UNIVERSITY OF CALCUTTA

Notification No. CSR/ 12 /18

It is notified for information of all concerned that the Syndicate in its meeting held on 28.05.2018 (vide Item No.14) approved the Syllabi of different subjects in Undergraduate Honours / General / Major courses of studies (CBCS) under this University, as laid down in the accompanying pamphlet:

List of the subjects

Sl. No.	Subject	Sl. No.	Subject
1	Anthropology (Honours / General)	29	Mathematics (Honours / General)
2	Arabic (Honours / General)	30	Microbiology (Honours / General)
3	Persian (Honours / General)	31	Mol. Biology (General)
4	Bengali (Honours / General /LCC2 /AECC1)	32	Philosophy (Honours / General)
5	Bio-Chemistry (Honours / General)	33	Physical Education (General)
6	Botany (Honours / General)	34	Physics (Honours / General)
7	Chemistry (Honours / General)	35	Physiology (Honours / General)
8	Computer Science (Honours / General)	36	Political Science (Honours / General)
9	Defence Studies (General)	37	Psychology (Honours / General)
10	Economics (Honours / General)	38	Sanskrit (Honours / General)
11	Education (Honours / General)	39	Social Science (General)
12	Electronics (Honours / General)	40	Sociology (Honours / General)
13	English ((Honours / General/ LCC1/ LCC2/AECC1)	41	Statistics (Honours / General)
14	Environmental Science (Honours / General)	42	Urdu (Honours / General /LCC2 /AECC1)
15	Environmental Studies (AECC2)	43	Women Studies (General)
16	Film Studies (General)	44	Zoology (Honours / General)
17	Food Nutrition (Honours / General)	45	Industrial Fish and Fisheries – IFFV (Major)
18	French (General)	46	Sericulture – SRTV (Major)
19	Geography (Honours / General)	47	Computer Applications – CMAV (Major)
20	Geology (Honours / General)	48	Tourism and Travel Management – TTMV (Major)
21	Hindi (Honours / General /LCC2 /AECC1)	49	Advertising Sales Promotion and Sales Management –ASPV (Major)
22	History (Honours / General)	50	Communicative English –CMEV (Major)
23	Islamic History Culture (Honours / General)	51	Clinical Nutrition and Dietetics CNDV (Major)
24	Home Science Extension Education (General)	52	Bachelor of Business Administration (BBA) (Honours)
25	House Hold Art (General)	53	Bachelor of Fashion and Apparel Design – (B.F.A.D.) (Honours)
26	Human Development (Honours / General)	54	Bachelor of Fine Art (B.F.A.) (Honours)
27	Human Rights (General)	55	B. Music (Honours / General) and Music (General)
28	Journalism and Mass Communication (Honours / General)		

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

SENATE HOUSE
KOLKATA-700073
The 4th June, 2018

(Dr. Santanu Paul)
Deputy Registrar
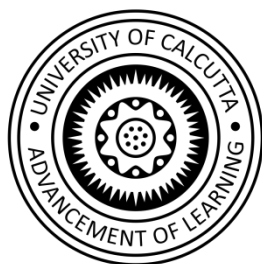
UNIVERSITY
OF
CALCUTTA

SYLLABUS
of
Bachelor of Science (B. Sc.)
(Major)
in
Computer Application (CMAV)
Choice Based Credit System (CBCS)
2018

Syllabus for B.Sc. (Major) in Computer Application (CMAV) with Choice Based Credit System (CBCS) for Semesters– I-VI from the Academic Session 2018-19

SEMESTER – I

Semester	Courses	Topics	Credit
I	**CMAV-M-CC-1-1-TH** (Core Course-1) Theory	**Digital Logic and Computer Organization**	4
	CMAV-M-CC-1-1-P (Core Course-1) Practical	**Word Processing, Spreadsheet and Presentation**	2
	CMAV-M-CC-1-2-TH (Core Course-2) Theory	**Structured Programming Language C**	4
	CMAV-M-CC-1-2-P (Core Course-2) Practical	**Programming in C**	2

SEMESTER – I

CMAV-M-CC-1-1-TH: Digital Logic and Computer Organization
Core Course-1: Theory: 04 Credits: 60 hours

Number Systems: (03 hours)
Weighted and Non-Weighted Codes, positional, Binary, Octal, Hexadecimal, Binary coded Decimal (BCD), Gray Codes, Alphanumeric codes, ASCII, EBCDIC, Conversion of bases, Parity bits, Single Error bit detection and correcting codes: Hamming Codes, Fixed and Floating Point Arithmetic: Addition, Subtraction, Multiplication and Division.

Boolean Algebra: (05 hours)
Basic logic gates (AND, OR, NOT), De-Morgan's Theorem, Universal Logic gates (NAND, NOR), Minterm, Maxterm, Minimization of Boolean Functions using K-Map up-to four variables, Two level and multilevel implementation using logic gates, Simplification of logic expression.

Combinational Circuits: (15 hours)
Half adders, Full Adder (3-bit), Half Subtractor, Full Subtractor (3-bit) and construction using Basic Logic Gates (OR, AND, NOT) and Universal Logic Gates (NAND & NOR), BCD Adder, 1'S & 2'S Complement Adder/Subtractor unit Construction using 4 bit Full adders units, 4 bit Comparators, Multiplexer: Expansion (Cascading), Function Realization.
Encoders:- Realization of simple Encoders and priority Encoders**;** De-multiplexer, Cascading, Decoder- Function Realization**;** Parity bit Generator/Checker, Gray to Binary code converter, Binary to Gray Code Converter.

Sequential Circuits: (10 hours)
Set/Reset (SR), D, J-K, T Flip-flops using basic gates and NAND gates, Race around Condition, Master Slave J-K Flip Flop; Registers: Serial Input Serial Output, Serial Input Parallel Output, Parallel input Serial Output, Parallel Input parallel Output; Counters: Asynchronous   and Synchronous Counters: UP/DOWN Counters, Mod - N Counters.

Basic Structure of Computers and micro-operation   (05 hours)
Basic Functional Units, Basic Operational Concept, Bus Structure, IAS Computer; Registers,

Memory, Three State Bus Buffers, Arithmetic and Logical micro-operations, Instruction codes, Input/ output, Interrupt; CISC and RISC processors.

CPU Organization   (12hours)

Arithmetic and Logic Unit (ALU)- Combinational ALU, 2'S Complement Addition, Subtraction Unit, Booths Algorithm for Multiplication, Division Hardware using Restoration Division Algorithm, General register organization, Control Word, Accumulator Based, Register Based, Stack Type CPU organization; Control Unit, Micro-programmed Control Unit; Program Counter, Stack Pointer Register, Memory Address Register, Instruction Register, Memory Buffer Register, Flag registers, Temporary Registers.

Instructions.   (02 hours)

Operational Code, Operands, Zero, One, Two and Three Address Instruction, Instruction Types, Addressing modes, Data Transfer and Manipulation instructions, Program control instructions.

Input / Output Organization   (03 hours)

Polling, Interrupts, subroutines, Memory mapped IO, IO mapped IO, DMA, I/O Bus and Protocol, SCSI, PCI, USB, VDU, Keyboard, Mouse, Printer, Scanner

Memory   (05 hours)

Primary memory: ROM, PROM, EPROM, EEPROM, Flash memory, RAM: SRAM, DRAM, Cache Memory: Mapping Functions, Virtual memories, Address Translation, Memory Management requirements, Secondary Storage: Magnetic Hard Disks, Optical Disks, Magnetic Tape Systems.

CMAV-M-CC-1-1-P: Word Processing, Spreadsheet and Presentation
Core Course-1: Practical: 02 Credits: 40 hours

Word Processing: (15 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. (using MSWord and Latex)

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.

Text/Reference Books
1. Digital Circuits, Vol - I & II, D. Ray Chaudhuri, Platinum Publishers.
2. Digital Systems - Principle & Applications, Tocci & Widmer, EEE.
3. Digital Principle & Applications, Malvino & Leach, McGraw Hill.
4. Digital Design, Mano, PHI.
5. Computer System Architecture, Morris Mano, Pearson.
6. Computer Organization & Architecture, Williams Stallings, Pearson.

7. Computer Organization, Hamacher, Vranesic and Zaky, McGraw Hill.
8. Computer Architecture and Organization, J P Hayes, Tata McGRaw Hill.
9. Structured Computer Organization, Andrew S. Tanenbaum, Austin, Pearson.

CMAV-V-CC-1-2-TH: Structured Programming Language C
Core Course-2: Theory: 04 Credits: 60 hours

Introduction: (4 hours)   History, Basic
Structure, Algorithms, Structured programming constructs.

C Programming elements: (8 hours)   Character sets,
Keywords, Constants, Variables, Data Types, Operators- Arithmetic, Relational, Logical and
Assignment; Increment and Decrement and Conditional, Operator Precedence and Associations;
Expressions, type casting. Comments, Functions, Storage Classes, Bit manipulation, Input and
output.

C Preprocessor: (6 hours)   File
inclusion, Macro substitution.

Statements: (6hours)
Assignment, Control statements- if, if else, switch, break, continue, goto, Loops-while, do_while, for.

Functions: (6 hours)
Argument passing, return statement, return values and their types, recursion

Arrays: (7hours)
String handling with arrays, String handling functions.

Pointers: (10 hours)
Definition and initialization, Pointer arithmetic, Pointers and arrays, String functions and
manipulation, Dynamic storage allocation.

User defined Data types: (7 hours)
Enumerated data types, Structures. Structure arrays, Pointers to Functions and Structures, Unions

File Access: (6hours)
Opening, Closing, I/O operations.

CMAV-M-CC-1-2-P: Programming with C
Core Course-2: Practical: 02 Credits: 40 hours

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. Create Matrix class using templates. 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.

These are only examples, more can be included related to the theory.

Use open source C compiler.

Text/Reference Books:

1. Programming with C, Byron S. Gottfried, McGraw Hill.
2. The C Programming Language, Kernighan and Dennis, PHI.
3. The Complete reference C, Herbert Schildt, McGraw Hill.
4. Let Us C, Kanitkar, BPB Publication.
5. Programming in ANSI C, Balaguruswamy, McGraw Hill.
6. Programming Languages, Allen B. Tucker, Tata McGraw Hill.

Semester	Courses	Topics	Credit
II	**CMAV-M-CC-2-3-TH** (Core Course – 3) Theory	**Data Structure**	4
	CMAV-M-CC-2-3-P (Core Course – 3) Practical	**Data Structure using C**	2
	CMAV-M-CC-2-4-TH (Core Course – 4) Theory	**Discrete Mathematics**	4
	CMAV-M-CC-2-4-P (Core Course – 4) Practical	**Scripting Language Python, Perl**	2

CMAV-M-CC-2-3-TH: Data Structure
Core Course-3: Theory: 04 Credits: 60 hours

Introduction to Data Structure: (01 hour)
Abstract Data Type.

Arrays: (05 hours)
1D, 2D and Multi-dimensional Arrays, Sparse Matrices. Polynomial representation (Polynomial Representation as Application).

Linked Lists: (09 hours)
Singly, Doubly and Circular Lists; Normal and Circular representation of Self Organizing Lists; Skip Lists, Polynomial representation (Polynomial Representation as Application).

Stacks: (05 hours)
Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

Queues: (05 hours)
Array and Linked representation of Queue, Circular Queue, De-queue, Priority Queues

Recursion: (05 hours)
Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

Trees: (15 hours)
Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion, Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

Searching and Sorting: (10 hours)
Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Merge Sort, Quick sort, Shell Sort, Comparison of Sorting Techniques

Hashing: (05 hours)

Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collision by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function.

CMAV-M-CC-2-3-P: Data Structure using C
Core Course-3: Practical: 02 Credits: 40 hours

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion, (ii) using iteration
12. (ii) WAP to display fibonacci series (i)using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
    (a) Insertion (Recursive and Iterative Implementation)
    (b) Deletion by copying
    (c) Deletion by Merging
    (d) Search a no. in BST
    (e) Display its preorder, postorder and inorder traversals Recursively
    (f) Display its preorder, postorder and inorder traversals Iteratively
    (g) Display its level-by-level traversals
    (h) Count the non-leaf nodes and leaf nodes
    (i) Display height of tree
    (j) Create a mirror image of tree
    (k) Check whether two BSTs are equal or not
15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
16. WAP to reverse the order of the elements in the stack using additional stack.
17. WAP to reverse the order of the elements in the stack using additional Queue.
18. WAP to implement Diagonal Matrix using one-dimensional array.
19. WAP to implement Lower Triangular Matrix using one-dimensional array.
20. WAP to implement Upper Triangular Matrix using one-dimensional array.
21. WAP to implement Symmetric Matrix using one-dimensional array.
22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
23. WAP to implement various operations on AVL Tree.

These are only sample programs, more can be included related to the theory.

Text/ Reference Books:

1) Fundamentals of Data Structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Pr.
2) Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, Cengage Learning
3) Data Structures In C, Noel Kalicharan, CreateSpace Independent Publishing Platform.
4) Adam Drozdek, Data Structures and algorithm in C, Cengage Learning.
5) The C Programming Language, Brian W. Kernighan and Dennis Ritchie, Prentice Hall.
6) Sartaj Sahni, Data Structures, Algorithms and applications in C++, Second Edition, Universities Press, 2011.

CMAV-M-CC-2-4-TH: Discrete Mathematics
Core Course-4: Theory: 04 Credits: 60 hours

Sets and Propositions: (10 hours)
Combinations of sets, Finite and Infinite sets, uncountable Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion; Multisets, Discrete probability.

Relations and Functions: (10 hours)
Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals; Binary relations, Equivalence relations and partitions, Partial ordering; Relations and Lattices; Chains and anti-chains; Functions and pigeon-hole principle,

Recurrence Relations and Recursive Algorithms: (10 hours)
Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Homogeneous solutions; Total solutions; Substitution Method, Recurrence Trees, Master Theorem

Graph Theory   (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, Spanning Trees and cut-sets, Binary search trees, Minimum spanning trees.

Prepositional Logic: (05 hours)
Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

Analysis of Algorithms: (05 hours)
Time complexity of algorithms; Complexity of problems; Introductory remarks on tractable and intractable problems.

Text/ Reference Books:
1. Elements of Discrete Mathematics, C.L. Liu, TMH.
2. Discrete Mathematics, Johnson-baugh, PE.
3. Discrete Mathematical Structure, Kolman et al., PHI.

CMAV-M-CC-2-4-P: Scripting Language Python, Perl
Core Course-4: Practical: 02 Credits: 40 hours

Planning the Computer Program: (02 hours)

Concept of problem solving, Problem definition, Program design, Debugging, Types of errors in programming, Documentation.

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

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, Assignment, Operator, Ternary operator, Bit wise operator)

Creating Python Programs: (15 hours)
Input and Output Statements, Control statements (Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments, Exception handling.

Iteration and Recursion: (05 hours)
Conditional execution, Alternative execution, Nested conditionals, Return statement, Recursion, Stack diagrams for recursive functions, Multiple assignment, while statement, for statement.

Strings and Lists: (10 hours)
String as a compound data type, Length, Traversal and the for loop, 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. Cloning lists, Nested lists

Object Oriented Programming: (02 hours)
Introduction to Classes, Objects and Methods, Standard Libraries.

Scripting language laboratory problems to be done by Python/ Perl.
At least 10 assignments should be done.

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

4. Python Programming for the Absolute Beginner, Michael Dawson, Cengage Learning.   5. Learning to Program in Python 2017, P. M. Heathcote, PG Online Limited

6. Programming Perl , Larry Wall, O'Reilly).

Semester	Courses	Topics	Credit
III	CMAV-M-CC-3-5-TH (Core Course-5) Theory	Operating System	4
	CMAV-M-CC-3-5-P (Core Course – 5) Practical	Shell Programming (Unix/ Linux)	2
	CMAV-M-CC-3-6-TH (Core Course – 6) Theory	Introduction to Algorithm	4
	CMAV-M-CC-3-6-P (Core Course – 6) Practical	Algorithm Lab	2
	CMAV-M-CC-3-7-TH (Core Course – 7) Theory	Microprocessor and its Applications	4
	CMAV-M-CC-3-7-P (Core Course – 7) Practical	Programming Microprocessor 8085	2
	Skill Enhancement Course, SEC-A **(Candidate has to opt any one topic from the under mentioned courses)**		
	CMAV-M-SEC-A-3-1-TH Skill Enhancement Course, SEC-A-1	Multimedia and its Applications	2
	CMAV-M-SEC-A-3-2-TH Skill Enhancement Course, SEC-A-2	Sensor Network and IoT	2

CMAV-M-CC-3-5-TH: Operating System
Core Course- 5: Theory: 04 Credits: 60 hours

Introduction   (10 hours)
Basic OS functions, types of operating systems batch systems–multiprogramming systems, time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

Operating System Organization   (6 hours)
Processor and user modes, kernels, system calls and system programs.

Process   (15 hours)
System view of the process and resources, process hierarchy, threads, threading issues, thread libraries;
Process Scheduling
Preemptive and non-preemptive scheduling, Long term, short term and medium term
Process Synchronization: Concurrent and processes, critical section, semaphores and application, methods for inter-process communication;

Deadlock: (10 hours)
Definition, Prevention, Avoidance, Detection, Recovery.

Memory Management   (10 hours)
Physical and virtual address space; memory allocation strategies –fixed and variable partitions, paging, segmentation, virtual memory

File and I/O Management   (5 hours)
Directory structure, file operations, file allocation methods, disc management.

Protection and Security (4 hours)

Policy mechanism, Authentication, Internal access Authorization.

CMAV-M-CC-3-5-P: Shell Programming (Unix/ Linux)
Core Course- 5: Practical: 02 Credits: 40 hours

Shell programming and O.S. internals

1. WRITE A PROGRAM (using *fork()* and/or *exec()* commands) where parent and child execute:
   a) same program, same code.
   b) same program, different code.
   c) before terminating, the parent waits for the child to finish its task.
2. WRITE A PROGRAM to report behavior of Linux kernel including kernel version, CPU type and model. (CPU information)
3. WRITE A PROGRAM to report behavior of Linux kernel including information on configured memory, amount of free and used memory. (memory information)
4. WRITE A PROGRAM to print file details including owner access permissions, file access time, where file name is given as argument.
5. WRITE A PROGRAM to copy files using system calls.
6. Write program to implement FCFS scheduling algorithm.
7. Write program to implement Round Robin scheduling algorithm.
8. Write program to implement SJF scheduling algorithm.
9. Write program to implement non-preemptive priority based scheduling algorithm.
10. Write program to implement preemptive priority based scheduling algorithm.
11. Write program to implement SRJF scheduling algorithm.
12. Write program to calculate sum of n numbers using *thread* library.

The above examples are only samples, more can be included related to the theory.

Text/ Reference Books:

1. Operating Systems Concepts, A Silberschatz, P.B. Galvin, G. Gagne, 8th Edition, John Wiley Publications 2008.
2. Modern Operating Systems, A.S. Tanenbaum, 3rd Edition, Pearson Education 2007.
3. Operating Systems: A Modern Perspective, G. Nutt, 2nd Edition Pearson Education 1997.
4. Operating Systems, Internals & Design Principles W.Stallings, 2008 5th Edition, PHI.
5. Operating Systems- Concepts and design, M. Milenkovic, Tata McGraw Hill 1992.
6. Sumitabha Das , UNIX Concepts and Applications, Tata McGraw-Hill

CMAV-M-CC-3-6-TH: Introduction to Algorithms
Core Course- 6: Theory: 04 Credits: 60 hours

Introduction to Algorithms: (05 hours)

Definition, Characteristics, Recursive and Non-recursive algorithms.

Asymptotic Complexity Analysis of Algorithms: (10 hours)

Space and Time Complexity, Efficiency of an algorithm, Growth of Functions, Polynomial and Exponential Complexity, Asymptotic Notations: Big O Notation and Small o notation, Big Ω and Small ω, Big Θ and Small φ Notations, Properties: Best case/worst case/average case analysis of well-known algorithms.

Algorithm Design Techniques: (15 hours)

Concepts and simple case studies of Greedy algorithms. Divide and conquer: Basic concepts, Case study of selected searching and sorting problems as divide and conquer techniques: Dynamic programming: General issues in Dynamic Programming, Case study of Binomial Coefficient computation.

Graph Representation and Algorithm: (25 hours)

Graph traversal algorithms: BFS, DFS, Minimal spanning trees: Prim's Algorithm, Kruskal's Algorithm, Shortest path algorithms: Floyd's Algorithm, Floyd-Warshall Algorithm, Dijkstra's Algorithm, Graph Coloring Algorithms.

Classification of Problems: (05 hours)

P, NP, Satisfiability, Cook's Theorem (Statement Only).

CMAV-M-CC-4-9-P: Algorithms Lab.
Core Course- 9: Practical: 02 Credit: 40 hours

Lab. based on Graph Theory and Numerical Methods using C

Graph Algorithms:

Implementation of Graph algorithms: Single Spanning Tree Generation using - BFS, DFS, Minimal Spanning Tree Generation using - Prim's Algorithm, Kruskal's Algorithm, Shortest Path finding using - Floyd's Algorithm, Floyd-Warshall Algorithm, Dijkstra's Algorithm, Graph Partitioning Algorithm.

Text/References Books:

1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein, TMH.
2. The Design and Analysis of Algorithms, Aho, Hopcroft and Ullman, Pearson Education.
3. The Art of Computer Programming, D.E.Knuth, Pearson Education,Vol. 3,
4. Algorithm Design, Jon Kleiberg and Eva Tardos, Pearson Education
5. Data Structures and Algorithms - K.Mehlhorn , EATCS, Vol. I & Vol. 2.
6. Computer Algorithms, S.Baase, Pearson Education
7. Fundamentals of Computer Algorithms, E.Horowitz and Sahani, Galgotia

CMAV-M-CC-3-7-TH: Microprocessor and its Applications
Core Course- 7: Theory: 04 Credits: 60 hours

Introduction to Microcomputer based system: (3 hours)

History of evolution of Microprocessor and Microcontrollers and their advantages and disadvantages.

Microprocessor Architecture and Memory Interfacing: (14 hours)

Basic Architecture of Microprocessor 8085 and explanation of each block, Microprocessor 8085 pin out and signals, Addressing modes, Instruction Formats, Instruction Cycle, Clock Cycle, Multiplexed Address Data Bus, Control and Status signals, Microprocessor and Bus Timing, De-multiplexing of Address Data Bus, Generation of Control Signals for I/O and Memory, Basic concepts in Memory Interfacing, Address Decoding and memory Addresses.

Interfacing I/O Devices: (10 hours)

Basic Interfacing concepts, Peripheral I/O instructions (I/O mapped I/O), Device Selection and data Transfer, Absolute and Partial Decoding, Input Interfacing, Interfacing I/O using decoders, Memory mapped I/O techniques, Interfacing 8155 memory segment.

Programming 8085:   (10 hours)
Instruction Set of 8085, Different Programming Techniques, Stack and Subroutines, Counter and Time Delays, Code Conversion, BCD Arithmetic and 16 bit Data Operation.

Interfacing Peripheral (I/O) and Applications: (13 hours)
Interrupts: 8085 Interrupt, RST instructions, Software and Hardware interrupt, multiple Interrupts and Priorities, 8085 Vectored Interrupts, Restart as Software Instructions.
Interfacing Digital to Analog Converters, Analog to Digital Interfacing, keyboard interfacing, interfacing 8255 (Mode - 0, BSR), Support IC chips- 251,8237/8257,8259

Microprocessor 8086:   (10 Hours)
The 8086 microprocessor- Architecture, Instruction set, Addressing modes, Interrupts, Memory interfacing with 8086.

CMAV-M-CC-3-7-P: Programming Microprocessor 8085
Core Course- 7: Practical: 02 Credits: 40 hours

1. Assembly Language Programming for Arithmetic Operations like Addition, Subtraction, Multiplication and Division on 8, 16 bit data.
2. Assembly Language Programming for different logical operations.
3. Assembly Language Programming for code conversions.
4. Assembly Language Programming for different sorting techniques.
5. Assembly Language Programming for memory block transfer.
6. Assembly Language Programming for AP series and Fibonacci series.
7. Assembly Language Programming for HCF, LCM etc.
8. Assembly Language Programming for Searching.
9. Assembly Language Programming for frequency distribution.
10. Block Replacement and transfer

Many more programs can be included related to the programming techniques of Microprocessor 8085

Text/Reference books:

1.   Microprocessor architecture, programming and applications with 8085/8085A, Wiley eastern Ltd, 1989 by Ramesh S. Gaonkar.
2.   Intel Corp: The 8085 / 8085A. Microprocessor Book – Intel marketing communication, Wiley inter science publications, 1980.
3.   Advanced Microprocessors by Ray and Bhurchandi - TMH.
4.   Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
5.   The Intel Microprocessors: 8086/8088, 80186, 80286, 80386 & 80486, Bary B. Brey, Prentice Hall, India1996.

Skill Enhancement Course: SEC-A: Multimedia and its Applications / Sensor Network & IoT

CMAV-M-SEC-A-3-1-TH: Multimedia and its Applications
Skill Enhancement Course: SEC-A: Choice -1: Theory: 02 Credit: 40 hours

Multimedia: (02 hours)
Introduction to multimedia, Components, Uses of multimedia.

Making Multimedia: (05 hours)
Stages of a multimedia project, Requirements to make good multimedia, Multimedia Hardware - Macintosh and Windows production Platforms, Hardware peripherals - Connections, Memory and storage devices, Multimedia software and Authoring tools.

Text: (02 hours)
Fonts & Faces, Using Text in Multimedia, Font Editing & Design Tools, Hypermedia & Hypertext**.**

Images: (04 hours)
Still Images – Bitmaps, Vector Drawing, 3D Drawing & rendering, Natural Light & Colors, Computerized Colors, Color Palletes, Image File Formats.

Sound: (02 hours)
Digital Audio, MIDI Audio, MIDI vs Digital Audio, Audio File Formats.
Video: (05 hours)
How Video Works, Analog Video, Digital Video, Video File Formats, Video Shooting and Editing.

Animation: (05 hours)
Principle of Animations. Animation Techniques, Animation File Formats.
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, Graphics and animation.
Multi-modal Communication: (05 hours)
Video conferencing, networking support, Trans-coding

Text/ Reference Books:
1. Multimedia: Making it work by Tay Vaughan, TMH.
2.Multimedia: Computing, Communications Applications by R Steinmetz and K Naharstedt, Pearson.
3. Multimedia Handbook by Keyes, TMH.
4. Multimedia System Design by K. Andleigh and K. Thakkar, PHI.

CMAV-M-SEC-A-3-2-TH: Sensor Network and IoT
Skill Enhancement Course: SEC-A: Choice -2: Theory: 02 Credit: 40 hours

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

 Node architecture   (03 hours)
 Sensing subsystem, The processor subsystem, communication interface and prototypes.

 Operating System   (05 hours)
 Functional aspects, non-functional aspects, Prototypes.

 Basic Architectural framework
 Physical Layer   (03 hours)
 Basic components, source coding, channel encoding, Modulation and signal properties.

Medium Access control (05 hours)

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

Network layer (02 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:

Localization: ranging techniques, range based, range free and event driven.

Security (qualitative discussion only.) (10 hours)

Fundamental of network security, challenges in wireless sensor networks, security attacks, 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, Security.

Text/ Reference Books:

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.

Semester	Courses	Topics	Credit
IV	CMAV-M-CC-4-8-TH (Core Course – 8) Theory	Data Communication, Networking and Internet Technology	4
	CMAV-M-CC-4-8-P (Core Course – 8) Practical	Computer Networking and Web Design	2
	CMAV-M-CC-4-9-TH (Core Course – 9) Theory	Database Management System	4
	CMAV-M-CC-4-9-P (Core Course – 9) Practical	RDBMS Lab. using SQL and PHP	2
	CMAV-M-CC-4-10-TH (Core Course – 10) Theory	Object Oriented Programming System (OOPs)	4
	CMAV-M-CC-4-10-TH (Core Course – 10) Practical	OOPs Lab. using C++/ Java	2
	Skill Enhancement Course, SEC-B **(Candidate has to opt any one topic from the under mentioned courses)**		2
	CMAV-M-SEC-B-4-1-TH Skill Enhancement Course, SECB1	Information Security	2
	CMAV-M-SEC-B-4-2-TH Skill Enhancement Course, SECB2	E-Commerce	2

SE M

CMAV-M-CC-4-8-TH: Data Communication, Networking and Internet Technology
Core Course- 8: Theory: 04 Credit: 60 hours

Data Communication Concepts (10 hours)
Analog and Digital Signals, Periodic and Non-periodic signals, Time and Frequency Domain, Bandwidth and Data rate, Signal rate, Serial and Parallel Transmission

Various modes of transmission (05 hours)
Simplex/ Half Duplex, Duplex; Features of guided and unguided transmission media; Circuit switching: time division & space division switch;

Physical structure of Network (25 hours)
Types of connections (Topologies), Categories of Computer Network: LAN, MAN, WAN
Modulation and Encoding: AM, FM, PM; Multiplexing: FDM, TDM, WDM, PCM,
OSI Model Architecture

Internet Technology (20 hours)
Internet Architecture, Client/ Server architecture of Internet network, OSI Reference Model, Need of Internet protocols – TCP/IP, Ports, Domain Name Server (DNS), Internet service providers, Dial up, ISDN, CRC, Routing, Cable, Modem, E-mail, IRC, Voice & Video Conferencing, Browsers, WWW, Google services, Internet advertising, ATM, Web tools- HTTP

CMAV-M-CC-4-8-P: Computer Networks and Web Design
Core Course- 8: Practical: 02 Credit: 40 hours

Computer Networks: Practical: (05 hours)
Familiarization with Networking cables (CAT5, CAT6, UTP), Connectors (RJ-45, T-connector), Hubs, Switches, LAN installation & configuration (peer-to-peer) process.
Web Design: Practical: (35 hours)
 Web page design by HTML & PHP

 PHP Programming **(1 +2 Lab)**

 Introduction to PHP **(3L)**
➢ PHP introduction, inventions and versions, important tools and software requirements (like Web Server, Database, Editors etc.)
➢ PHP with other technologies, scope of PHP
➢ Basic Syntax, PHP variables and constants
➢ Types of data in PHP , Expressions, scopes of a variable (local, global)
➢ PHP Operators : Arithmetic, Assignment, Relational , Logical operators, Bitwise , ternary and MOD operator.
➢ PHP operator Precedence and associativity

 Handling HTML form with PHP
HTML (5L)
➢ Capturing Form Data
➢ GET and POST form methods
➢ Dealing with multi value fields
➢ Redirecting a form after submission

 PHP conditional events and Loops **(3L)**
➢ PHP IF Else conditional statements (Nested IF and Else)
➢ Switch case, while ,For and Do While Loop
➢ Goto , Break ,Continue and exit

 PHP Functions **(2L)**
➢ Function, Need of Function , declaration and calling of a function
➢ PHP Function with arguments, Default Arguments in Function
➢ Function argument with call by value, call by reference
➢ Scope of Function Global and Local

 String Manipulation and Regular Expression **(2L)**
➢ Creating and accessing String , Searching & Replacing String
➢ Formatting, joining and splitting String , String Related Library functions
➢ Use and advantage of regular expression over inbuilt function
➢ Use of preg_match(), preg_replace(), preg_split() functions in regular expression

 Array **(2L)**
➢ Anatomy of an Array ,Creating index based and Associative array ,Accessing array
➢ Looping with Index based array, with associative array using each() and foreach()
➢ Some useful Library function

Text/ Reference Books:

1. B.A. Forouzan, "Data Communication and Networking", 3rd Edition, Tata McGraw Hill.
2. A.S. Tanenbaum, "Computer Networks (4th Edition) – Pearson Education/ PHI
3. W. Stallings, "Data and Computer Communication (5th Edition) – PHI/ Pearson Education
4. Black, "Data & Computer Communication", PHI.
5. Harvey M. Deitel & Paul J. Deitel, "Internet & World Wide Web: How to program:, 4/e.
6. Shishir Gundavaram, "CGI Programming on the world wide web", O'Relly and Associates', 1996.

CMAV-M-CC-4-9-TH: Database Management System (DBMS)
Core Course- 9: Theory: 04 Credit: 60 hours

Introduction (4 hours)
Drawbacks of Legacy System; Advantages of DBMS; Layered Architecture of Database, Data Independence; Data Models; Schemas And Instances; Database Languages; Database Users, DBA; Data Dictionary; Functional Components of a DBMS

Entity Relationship(ER) Modeling (4 hours)
Entity, Attributes and Relationship, Structural Constraints, Keys, ER Diagram of Some Example Database, Weak Entity Set, Specialization and Generalization, Constraints of Specialization and Generalization, Aggregation.

Relational Model (8 hours)
Basic Concepts of Relational Model; Relational Algebra; Tuple Relational Calculus; Domain Relational Calculus.

Integrity Constraints (4 hours)
Domain Constraints, Referential Integrity, Assertions, Triggers.

Relational Database Design (8 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 Or BCNF Using FD; Lossless Join Decomposition Algorithm; Dependency preservation.

SQL (20 hours)
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.

Record Storage and File Organization (Concepts only) (8 hours)
Fixed Length and Variable Length Records; Spanned and Un-Spanned Organization of Records; Primary File Organizations and Access Structures Concepts; Unordered, Sequential, Hashed; Concepts of Primary and Secondary Index; Dense and Sparse Index; Index Sequential Files; Multilevel Indices.

Transaction Processing (Concepts only)   (4 hours)
ACID Properties; Transaction States, Concurrent Execution; Serializability (Conflict and View), Recoverability, Test for Serializability.

CMAV-M-CC-4-9-P: Relational Database Management System
Core Course- 9: Practical: 02 Credit: 40 hours

RDBMS Lab using My SQL & PHP

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.
5. SQL and Relational Theory: How to Write Accurate SQL Code, Christopher J. Date, O'Reilly Media
6. Database Systems: A Practical Approach to Design, Implementation and Management, Thomas M. Connolly and Carolyn E. Begg, Pearson

CMAV-M-CC-4-10-TH: Object Oriented Programming System (OOPs)
Core Course- 10: Theory: 04 Credit: 60 hours

Introduction to Java   (4 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   (8 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   (4 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 and Event Handling (15 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.

CMAV-M-CC-5-10-P: Object Oriented Programming Lab.
Core Course- 10: Practical: 02 Credit: 40 hours
OOPs Lab Using C++/ 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, Gilad Bracha, Alex Buckley, Published by Addison Wesley.
3.   Effective Java by Joshua Bloch, Publisher: Addison-Wesley.
4.   Programming with Java by E. Balaguruswamy, McGraw Hill.
5.   Java: How to Program by Paul Deitel, Harvey Deitel, Prentice Hall.
5.   Programming with JAVA by John R. Hubbard, Schaum's Series.

Skill Enhancement Course: SEC-B: Information Security/ E-Commerce

CMAV-M-SEC-B-4-1-TH: Information Security
Skill Enhancement Course: SEC-B: Choice -1: Theory: 02 Credit: 40 hours

Overview (03 hours)
Overview of Security Parameters: Confidentiality, Integrity and availability-security violation, Assumptions and Trust- Security assurance, OSI security architecture,

Cryptography (10 hours)
Mathematical Tools for Cryptography, Symmetric Encryption Algorithm, Theory of Block cipher design, Symmetric cipher model, Risk assessment, quantitative and qualitative approaches, 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: (02 hours)
Groups, Rings, Fields-Modular, Prime numbers, Fermat's and Euler's Theorem, Chinese remainder Theorem, Discrete Logarithm.

Hash Functions and Digital Signatures (05 hours)

Authentication requirement – Authentication function -MAC, Hash functions, Security of hash function, Hashing Algorithms: MD5.

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) (05hours)

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).

Cyber Law (10 hours)

Cyber laws to be covered as per IT 2008:

Definitions, Digital Signature And Electronic Signature.

1) [Section 43] Penalty and Compensation for damage to computer, computer system, etc.
2) [Section 65] Tampering with Computer Source Documents.
3) [Section 66 A] Punishment for sending offensive messages through communication service, etc.
4) [Section 66 B] Punishments for dishonestly receiving stolen computer resource or communication device.
5) [Section 66C] Punishment for identity theft.
6) [Section 66D] Punishment for cheating by personation by using computer resource.
7) [Section 66E] Punishment for violation of privacy.
8) [Section 66F] Punishment for cyber terrorism.
9) [Section 67] Punishment for publishing or transmitting obscene material in electronic form.
10) [Section 67A] Punishment for publishing or transmitting of material containing sexually explicit act, etc. in electronic form.
11) [Section 67B] Punishment for publishing or transmitting of material depicting children in sexually explicit act, etc. in electronic form.
12) [Section 72] Breach of confidentiality and privacy.

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.
4. Understanding Cryptography, Paar and Pelzi, Springer.
5. Cryptography and Network Security, Behrouz A Forouzan, McGraw Hill Education.
6. Information Security Principles and Practices by M. Merkow, J. Breithaupt,, Pearson Education.

CMAV-M-SEC-B-4-2-TH: E-Commerce
Skill Enhancement Course: SEC-B: Choice -2: Theory: 02 Credit: 40 hours

An introduction to Electronic commerce: (10 hours)
What is E-Commerce (Introduction And Definition), Main activities E-Commerce, Goals of E-Commerce, Technical Components of E-Commerce, Functions of E-Commerce, Advantages and disadvantages of E-Commerce, Scope of E-Commerce, Electronic Commerce Applications, 9 Electronic Commerce and Electronic Business (C2C) (C2G,G2G, B2G, B2P, B2A, P2P, B2A, C2A, B2B, B2C).

The Internet and WWW: (10 hours)
Evolution of Internet, Domain Names and Internet Organization (.edu, .com, .mil, .gov, .net etc.) , Types of Network, Internet Service Provider, World Wide Web, Internet & Extranet, Role of Internet in B2B Application, building own website, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Banner, Exchange, Shopping Bots

Internet Security: (10 hours)
Secure Transaction, Computer Monitoring, Privacy on Internet, Corporate Email privacy, Computer Crime(Laws , Types of Crimes), Threats, Attack on Computer System, Software Packages for privacy, Hacking, Computer Virus(How it spreads, Virus problem, virus protection, Encryption and Decryption, Secret key Cryptography, DES, Public Key Encryption, RSA, Authorization and Authentication, Firewall, Digital Signature(How it Works).

Electronic Data Exchange: (10 hours)
Introduction, Concepts of EDI and Limitation, Applications of EDI, Disadvantages of EDI, EDI model, Electronic Payment System: Introduction, Types of Electronic Payment System, Payment Types, Value Exchange System, Credit Card System, Electronic Fund Transfer, Paperless bill, Modern Payment Cash, Electronic Cash.

Internet Marketing: (10 hours)
The PROS and CONS of online shopping, The cons of online shopping, Justify an Internet business, Internet marketing techniques, The E-cycle of Internet marketing, Personalization e-commerce

Text/ Reference Books :
1. E-Commerce Concepts, Models, Strategies by G.S.V.Murthy, Himalaya Publishing House.
2. The E-Commerce Book, Teffano Korper and Juanita Ellis, Morgan Kaufmann
3. E-Commerce 2017, Kenneth C. Laudon and Carol Guercio Traver, Pearson
4. E- Commerce, Kamlesh K Bajaj and Debjani Nag Tata McGraw-Hill Education
5. Electronic commerce by Gray P. Schneider , International Student Edition.
6. E-Commerce, Fundamentals and Applications by Henry Chan, Raymond Lee, Tharam Dillon, Elizabeth Chang, Wiley Student Edition.

SEMESTER – V & VI

Semester	Courses	Topics	Credit
V	**CMAV-M-CC-5-11-TH** (Core Course – 11) Theory	**Theory of Computation**	**4**
	CMAV-M-CC-5-11-P (Core Course – 11) Practical	**Structured Programming Language Java**	**2**
	CMAV-M-CC-5-12-TH (Core Course – 12) Theory	**Computer Graphics**	**4**
	CMAV-M-CC-5-12-P (Core Course – 12) Practical	**Graphic User Interface (GUI) Building using RAD Tools**	**2**
VI	**CMAV-M-CC-6-13-TH** (Core Course – 13) Theory	**Software Engineering**	**4**
	CMAV-M-CC-6-13-P (Core Course – 13) Practical	**PROJECT**	**2**
	CMAV-M-CC-6-14-TH (Core Course – 14) Theory	**Industrial Training**	**4**
	CMAV-M-CC-6-14-P (Core Course – 14) Practical	**Entrepreneurship Development**	**2**
DSE-A	**Discipline Specific Elective Courses- DSE-A** **Candidates have to opt any one topic either from DSE-A-1 or from DSE-A-2 in Semester-V & another topic either from DSE-A-3 or from DSE-A-4 in Semester-VI**		
	CMAV-M-DSE-A--1-TH Discipl.Sp.Elec.DSEA1,Theory	**Digital Image Processing**	**4**
	CMAV-M-DSE-A--1-P Discipl.Sp.Elec.DSEA1, Pract.	**Image Processing Lab.**	**2**
	CMAV-M-DSE-A--2-TH Discipl.Sp.Elec.DSEA2,Theory	**Data Mining & its Applications**	**4**
	CMAV-M-DSE-A--2-P Discipl.Sp.Elec.DSEA2, Pract.	**Data Mining Lab.**	**2**
	CMAV-M-DSE-A--3-TH Discipl.Sp.Elec.DSEA3,Theory	**Embedded Systems**	**4**
	CMAV-M-DSE-A--3-P Discipl.Sp.Elec.DSEA3, Pract.	**Embedded Systems Lab.**	**2**
	CMAV-M-DSE-A--4-TH Discipl.Sp.Elec.DSEA4,Theory	**R Programming**	**4**
	CMAV-M-DSE-A--4-P Discipl.Sp.Elec.DSEA4, Pract.	**R Programming Lab.**	**2**
DSE-B	**Discipline Specific Elective Courses- DSE-B** **Candidates have to opt any one topic either from DSE-B-1 or from DSE-B-2 in Semester-V & another topic either from DSE-B-3 or from DSE-B-4 in Semester-VI**		
	CMAV-M-DSE-B--1-TH Discipl.Sp.Elec.DSE-B-1,Theory	**Operation Research (O.R.)**	**4**
	CMAV-M-DSE-B--1-P Discipl.Sp.Elec.DSE-B-1, Pract.	**Operation Research (O.R.) Lab. using C/ Python**	**2**
	CMAV-M-DSE-B--2-TH Discipl.Sp.Elec.DSE-B-2,Theory	**Introduction to Computational Intelligence**	**4**
	CMAV-M-DSE-B--2-P Discipl.Sp.Elec.DSE-B-2, Pract.	**Computational Intelligence Laboratory**	**2**
	CMAV-M-DSE-B--3-TH Discipl.Sp.Elec.DSE-B-3,Theory	**Advanced Java**	**4**
	CMAV-M-DSE-B--3-P Discipl.Sp.Elec.DSE-B-3, Practical	**Advanced Java Laboratory**	
	CMAV-B-DSE-B--4-TH Discipl.Sp.Elec.DSE-B-4, Theory	**Pattern Recognition**	**4**
	CMAV-B-DSE-B--4-P Discipl.Sp.Elec.DSE-B, Practical	**Pattern Recognition Lab.**	**2**

CMAV-M-CC-5-11-TH: Theory of Computation
Core Course-11: Theory: 04Credit: 60hours

Finite Automata: (15 hours)
Definition of a Finite Automaton, Model, Representation, Classification – with respect to output function Mealy and Moore Machines, with respect to State Transition – Deterministic and Non-Deterministic Machine, Examples, conversion algorithms Mealy to Moore and Moore to Mealy, Non-Deterministic to equivalent Deterministic-Optimized and Non-optimized technique ideas and algorithms, with null transition and without null transitions, Finite and Infinite state machines, Removal of Null-transitions, Acceptability of String by a Finite Automaton, Design of different Finite State Machines – examples like serial adder, serial parity generator, sequence generator and checker etc, Minimized Equivalent Machine, State Minimization Algorithm – Row elimination method, Implication Table Method

Formal Languages and Grammar: (15 hours)
Introduction to Formal Grammar and Language, Formal Definition, Chomsky's Classification of Grammar – Type 0, Type-1 or Context Sensitive, Type-2 or Context Free and Type-3 or Regular Grammar, Illustration of each of these classes with example, Sentential form, Sentences – Languages or strings, Derivations – left, right and random derivation, Derivation tree, Parse Tree, Syntax Tree, Ambiguous Grammar and Language, Designing of Grammar for a language, Finding Language for Given Grammar, Finding Equivalent Minimized Context Free Grammar –a) by the removing Grammar Variables which are not generating any terminal string, and b) by the removing Terminal Symbols which are not generating from the start symbol and c) by the removing null production and d) by the removing unit production, Definition and basic idea about Push Down Automaton

Regular Expression: (15 hours)
Basic Idea and Definition, Regular Expression basic Identities, Arden's Theorem – Statement (without Proof) and application for reduction of equivalent regular expressions, Thompson's Construction Algorithm – Regular expression to Finite Automata conversion, State Transition System to Regular Expression conversion algorithm by Arden's Algebraic Method, FA to Regular Grammar and Regular Grammar to FA conversion algorithms and applications.

Turing Machine: (15 hours)
Concepts of Turing Machine, Formal Definitions, Classifications – Deterministic and Non-Deterministic Turing Machines, Simple Design of Turing Machines like – Unary Adder, Subtractor, Concatenator, Odd / even count etc and concepts of Universal Turing Machines and Turing Computing, Difference and Similarities between Turing Machine and a General Purpose Computer, Definition and significant of Halting Problem in Turing Machine.

Text/ Reference Books:

1. Introduction to Automata Theory, Languages, and Computation by John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, Pearson.
2. Theory of Computer Science (Automata, Languages & Computation) by K L P Misra & N Chandrasekharan, 3rd Edition, PHI.
3. Introduction to Theory of Computation by Micheal Sipser, 3rd Edition, Cengage Learning.
4. Switching and Finite Automata Theory by Zvi Kohavi, Niraj.K.Jha, 3rd Edition, TMH.

5. Formal Language and Automata, P. Linz, Narosa

CMAV-M-CC-5-11-P: Structured Programming Language Java
Core Course- 11: Practical: 02Credit: 40 hours

At least ten laboratory assignments to be done with structured programming language Java. Independent programming project in Java – A client-server application (Network conference/ Railway reservation/ Bank accounts/ simple network game).

Text/ Reference Books:
1. Core Java (2 volumes) by Horstmann et al. (PE).
2. Java in a Nutshell by Flanagan (O'Reilly)

CMAV-M-CC-5-12-TH: Computer Graphics
Core Course-12: Theory: 04Credit: 60hours

Introduction: (03 hours)

Basic concepts of Graphics Devices– Monochrome and Color Monitor displaying technique only and Printing technique of Printer device, 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, Image Color Model, Color Coding, Lookup Table based color mapping, Video Memory, Image Frame and frame image data areas of an image file.

Graphics Kernel System: (05 hours)

Basic elements, its representations and related operations, layered structures, hardware and software operation elements

Basic geometrical shapes formation algorithms: (10 hours)

Concepts Co-ordinate System, Line Segment, Circle and arc segment, elliptic segment and its formation DDA, Bresenham's and Midpoint scan conversion algorithms.
Basic Operations on Images:

Two and Three Dimensional Transformations: (12 hours)

Geometric Transformations operations - Translation, Rotation, Scaling. Reflection, Shearing and Inverse of these operations, Homogeneous coordinate system representation, matrix representation
Coordinate 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 and Three Dimensional Clipping: (10 Lectures)

Point Clipping, Line Clipping – Region coding, Cohen-Sutherland Algorithm, Midpoint subdivision Algorithm; Polygon and Polygon net model storing – Explicit Vertex method, Polygon Listing and Explicit Edge Listing and Basic Idea of Polygon Clipping (No mathematical foundation and algorithms)

Projection: (15 Lectures)

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: (05 Lectures)

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

CMAV-M-CC-5-12-P: Graphic User Interface (GUI) Building using RAD Tools
Core Course- 12: Practical: 02Credit: 40 hours
At least five Laboratory assignments to be done.

Text/ Reference Books:
1. Computer Graphics by Zhigang Xiang, Roy Plastock, Schaum's Outlines Series.
2. Computer Graphics by Hern & Baker
3. Procedural Elements for Computer Graphics by David F. Roger, 2nd Edition, TMH
4. Computer Graphics by Folly & Vandam

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SEMESTER – VI: Core Courses

CMAV-M-CC-6-13-TH: Software Engineering
Core Course-13: Theory: 04Credit: 60hours

Introduction: (3 hours)
Defining system, open and closed system, modeling of system through computer hardware, communication systems, external agents and software systems; Importance of Engineering Methodology towards computerization of a system

Software Life Cycle: (5 hours)
Classical and Iterative Waterfall Model; Spiral Model and its importance towards application for different system representations, Comparative Studies

Software Requirement and Specification Analysis: (25 hours)
Requirements Principles and its analysis principles; Specification Principles and its representations
Software Design Analysis – Different level 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 – Heuristic and Empirical Modeling; COCOMO

Software Testing: (17 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: (10 hours)
Concepts of Quality, Quality Control, Quality Assurance, SQA Activities, IEEE Standard for Statistical Software Quality Assurances (SSQA) criterions.

Text/ Reference Books:
1. Software Engineering: A Practitioner's Approach by R.S. Pressman, McGraw-Hill.
2. An Integrated Approach to Software Engineering by P. Jalote, Narosa Publishing House.
3. Software Engineering by K.K. Aggarwal and Y. Singh, New Age International Publishers.

4. Software Engineering by I. Sommerville, Addison Wesle.
5. Software Engineering for Students by D. Bell, Addison-Wesley.
6. Fundamentals of Software Engineering by R. Mall, PHI.

CMAV-M-CC-6-13-P: PROJECT
Core Course- 13: Practical: 02Credit: 40 hours
Project: A software project should be done by the students based on software on current topics of public utility. The students are supposed to submit the project reports which will be duly certified by the project guides or the concerned authorities of the college.

CMAV-M-CC-6-14-TH: Industrial Training
Core Course-14: Theory: 04Credit: 60hours

Industrial Training should be of at least two months duration during the third year at any IT concern/ organization which will give a report at the end of training. The report should be duly certified by the concerned authorities of the organization where the students undergo training. There will also be an oral presentation of the report by the students followed by a viva-voce examination.

CMAV-M-CC-6-14-P: Entrepreneurship Development
Core Course-14: Practical: 02 Credit: 40 hours
This topic should be guided by the departmental teachers as per requirement of the progress of the current technology in this field.

Discipline Specific Elective Course A: DSE-A:
Digital Image Processing/ Data Mining & its Applications/ Embedded Systems/ R Programming

CMAV-M-DSE-A--1-TH: Digital Image Processing
DSE-A: Choice-1: Theory: 04 Credit: 60 hours

Introduction   (05 hours)
Image definition and its representation, Pixels, Co-ordinate conventions, Image formats (Study of the image matrix), neighbourhood metrics, Sampling and quantization, Types of distance measure (concept only).

Spatial Domain   (10 hours)
Image enhancement techniques in spatial domain, Contrast stretching, Histogram Processing, Noise smoothing, Sharpening, Pixel Classification.

Thresholding   (15 hours)
Grey level thresholding, global/ local thresholding, Iterative thresholding, Edge detection operators, Region growing, Split/ merge techniques, Image feature/ primitive extraction, Background correction, Color enhancement

Image restoration (15 hours)

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Restoration from projections, Hough transform, Huffman coding, Segmentation

Image Segmentation (15hours)

Boundary detection based techniques, Point, line detection, Edge detection, Local processing, Regional processing, Region-based segmentation.

CMAV-M-DSE-A--1-P: Image Processing Lab.
DSE-A: Choice-1: Practical: 02 Credit: 40 hours

Study of the Image matrices of different images using SciLab / GNU Octave.

Text/ Reference Books:

1) Digital Image Processing by Gonzalez, Pearson.

2) Digital Image Processing by Jayaraman and Veerakumar, TMH.

3) Digital Image Processing using MATLAB by Gonzalez, Eddins and Woods, McGraw Hill.

4) Digital Image Processing by Annadurai, Pearson.

5) Digital Image Processing; A remote sensing perspective by Jensen, Pearson.

6) Digital Image Processing by Castleman, Pearson.

7) B. Chanda and D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, New Delhi, 2000.

CMAV-M-DSE-A--2-TH: Data Mining and its Applications
DSE-A: Choice-2: Theory: 04 Credit: 60 hours

Introduction: (15 hours)

Definition of Data Mining, Data pre-processing, Data cleaning, Data transformation, Data Reduction, Data Visualization, Data extraction from large dataset, Data integration, sub-sampling, Feature selection, Scalability issues of data mining algorithms, text mining, web mining.

Classification and Prediction: (30 hours)

Structural patterns of data, Tools for pattern recognition (preliminary concept), Linear models for classification, Evaluating the accuracy of the classifier or predictor, Bayesian Classification, Training and Test sets, Parametric and Non-parametric Learning, Minimum Distance Classifiers, k-NN rule, Discriminant Analysis, Decision trees. Similarity Measure, Basic hierarchical and non-hierarchical Clustering algorithms, Some Applications, Neural Learning,

Data Warehousing (DWH): (15 hours)

Introduction: Definition and description, need for data ware housing, need for strategic information, failures of past decision support systems, Application of DWH.

CMAV-M-DSE-A--2-P: Data Mining Lab.
DSE-A: Choice-2: Practical: 02 Credit: 40 hours

Data mining using PYTHON/C

Text/ Reference Books :

1. Ian H. Witten, Eibe Frank, Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Third Edition, Morgan Kaufman.
2. R.O. Duba, P.E. Hart and D.G. Stork, "Pattern Classification and Scene Analysis", 2nd Ed., Wiley, New York, 2000.
3. J.T. Tou and R.C. Gonzalez, "Pattern Recognition Principles", Addison-Wesley, London, 1974
4. Data Mining Concepts and Techniques by Jiawei Han and Micheline Kamber, Morgan Kaufmann Publishers.
5. Data Warehousing, Data Mining and OLAP by Berson, Tata McGraw Hill.
6. Introduction to Data Mining by Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education.
7. Data mining: Introductory and Advanced Topics by Dunham M H," Pearson Education.

CMAV-M-DSE-A--3-TH: Embedded Systems
DSE-A: Choice-3: Theory: 04 Credit: 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: (15 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, Motor control using 8051 C.

Programmable logic devices and Hardware description Language: (10 Hours)
PAL, PLA, PLD, ASIC, FPGA (Qualitative study).

Hardware Description Language (VHDL): (15 Hours)
Basic Terminology, Entity Declaration, Architecture body, Configuration and package declaration, Package body, Model analysis and Simulation.
Basic Language elements, Behavioral Model, Dataflow Model, Structural Model, Subprogram and overloading, Applications.

CMAV-M-DSE-A--3-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. Programming Using Embedded C for 8051.
3. VHDL programs for construction and simulation of various digital circuits.

Text/ Reference Books:
1. David E.Simon, "An Embedded software primer", Pearson Education.
2. Kenneth J. Ayala, "The 8051 Microcontroller", Thomson.
3. Raj Kamal, "Embedded Systems:, TMH.
4. Raj Kamal, "Microcontroller", Pearson Education.
5. A VHDL Primer, J. Bhasker, Prentice Hall
6. FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version, Pong P. Chu, Wiley-Interscience

CMAV-M-DSE-A--4-TH: R-Progrmming
DSE-A: Choice-4: Theory: 04 Credit: 60 hours

Data structures: Basic data structures (vector, matrix, list and data frame, match data types and the functions that identify them, and remember common gotchas (is.vector, is.numeric etc.).   **(7 hours)**

Subsetting: Types of subsetting, understand how 1d subsetting generalises to 2d subsetting, describe the difference between simplifying and preserving subsetting.   **(7 hours)**

Input and output: Identify the correct function to read/write a data frame to/from disk (csv, tab delimited or fixed width file), use common arguments (na.string, sep, header) to deal with files that have unusual structure.   **(8 hours)**

Functions & control flow: Convert a simple script into parameterised functions, describe a simple R function in words, describe R's argument matching semantics (position, partial, exact), execute a script of R code with source()).   **(8 hours)**

Control flow: Describe the structure of an if statement, use a for loop to repeat the same operation on different elements of a data structure, convert a for loop to a while loop.   **(7 hours)**

Vectorisation/recycling: Describe what vectorisation means, distinguish internal and external vectorisation, and the performance consequence of each functions, use vectorised operations instead of for loops to perform simple mathematical operations (log, addition, subtraction etc.), use lapply(), sapply() and apply() to vectorise operations that are not already vectorised.   **(8 hours)**

Recovering from errors: Recognise and remedy simple syntax errors (missing quotes, missing parentheses etc.).   **(7 hours)**

Package management: Install packages with install.packages(), load a package with library() or require(), determine which packages are out of date, understand lifetime of install.packages/library effects, use :: to refer to a function in a specific package.   **(8 hours)**

CMAV-M-DSE-A--4-P: R Programming Lab.
DSE-A: Choice-4: Practical: 02 Credit: 40 hours
Sample practical problems can be taught related to theory.

Text/ Reference Books:
 Online Tutorials may be consulted.

Discipline Specific Elective Course B: DSE-B:

Operation Research / Introduction to Computational Intelligence/ Advanced Java/ Pattern Recognition

CMAV-M-DSE-B--1-TH: Operation Research (O.R.)
DSE-B: Choice-1: Theory: 04 Credit: 60 hours

Introduction: (05 hours)
Origin and development of operation research, Nature and characteristic features, models in O.R., application of O.R.

Linear Programming Problem: (05 hours)
Introduction, mathematical formulation of the problem and graphical solution method.

Simplex Method: (20 hours)
Introduction, computational procedure, artificial variable, problem of degeneracy, application of simplex method.

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, unbalanced transportation problem.

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

Game Theory: (05 hours)
Some basic terminology, Two-person Zero-sum Game, Game without Saddle Point – Mixed strategy, Algebraic method for 2×2 Game

Network Scheduling: (05 hours)
Introduction, Critical Path Method (CPM), PERT calculation.

CMAV-M-DSE-B--1-P: Operation Research (O.R.) Lab. using C/ Python
DSE-B: Choice-1: Practical: 02 Credit: 40 hours
Lab sessions related to Theory.

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
4. Operations Research: Applications and Algorithms, Wayne L. Winston, Duxbury Press
5. Operations Research Techniques for Management by V.K.Kapoor, 7th Edition, Sultan Chand and Sons
6. INTRODUCTION TO OPERATIONS RESEARCH,   Frederick S. Hillier and G. Lieberman, McGraw-Hill Higher Education

CMAV-M-DSE-B--2-TH: Introduction to Computational Intelligence
DSE-B: Choice-2: Theory: 04 Credit: 60 hours

Introduction   (20 hours)
Introduction to Artificial Intelligence, Brief History and Application, Structures and Strategies for state space search- Data driven and goal driven search, Heuristic search, Depth First and Breadth First search, Iterative deepening, A* algorithm, Game playing (Minimax), Rule-based system, Semantic Nets, Frames, Scripts, Conceptual Dependency, Introduction to PROLOG.

Neural Network   (20 hours)
Basics of Artificial Neural Network, Characteristics and Comparison with biological neural network, Basic model of Artificial Neural Network: Single layer Perceptron model, Learning, Feed Forward Neural Network, Error, Back Propagation and weight updation, Perceptron, Bayesian Networks, Neural computational model- Hopfield Nets.

Rough sets   (02 hours)
Basic difference between Rough sets and Fuzzy sets

Fuzzy Logic and Application   (18 hours)
Fuzzy sets, application – basic operations, Properties, Fuzzy Relations, Fuzzy inference, Notion of Fuzziness, Operations on Fuzzy sets, Fuzzy Numbers, Brief overview of crisp sets, Crisp relations, Fuzzy relations, Max*-composition of fuzzy relation, Max*-transitive closure, Probability measures of fuzzy events, Fuzzy expected value, Approximate reasoning, Different methods of role aggregation and defuzzification,

CMAV-M-DSE-B-2-P: Computational Intelligence Laboratory
DSE-B: Choice 2: Practical: 02 Credit: 40 hours

Text/ Reference Books:
1. Christopher M. Bishop, "Pattern Recognition and Machine Learning".
2. E, Rich and K. Knight, "Artificial Intelligence", 2/e, Tata Mc. Graw Hill.
3. David Kriesel, "A Brief Introduction to Neural Network".
4. H.J.Zimmermann, "Fuzzy Set Theory – and its Applications"
5. Ivo Duntsch & Gunther Gediga, "Rough Set Data Analysis : A road to Non-invasive Knowledge Discovery", Methodos.
6. P.D. Wassermann, "An Introduction to Neural Computing: Theory and Practice", Van Nostrand Reinhold, New York, 1989.
7. B. Yegnarayana, "Artificial Neural Networks", Prentice Hall of India.

CMAV-M-DSE-B--3-TH: Advanced Java
DSE-B: Choice-3: Theory: 04 Credit: 60 hours

Basics of Servlet   (10 hours)
Servlet: What and Why?, Servlet API, Servlet Interface, GenericServlet, HttpServlet, Servlet Life Cycle, ServletRequest methods, Servlet Collaboration, ServletConfig.

Session Tracking   (04 hours)

Cookies, Hidden Form Field, URL Rewriting, Http Session

Basics of JSP (10 hours)
Life cycle of JSP, JSP API, JSP in Eclipse and other IDE's, Scripting elements, Implicit Objects, Directive Elements, Exception Handling, Action Elements, MVC in JSP.

JavaMail API (06 hours)
Sending Email, Sending email through Gmail server, Receiving Email, Sending HTML content

Design Pattern (06 hours)
Singleton, DAO, DTO, MVC, Front Controller, Factory Method

Introduction to JavaEE (08 hours)
The Need for JavaEE., Overview on the JavaEE Architecture, The EJB Model, Session Beans, JMS Overview.

Javascript (06 hours)
Introduction to Javascript, Ways to use Javascript, Working with events, Client-side Validation.

JQuery (10 hours)
Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples,
Key Services of the Application Server.

CMAV-M-DSE-B-3-P: Advanced Java Laboratory
DSE-B: Choice 3: Practical: 02 Credit: 40 hours

Text/ Reference Books:
1. Core Servlets and Javaserver Pages: Core Technologies, Marty Hall and Larry Brown, Prentice Hall.
2. JavaScript: The Definitive Guide, David Flanagan, O'Reilly.
3. Enterprise JavaBeans 3.0, Richard Monson-Haefel and Bill Burke, O'Reilly.
4. JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, Wiley;
5. Professional JavaScript for Web Developers, Nicholas C. Zakas, Wrox
6. Java Design Pattern Essentials,Tony Bevis, Ability First Limited
7. Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Addison-Wesley Professional

CMAV-M-DSE-B--4-TH: Pattern Recognition
DSE-B: Choice-4: Theory: 04 Credit: 60 hours

Introduction to Pattern Recognition (20 hours)
Probability distribution, Bayes classification, Error probability, Error bounds, Bhattacharya bounds, Error rates and their estimation, Parametric and Non-parametric learning, Density estimation,

Classification (20 hours)

Classification trees, Unsupervised classification, Split/ Merge techniques, Hierarchical clustering algorithms, Cluster validity, Set estimation, Optimal and sub-optimal feature selection algorithms, K-nearest neighbor rule and its error rate, Syntactic approach to pattern recognition.

Neural Network models for pattern recognition: (20 hours)
Learning, Supervised and unsupervised classification, Feature analysis, Fuzzy sets theoretic models for pattern recognition.

CMAV-M-DSE-B-4-P: Pattern Recognition Lab.
DSE-B: Choice 4: Practical: 02 Credit: 40 hours
Lab. works should be done related to theory

Text/ Reference Books:
1. K. Fukunaga: Introduction to Statistical Pattern Recognition, Academic Press, New York, 1990.
2. S.K. Pal and S. Mitra: Neuro-Fuzzy Pattern Recognition: Methods in Soft Computing, John Wiley, New York, 1999,
3. S.K. Pal and A. Pal: Pattern Recognition: From Classical to Modern Approaches, World Scientific, Singapore, 2001.
4. R.C.Gonzalez and M.G.Thomason: Syntactic Pattern Recognition: An Introduction, Addison-Wesley, Reading, Mass., 1978.
5. M.R.Anderberg: Cluster Analysis for Application, Academic Press, New York, 1973.