set of integer numbers using bubble sort.
9. Write a shell script to find out the factorial of a given number.
10. Write a shell script to reverse a string and check whether it is a palindrome.
11. Write a shell script to find the roots of a quadratic equation $ax^2 + bx + c = 0$, considering all possible cases.
12. Write a shell script for menu based system to insert records for employees with employee ID, name, designation, salary in a data file, also display records when necessary. Display salary for the employee asked.

These are only examples, more can be included.

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

Skill Enhancement Courses (SEC-A & B): Choices : Semesters-3 to 6		
Courses	**Topics**	**Credit**
CMS-G-SEC-A-X-1-TH	Communication, Computer Network and Internet	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

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 Computer Network: (30 hours)

Introduction: Components, Uses, Application
Network Hierarchy: LAN, MAN, WAN; Topology;
Reference Model: OSI; Functionalities of each layer, **Data and Signals (Analog and Digital):** Periodic & Non-periodic signals, 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), Noise, Attenuation.

Digital Transmission: Line Coding (NRZ, RZ, Manchester); Block Coding (Basic Idea); Code Modulation (PCM, DM), Concepts of ADSL Modem.

Analog Transmission: Shift Keying (ASK, FSK, PSK, QAM)

Multiplexing: FDM, TDM, WDM.

Internet: (10 hours)
Bridges, Routers, Modem, Connectivity concept, DNS, URL, ISDN, WWW, Browser, Protocols, TCP, 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; Prototype Model; Evolutionary Model and its importance towards application for different system representations, Comparative Studies

Software Requirement and Specification Analysis: (07 hours)
Requirements Principles and its analysis principles; Specification Principles and its representations

Software Design Analysis: (12 hours)
Different levels of DFD Design, Physical and Logical DFD, Use and Conversions between them, Decision Tables and Trees, Coupling and Cohesion of the different modules, COCOMO

Software Testing: (07 hours)
Software Verification and Validation; Testing objectives, Testing Principles, Testability; Error and Faults; Unit Testing, White Box and Blank Box Testing.

Software Quality Assurances: (02 hours)
Concepts of Quality, Quality Control, Quality Assurance

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

Internet Firewalls for Trusted System: (05 hours)

Roles of Firewalls, Firewall related terminology, Types of Firewalls.

E-Mail, IP & Web Security (Qualitative study) (10hours)

E-mail Security: Security Services for E-mail-attacks possible through E-mail.

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

Discipline Specific Elective- A (DSE- A): Candidate has to opt any 2 from the following topics		
CMS-G-DSE-A-5-1-TH	Data base Management System (DBMS)	04
CMS-G-DSE-A-5-1-P	DBMS Lab using SQL	02
CMS-G-DSE-A-5-2-TH	Operation Research	04
CMS-G-DSE-A-5-2-P	Operation Research Lab using C	02
CMS-G-DSE-A-5-3-TH	Computer Graphics	04
CMS-G-DSE-A-5-3-P	Computer Graphics Lab using C	02
Discipline Specific Elective- B (DSE- B): Candidate has to opt any 2 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	Object Oriented Programming	04
CMS-G-DSE-B-6-2-P	Object Oriented Programming by Java	02
CMS-G-DSE-B-6-3-TH	Computational Mathematics	04
CMS-G-DSE-B-6-3-P	Computational Mathematics Lab using C	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: (12 hours)
Drawbacks of Legacy System; Advantages of DBMS; Layered Architecture of Database, Data Independence; Data Models; Schemas and Instances; Database Languages.

ER Model: (12 hours)
Entity, Attributes and Relationship; Structural Constraints; Keys; ER Diagram of Some Example Database; Weak and Strong Entity Set; Symbolic Conventions; Specialization and Generalization; Constraints of Specialization and Generalization; Aggregation.

Relational Model: (14 hours)
Basic Concepts of Relational Model; Relational Algebra; Tuple Relational Calculus

Relational Database Design: (22 hours)
Problems of Un-Normalized Database; Functional Dependencies (FD), Derivation Rules, Closure of FD Set, Membership of a Dependency, Canonical Cover; Decomposition to 1NF, 2NF, 3NF and BCNF using FD; Lossless Join Decomposition Algorithm; Dependency preservation.

CMS-G-DSE-A-5-1-P: DBMS Lab using SQL
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.

Text/ Reference Books:

1. Fundamentals of Database Systems 6th Edition, R. Elmasri, S.B. Navathe, Pearson Education.
2. Database Management Systems, R. Ramakrishanan, J. Gehrke,3rd Edition, McGraw-Hill.
3. Database System Concepts 6th 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

Concept of OOPs (02 hours)
Difference with procedure oriented programming, Data abstraction and information hiding: Objects, Classes, methods.

Introduction to Java (04 hours)
Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods).

Arrays, Strings and I/O (08 hours)
Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

Object-Oriented Programming Overview (04 hours)
Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata. (14 hours)
Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

Exception Handling, Threading, Networking and Database Connectivity (15 hours)
Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using

java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

Applets (13 hours)

Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, textfields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

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

Object Oriented Programming Lab. by using Java

Text/Reference Books

1. Java: The Complete Reference, Herbert Schildt, McGraw-Hill Education.
2. The Java Language Specification, Java SE by James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley, Published by Addison Wesley.
3. Effective Java by Joshua Bloch, Publisher: Addison-Wesley.
4. Core Java 2 by Cay S. Horstmann, GaryCornell, Volume 1 , Prentice Hall.
5. Programming with Java by E. Balaguruswamy, McGraw Hill.
6. Java: How to Program by Paul Deitel, Harvey Deitel, Prentice Hall.
7. Programming with JAVA by John R. Hubbard, Schaum's Series.

CMS-G-DSE-A-5-3-TH: Computer Graphics
Discipline Specific Elective Course – A (DSE-A-3): Choice-3: Theory: 60 hours

Introduction (05 hours)

Basic concepts of Graphics Devices– CRT monitor, Monochrome and Color Monitor displaying technique only, Physical and logical units of graphics devices – Pixel and its different properties, Basic idea for image or picture formation using pixels – Raster Scan and Vector Scan.

Basic geometrical shapes formation algorithms (05 hours)

Concepts Co-ordinate System, Line Segment, Digital Differential Analyzer, Circle and arc segment, Bresenham's and Midpoint scan conversion algorithms.

Two Dimensional Transformations (14 hours)

Transformations operations - Translation, Rotation, Scaling. Reflection, Shearing and Inverse of these operations, Homogeneous coordinate system representation, matrix representation.
Composite Transformations Operations – Basic ideas and matrix representations by matrix concatenation for a particular operation.

Two Dimensional Clipping (08 hours)

View port, window port, display device, Point Clipping, Line Clipping, Cohen-Sutherland line clipping algorithm, Sutherland Hudgeman polygon clipping algorithm

Projection (08 hours)

Basic Concept of Projection operation and its application, Classification – Perspective, Parallel and its subclasses, Principles of these projections (Geometric representation only, no Mathematical Foundation and algorithms)

Applications (02 hours)

Basic Concepts Computer Art, Animation – Animating and modeling of real world, Morphing – Classification of morphing and Application to the Advertisements and publicities.

CMS-A-DSE-A-5-3-P: Computer Graphics Lab using C
DSE-A: Choice-3: Practical: 02 Credit: 40 hours

Computer Graphics lab is only based on theory including only Two-dimensional Transformation and Line Drawing.

Text/ Reference Books:

1. Computer Graphics by Zhigang Xiang, Roy Plastock, Schaum's Outlines Series.
2. Computer Graphics by Hearn & Baker, Pearson.
3. Procedural Elements for Computer Graphics by David F. Roger, 2nd Edition, TMH.
4. Computer Graphics by Foley, Van Dam, Feimer& John, Pearson.
5. Introduction to Computer Graphics and Multimedia, Mukhophadhyay and Chattopadhyay, Vikas publication.

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 characteristic features, 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 of degeneracy.

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

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

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

Assignment Problem: (05 hours)
Introduction, mathematical formulation and solution.

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 Simplex Method, Transportation Problem and Assignment Problem.

Text/ Reference Books:
1. Operations Research by Kanti Swarup, P.K. Gupta, Man Mohan, Sultan Chand & Sons
2. Schaum's Outline of Operations Research, Richard Bronson and Govindasami Naadimuthu, 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's 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.

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 Narsingh Deo, PHI.
4. Introduction to Graph Theory by D B West, 2nd edition, Pearson Education