UNIVERSITY OF CALCUTTA

GURUPADA SAREN
SECRETARY
COUNCILS FOR UNDERGRADUATE STUDIES,
UNIVERSITY OF CALCUTTA.

SENATE HOUSE
Kolkata – 700 073.
Phone : 2241-0071-74,
2241-0077-78,2241-4989-90,
2241-2850-51,2241-2859
Fax : 91-033-2241-3222
E-mail :u.g.councilsc.u@gmail.com
Website :www.caluniv.ac.in

Ref.No : CUS/337 (cir.)/18
Dated the 22nd May, 2018

To
The Principals/T.I.C.
offering Computer Science *(Honours)*
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the **draft Syllabus for Computer Science *(Honours)*** under **CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G.B.O.S. in Computer Science, C.U.**, will be implemented from the academic session 2018-2019.

You are requested kindly to go through it and send your feedback within 29th May, 2018.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U**. or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Himadri Bhattacharyya** through e-mail **(hima.c@rediffmail.com).**

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,

22/05/18

Secretary

CMSA-CBCS(Semester –I to VI)from the Academic Session, 2018

Semester	*Courses*	*Course Name*	*Credit*
I	CMS-A-CC-1-1-TH (Core Course-1) Theory	Digital Logic	4
	CMS-A-CC-1-1-P (Core Course-1) Practical	Digital Circuits	2
	CMS-A-CC-1-2-TH (Core Course-2) Theory	Programming Fundamentals using C	4
	CMS-A-CC-1-2-P (Core Course-2) Practical	Programming in C	2
	Generic Elective, GE – 1	Mathematics and any one subject from Physics/Electronic Science/ Statistics	4
	Generic Elective GE - 1 Practical	As per GE-1	2
	Ability Enhancement Compulsory Course (AECC)	Communicative English / MIL	2
II	CMS-A-CC-2-3-TH (Core Course – 3) Theory	Computer Organization and Architecture	4
	CMS-A-CC-2-3-P (Core Course – 3) Practical	Computer Organization Lab.	2
	CMS-A-CC-2-4-TH (Core Course – 4) Theory	Basic Electronic Devices and Circuits	4
	CMS-A-CC-2-4-P (Core Course – 4) Practical	Basic Electronic Devices and Circuits Lab	2
	Generic Elective, GE – 2	Mathematics and any one subject from Physics/ElectronicScience/ Statistics	4
	Generic Elective GE - 2 Practical	As per GE-1	2
	Ability Enhancement Compulsory Course (AECC)	Environmental Studies	2
III	CMS-A-CC-3-5-TH (Core Course-5) Theory	Data Structure	4
	CMS-A-CC-3-5-P (Core Course – 5) Practical	Data Structure using C	2
	CMS-A-CC-3-6-TH (Core Course – 6) Theory	Computational Mathematics	4
	CMS-A-CC-3-6-P (Core Course – 6) Practical	Computational Mathematics Lab	2
	CMS-A-CC-3-7-TH (Core Course – 7) Theory	Microprocessor and its Applications	4
	CMS-A-CC-3-7-P (Core Course – 7) Practical	Programming Microprocessor 8085	2
	Generic Elective, GE - 3	Mathematics and any one from Physics/Electronic Science/ Statistics	4
	Generic Elective GE - 3 Practical	As per GE-1	2
	Skill Enhancement Course, SEC-A (Candidate has to opt any one topic from the under mentioned courses)		
	CMS-A-SEC-A-3-1-TH Skill Enhancement Course, SEC-A-1	Theory of Computation	2
	CMS-A-SEC-A-3-2-TH Skill Enhancement Course, SEC-A-2	Sensor Network and IoT	2

Semester	*Courses*	*Course Name*	*Credit*
IV	**CMS-A-CC-4-8-TH (Core Course – 8) Theory**	**Data Communication, Networking and Internet Technology**	**4**
	CMS-A-CC-4-8-P (Core Course – 8) Practical	**Computer Networks and Web Design**	**2**
	CMS-A-CC-4-9-TH (Core Course – 9) Theory	**Introduction to Algorithms & its Applications**	**4**
	CMS-A-CC-4-9-P (Core Course – 9) Practical	**Algorithms Lab.**	**2**
	CMS-A-CC-4-10-TH (Core Course – 10) Theory	**Operating Systems**	**4**
	CMS-A-CC-4-10-TH (Core Course – 10) Practical	**Operating Systems Lab. (Shell Programming)**	**2**
	Generic Elective, GE – 4	**Mathematics and any one subject from Physics/Electronic Science/ Statistics**	**4**
	Generic Elective GE – 4 Practical	**As per GE-1**	**2**
	Skill Enhancement Course, SEC-B (Candidate has to opt any one topic from the under mentioned courses)		**2**
	CMS-A-SEC-B-4-1-TH Skill Enhancement Course, SECB1	**Information Security**	**2**
	CMS-A-SEC-B-4-2-TH Skill Enhancement Course, SECB2	**E-Commerce**	**2**
V	**CMS-A-CC-5-11-TH (Core Course – 11) Theory**	**Data Base Management System (DBMS)**	**4**
	CMS-A-CC-5-11-P (Core Course – 11) Practical	**RDBMS Lab using My SQL & PHP**	**2**
	CMS-A-CC-5-12-TH (Core Course – 12) Theory	**Object Oriented Programming System (OOPs)**	**4**
	CMS-A-CC-5-12-P (Core Course – 12) Practical	**OOPs Lab using Java**	**2**
VI	**CMS-A-CC-6-13-TH (Core Course – 13) Theory**	**Software Engineering**	**4**
	CMS-A-CC-6-13-P (Core Course – 13) Practical	**Software Engineering Lab**	**2**
	CMS-A-CC-6-14-TH (Core Course – 14) Theory	**Computer Graphics**	**4**
	CMS-A-CC-6-14-P (Core Course – 14) Practical	**Project**	**2**
DSE-A	**Discipline Specific Elective Courses- DSE-A Candidates has to opt any one topic in Semester-V & another topic in Semester-VIfrom following courses**		
	CMS-A-DSE-A--1-TH Discipl.Sp.Elec.DSE-A-1,Theory	**Digital Image Processing**	**4**
	CMS-A-DSE-A--1-P Discipl.Sp.Elec.DSE-A-1, Practical	**Image Processing Lab.**	**2**
	CMS-A-DSE-A--2-TH Discipl.Sp.Elec.DSE-A-2,Theory	**Data Mining & its Applications**	**4**
	CMS-A-DSE-A--2-P Discipl.Sp.Elec.DSE-A-2, Practical	**Data Mining Lab.**	**2**
	CMS-A-DSE-A--3-TH Discipl.Sp.Elec.DSE-A-3,Theory	**Embedded Systems**	**4**
	CMS-A-DSE-A--3-P Discipl.Sp.Elec.DSE-A-3, Practical	**Embedded Systems Lab.**	**2**
	CMS-A-DSE-A--4-TH Discipl.Sp.Elec.DSE-A-4,Theory	**Multimedia and its Applications**	**4**
	CMS-A-DSE-A--4-P Discipl.Sp.Elec.DSE-A-4, Practical	**Multimedia and its Applications Lab.**	**2**

DSE-B	**Discipline Specific Elective Courses- DSE-B** **Candidates has to opt any one topic in Semester-V & another topic in Semester-VI from following courses**		
	CMS-A-DSE-B--1-TH **Discipl.Sp.Elec.DSE-B-1,Theory**	**Operation Research (O.R.)**	**4**
	CMS-A-DSE-B--1-P **Discipl.Sp.Elec.DSE-B-1, Practical**	**Operation Research (O.R.) Lab. using C/ Python**	**2**
	CMS-A-DSE-B--2-TH **Discipl.Sp.Elec.DSE-B-2,Theory**	**Programming Techniques using Python**	**4**
	CMS-A-DSE-B--2-P **Discipl.Sp.Elec.DSE-B-2, Practical**	**Program Development using Python**	**2**
	CMS-A-DSE-B--3-TH **Discipl.Sp.Elec.DSE-B-3,Theory**	**Introduction to Computational Intelligence**	**4**
	CMS-A-DSE-B--3-P **Discipl.Sp.Elec.DSE-B-3, Practical**	**Computational Intelligence Laboratory**	**2**
	CMS-A-DSE-B--4-TH **Discipl.Sp.Elec.DSE-B-4, Theory**	**Advanced Java**	**4**
	CMS-A-DSE-B-4--P **Discipl.Sp.Elec.DSE-B-4, Practical**	**Advanced Java Laboratory**	**2**

UNIVERSITY
OF
CALCUTTA

SYLLABUS
of
Bachelor of Science (B. Sc.)
(Honours)
in
Computer Science (CMSA)
Choice Based Credit System (CBCS)
2018

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

SEMESTER – I

Semester	*Courses*	*Topics*	*Credit*
I	**CMS-A-CC-1-1-TH (Core Course-1) Theory**	**Digital Logic**	**4**
	CMS-A-CC-1-1-P (Core Course-1) Practical	**Digital Circuits**	**2**
	CMS-A-CC-1-2-TH (Core Course-2) Theory	**Programming Fundamentals using C**	**4**
	CMS-A-CC-1-2-P (Core Course-2) Practical	**Programming in C**	**2**
	Generic Elective, GE – 1	**Mathematics and any one subject from Physics/Electronic Science/ Statistics**	**4**
	Generic Elective GE - 1 Practical	**As above**	**2**
	Ability Enhancement Compulsory Course (AECC)	**Communicative English / MIL**	**2**

SEMESTER – I

CMS-A-CC-1-1-TH: Digital Logic
Core Course-1: Theory: 04 Credits: 60 hours

Integrated Circuits: (5 hours)
Bipolar Logic Families: DTL, TTL NOT Gate, TTL NAND Gate, TTL NOR Gate, Open Collector, Fan-in, Fan-out; MOS Logic Families: NMOS, PMOS, CMOS, SSI, MSI, LSI and VLSI classification

Number Systems: (5 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: (8 hours)
Fundamentals of Boolean Expression: Definition of Switching Algebra, Basic properties of Switching Algebra, Huntington's Postulates, 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: (20 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),

Multibit Adder- Ripple Carry Adder, Carry Look Ahead adder, BCD Adder, 1'S & 2'S Complement Adder/Subtractor unit Construction using 4 bit Full adders units, 1 bit, 2 bit, 3 bit and 4 bit Comparators using basic logic gates.
Data Selector-Multiplexer: Expansion (Cascading), Reduction, Function Realization, Universal function realization, Multifunction Realization.
Encoders:- Realization of simple Encoders and priority Encoders using Basic and Universal Logic gates
Data Distributor:- De-multiplexer, Cascading.
Chip Selector/Minterm Generator - Decoder- Function Realization, Cascading, BCD Decoders, Seven Segment Display and Decoders, realization of seven segment decoders using basic gates.
Parity bit and Code Converters: Parity bit Generator/Checker, Gray to Binary code converter, Binary to Gray Code Converter.

Sequential Circuits: (22 hours)
Set/Reset (SR) Latch: Using NAND and NOR gates, Gated S-R latches, D Latch, J-K Latch, T Flip Flop, Race around Condition, Master Slave J-K Flip Flop, Clock - Duty Cycle, Rising Time, Falling Time, Negative Edge Detector and Positive Edge Detector circuits, Edge Triggered SR, D and JK Flip Flop, Flip-Flop Conversions, Flip-Flops with Preset and Clear.
Registers: Serial Input Serial Output, Serial Input Parallel Output, Parallel input Serial Output, Parallel Input parallel Output, Universal Shift Registers.
Counters: Asynchronous Counter: UP/DOWN Counters, Mod - N Counters, BCD Counter (Counter Construction using J-K and T Flip Flops).
Synchronous Counter: UP/DOWN Counters, Mod-N Counters, Ring Counters, Johnson Counters.

CMS-A-CC-1-1-P: Digital Circuits
Core Course-1: Practical: 02 Credits: 40 hours

Combinational Circuits:

1. Implementation of different functions using Basic and Logic gates, SOP, POS
2. Study and prove De-Morgan's Theorem.
3. Universal function using NAND and NOR gates
4. Implementation of half and Full adder (3-bit) using basic logic gates and Universal logic gates (NAND & NOR).
5. Implementation of half and Full Subtractor (3-bit) using basic logic gates and Universal logic gates (NAND & NOR).
6. 1 Digit BCD adder using 7483 and other logic gates.
7. Design 4 to 1 multiplexer using logic/Universal gates and implement full adder/full subtractor.
8. Using 74153 and 74151 to implement full adder/ full subtractor and other functions.
9. Cascading of Multiplexers.
10. Design 2 to 4 decoder using basic / universal logic gates.
11. Study 74138 and 74139 and implement full adder / full subtractor and other functions.
12. Implementation of 1 bit Comparator using decoders.
13. Cascading of Decoders.
14. Design a parity generator and checker using basic gates.
15. Construct and study comparators using 7485.
16. Construct Comparator (2-bit) using logic gates
17. Design a seven segment display unit using Common anode/Common cathode and 7447 / 7448.
18. Study Priority Encoder Chip 74147/74148.

Sequential Circuits:

1. Realization of RS, D, JK Clocked/Gated Level Triggered Flip-Flop using basic/Universal logic gates.
2. Study and Conversion of Flip-Flops: D to JK, JK to D, JK to T, SR to JK, SR to D Flip-flop.
3. Design synchronous and asynchronous counters MOD-n (MOD-8, MOD-10) UP/ DOWN and connecting Seven Segment Display along with decoder for display of counting sequence.
4. Construction of ODD/EVEN 4 bit Synchronous Counter.
5. 4-bit binary arbitrary sequence synchronous counter.

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. Digital Integrated Electronics- H.Taub & D.Shilling, Mc Graw Hill.
7. Digital Circuits and Design, Salivahan, Vikas

CMS-A-CC-1-2-TH: Programming Fundamentals using 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.

CMS-A-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.

Computer Science (Honours) CMSA -CBCS Syllabus

SEMESTER – II

Semester	*Courses*	*Topics*	*Credit*
II	**CMS-A-CC-2-3-TH (Core Course – 3) Theory**	**Computer Organization and Architecture**	**4**
	CMS-A-CC-2-3-P (Core Course – 3) Practical	**Computer Organization Lab.**	**2**
	CMS-A-CC-2-4-TH (Core Course – 4) Theory	**Basic Electronic Devices and Circuits**	**4**
	CMS-A-CC-2-4-P (Core Course – 4) Practical	**Basic Electronic Devices and Circuits Lab**	**2**
	Generic Elective, GE – 2	**Mathematics and any one subject from Physics/ElectronicScience/ Statistics**	**4**
	Generic Elective GE - 2 Practical	**As above**	**2**
	Ability Enhancement Compulsory Course (AECC)	**Environmental Studies**	**2**

SEMESTER – II

CMS-A-CC-2-3-TH: Computer Organization and Architecture
Core Course-3: Theory: 04 Credits: 60 hours

Basic Structure of Computers (Qualitative Discussion) (05 hours)

Computer Types, Basic Functional Units, Basic Operational Concept, Bus Structure, Software, Performance, Multiprocessor and Multicomputer, IAS Computer, Historical perspectives.

Register Transfer and Micro-operation

Register Transfer Language, Register Transfer, Bus and Memory Transfers, Three State Bus Buffers, memory Transfer, Arithmetic and Logical micro-operations, Shift and Arithmetic shifts. (05 hours)

Basic Computer Organization and Design (05 hours)

Instruction Codes, Stored Program Organization, Indirect Address, Computer Registers, Common Bus System, Computer Instruction, Timing and Control, Instruction Cycle, fetch Decode, Register Reference Instructions, Memory Reference Instruction, Input-Output and Interrupt, Design of Basic Computer, Design of Accumulator Logic.

CPU Organization

Arithmetic and Logic Unit (ALU)- Combinational ALU, 2'S Complement Addition, Subtraction Unit, Booths Algorithm for Multiplication, Division Hardware using Restoration Division Algorithm. (06 hours)

General register organization, Control Word, Accumulator Based, Register Based, Stack Type CPU organization.

Control Unit

Hardwired Control Unit, Micro-programmed Control Unit: Control memory, Address (07

Sequencing, conditional branching, mapping of instructions, subroutine, Design of Control Unit. (06 hours)

CPU Registers

Program Counter, Stack Pointer Register, Memory Address Register, Instruction Register, Memory Buffer Register, Flag registers, Temporary Registers. (03 hours)

Instructions.

Operational Code, Operands, Zero, One, Two and Three Address Instruction, Instruction Types, Addressing modes, Data Transfer and Manipulation instructions, Program control instructions. (03 hours)

CISC and RISC processors

Introduction, relative merits and De-merits. (02 hours)

Input / Output Organization

Polling, Interrupts, subroutines, Memory mapped IO, IO mapped IO, DMA, I/O Bus and Protocol, SCSI, PCI, USB, Bus Arbitration. (08 hours)

Computer Peripherals

VDU, Keyboard, Mouse, Printer, Scanner (Qualitative approach). (10 hours)

Memory

(Primary memory: ROM, PROM, EPROM, EEPROM, Flash memory, RAM: SRAM, DRAM, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories, RAMBUS Memory, Cache Memory: Mapping Functions, Replacement Algorithms, interleaving, Hit and Rate penalty, Virtual memories, Address Translation, Memory Management requirements, Secondary Storage: Magnetic Hard Disks, Optical Disks, Magnetic Tape Systems.

CMS-A-CC-2-3-P: Computer Organization Lab.

Core Course-3: Practical: 02 Credits: 40 hours

(1). Construct an Arithmetic Unit capable of performing 4-bit subtraction and Addition using 2's complement method. Use Parallel Adders and other necessary logic gates.

(2). Construct a logical Unit using logic gates capable of performing 4-bit, Bitwise ORing, ANDing, XORing and inversion.

(3). Construct an 4-bit ALU unit which can perform the following operation;

Selection		Function
S_1	S_0	
0	0	Addition
0	1	Subtraction
1	0	XOR-ing
1	1	Complement

(4). Construct a 2-bit Carry Look Ahead Adder using logic gates.

(5). Study and Construct a 1-digit BCD/Decimal adder using parallel adders and other necessary logic gates.
(6). Construct a Binary Multiplier using basic logic gates.
(7). Construct a Binary Divider using basic logic gates.
(8). Subtraction with 1's complement method using parallel adders and other necessary logic gates.
(9). Construction of BCD Subtractor with 9'S complement method using parallel adders and logic gates.
(10). Construction of BCD Subtractor with 10'S complement method using parallel adders and logic gates.
(11). Binary magnitude comparators (up to 4 bits) using parallel adder and logic gates.
(12). Construct a Binary 4-bit and 8-bit adder using logic gates.
(13). Construct a Serial in Serial out 4-Bit register.
(14). Construct a 4-Bit Universal Shift register.
(15). Construct a 4 bit ring counter.
(16). Construct a 4 - Bit Johnson Counter.
(17) Construct RAM (4-bit) and extend it
(18). Horizontal and Vertical Cascading of Memory modules.
(19). Code converters using memory modules.

Text/Reference Books

1. Computer System Architecture, Morries Mano, Pearson.
2. Computer Organization & Architecture, Williams Stallings, Pearson.
3. Computer Organization, Hamacher, Vranesic and Zaky, McGraw Hill.
4. Computer Architecture and Organization, Govindrajalu, Tata McGraw Hill.
5. Computer Architecture and Organization, J P Hayes, Tata McGRaw Hill.
6. Structured Computer Organization, Andrew S. Tanenbaum, Austin, 6th edition, Pearson.

CMS-A-CC-2-4-TH: Basic Electronic Devices and Circuits
Core Course-4: Theory: 04 Credits: 60 hours

Basics of Circuit Theory: (04 hours)
KVL, KCL, Thevenin's, Norton's, Superposition, Maximum Power Transfer Theorem. Application to simple problems.

Theory of Semiconductor devices: (03 hours)
Semiconductor materials and their properties, classification based on energy band diagram, Intrinsic and extrinsic semiconductors, P & N type.

Diode and its applications: (09
Working Principle, construction and characteristics of PN junction diode, biasing, depletion region, Single Phase Half, Full wave and bridge rectifier using PN Junction

diode, Circuit, Working principle, Calculation of Average DC current and Voltage, RMS, Ripple Factor, efficiency, Peak Inverse Voltage (PIV). Zener diode: Characteristics and its application as a voltage regulator	hours)
Bipolar Junction Transistor: Principle of Junction Transistor (including current components, current gains), Types: CE, CB, CC), DC biasing in CE mode: Q-Point, load line analysis, Transistor as an amplifier. Inverter using transistors: Transfer characteristics and threshold voltages	(08 hours)
Unipolar Junction Transistor: Principle of JFET and MOSFET, Depletion and Enhancement mode operations, Concept of NMOS, PMOS and CMOS. CMOS circuits for basic logic gates (NOT, NAND, NOR)	(08 hours)
PNPN Devices: Working Principle of SCR, UJT, construction, characteristics and simple applications: SCR, DIAC, TRIAC, SCR regulated power supply, Switch Mode Power Supply (SMPS) qualitative study only. Concept and functions of Optoelectronic materials (LED, LCD, Photo Sensors and basics of Optical Fiber and Opto-couplers).	(08 hours)
Operational Amplifiers (OPAMP): Inverting Amplifier, Non-inverting Amplifier, Offset parameters, Inverting and Non-inverting Adder, Differentiator, Integrator, Scale changer and Schmitt Trigger. Concept of Virtual ground, CMRR, Signal Generation using OPAMP: Monostable, Astable (Square wave generator)	(12 hours)
Timer:Construction and Functional description of 555, Mono-stable, Bistable and Astable Operation, VCO.	(04 hours)
Data Acquisition: R-2R ladder DAC, Weighted resistor type DAC, Flash Type ADC, Counter, Successive Approximation Register (SAR), Dual Slope ADC and Integrating Type.	(04 hours)

CMS-A-CC-2-4-P: Basic Electronic Devices and Circuits Lab.
Core Course-4: Practical: 02 Credits: 40 hours

1. Study the forward characteristic of a p-n junction diode and calculate the static and dynamic resistance of the diode.
2. Construct a Half wave rectifier using power diodes and study its load regulation characteristics with or without capacitor filter.
3. Construct a Full wave rectifier using power diodes and study its load regulation characteristics with or without capacitor filter.
4. Construct a Bridge rectifier using power diodes and study its load regulation characteristics with or without capacitor filter.
5. Study the forward and reverse characteristic of a Zener diode and also determine the value of

the current limiting resistance.

6. Construct a Zener Voltage regulator and study its load regulation characteristics.
7. Construct a positive and negative voltage regulator using Three terminal linear voltage regulator 78XX and 79XX. Study its load regulation characteristics.
8. Construct a variable positive voltage regulator using Three terminal linear voltage regulator LM317 and study its load regulation characteristics for different sets of output voltage.
9. Study the Output characteristics of a transistor in CE mode and calculate the gain from the graph.
10. Using Transistor to construct NOT or Invert Operation and draw the transfer characteristics and measure the threshold voltage.
11. Construct and study an Inverting Amplifier using OPAMP with different sets of input and feedback resistors and Calculate the gain from the graph.
12. Construct and study an Non-Inverting Amplifier using OPAMP with different sets of input and feedback resistors and Calculate the gain from the graph.
13. Construct and study an Inverting Adder using OPAMP.
14. Construct and study an Non-Inverting adder using OPAMP.
15. Construct and study a subtractor using OPAMP.
16. Construct and study the OPAMP as a differentiator.
17. Construct and study the OPAMP as a integrator.
18. Construct an Astable Multivibrator using Timer 555.
19. Construct an Astable Multivibrator using OPAMP.
20. Study and construct a R-2R ladder digital to analog converter.
21. Convert an analog signal into digital using ADC 0809.

Text/Reference Books:

1. Electronic Devices & Circuits Theory, Boylested & Nashelsky, PHI.
2. Electronics fundamental & Application, Chattopadhyay, Rakshit, New Age International Publishers.
3. Op-Amps And Linear Integrated Circuits, R. A. Gayakwad, Prentice Hall.
4. Solid State Electronic Devices, Streetman, PHI.
5. Elements of Electronics, Bagde Singh, S Chand Publication.
6. Microelectronic circuits, Sedra Smith, Oxford.
7. Operational Amplifier and Linear Integrated Circuits, Coughlin Driscol.
8. Electronic Devices and Circuits, Salivahanan, Suresh Kumar, McGrawHill education

Computer Science (Honours) CMSA - CBCS Syllabus

SEMESTER – III

Semester	*Courses*	*Topics*	*Credit*
III	**CMS-A-CC-3-5-TH (Core Course-5) Theory**	**Data Structure**	**4**
	CMS-A-CC-3-5-P (Core Course – 5) Practical	**Data Structure using C**	**2**
	CMS-A-CC-3-6-TH (Core Course – 6) Theory	**Computational Mathematics**	**4**
	CMS-A-CC-3-6-P (Core Course – 6) Practical	**Computational Mathematics Lab**	**2**
	CMS-A-CC-3-7-TH (Core Course – 7) Theory	**Microprocessor and its Applications**	**4**
	CMS-A-CC-3-7-P (Core Course – 7) Practical	**Programming Microprocessor 8085**	**2**
	Generic Elective, GE - 3	**Mathematics and any one from Physics/Electronic Science/ Statistics**	**4**
	Generic Elective GE - 3 Practical	**As above**	**2**
	Skill Enhancement Course, SEC-A (Candidate has to opt any one topic from the under mentioned courses)		
	CMS-A-SEC-A-3-1-TH Skill Enhancement Course, SEC-A-1	**Theory of Computation**	**2**
	CMS-A-SEC-A-3-2-TH Skill Enhancement Course, SEC-A-2	**Sensor Network and IoT**	**2**

SEMESTER – III

CMS-A-CC-3-5-TH: Data Structure
Core Course- 5: 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: (5 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.

CMS-A-CC-3-5-P: Data Structure Lab.
Core Course- 5: 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.
7) Aaron M. Tanenbaum, Moshe J. Augenstein, Yedidyah Langsam, Dat,a Structures Using C and C++, 2nd ed., PHI, 2009.

CMS-A-CC-3-6-TH: Computational Mathematics
Core Course- 6: Theory: 04 Credits: 60 hours

Introduction: (05 hours)
Sets - finite and Infinite sets, uncountable Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion.

Growth of Functions: (05 hours)
Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals

Recurrences: (06 hours)
Recurrence Relations, generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem

Numerical Methods: (20 hours)

Errors in Approximate Calculations: Mathematical Preliminaries, Approximate and Rounding of Numbers, Significant figures, Error and their computation, Propagation of error, Percentage of error.

Interpolation: Newton Forward and Backward interpolation, Lagrange interpolation.

Solving Set of Linear Equations: Gaussian Elimination, Gauss– Jordan Elimination, Iteration method & its convergence condition and testing - Gauss-Seidel Iteration, Gauss-Jacobi Iterative Methods and different types of convergence, divergence.

Solving Non-linear equations: Bisection method, Regula-falsi method, Secant and Newton-Raphson method

Solving Differential Equations: Euler Method, Runge-Kutta second and fourth order method

Numerical Integration: Trapezoidal and Simpson's 1/3rd Rules.

Line fitting: Linear, Quadratic fit,

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, Introduction to Spanning Trees

Prepositional Logic: (04 hours)

Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory

CMS-A-CC-3-6-P: Computational Mathematics Lab.

Core Course- 6: Practical: 02 Credits: 40 hours

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

Text/ Reference Books:

1. C.L. Liu & Mahopatra, Elements of Discrete mathematics, 2nd Sub Edition 1985, Tata McGraw Hill.
2. Rosen, Discrete Mathematics and Its Applications, Sixth Edition 2006.
3. T.H. Coremen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, Prentice Hall on India, (3rd edition 2009).
4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms 1988 John wiley Publication.
5. J. L. Hein, Discrete Structures, Logic, and Computability, Jones and Bartlett Publishers, 3rd Edition, 2009.
6. D.J. Hunter, Essentials of Discrete Mathematics, Jones and Bartlett Publishers, 2008.
7. Numerical Analysis and Computational Procedures by Mollah; New Central Book.
8. Computer Oriented Numerical Methods, 3rd Edition, V Rajaraman, PHI
9. Graph Theory With Applications To Engineering And Computer Science by Narsingh Deo, PHI.
10. Graph Theory by J.A. Bondy and U.S.R. Murty, Springer.
11. Introduction to Graph Theory by D B West, 2nd edition, Pearson Education

CMS-A-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.

CMS-A-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. An introduction to micro computers Vol. 2 – some real Microprocessor – Galgotia Book Source, New Delhi by Adam Osborne and J. Kane.
4. Advanced Microprocessors by Ray and Bhurchandi - TMH.
5. Intel Corp. Micro Controller Handbook – Intel Publications, 1994.
6. Microprocessors and Interfacing by Douglas V. Hall, McGraw Hill International
7. Assembly Language Programming the IBM PC by Alan R. Miller, Subex Inc, 1987.
8. The Intel Microprocessors: 8086/8088, 80186, 80286, 80386 & 80486, Bary B. Brey, Prentice Hall, India1996.

Skill Enhancement Course: SEC-A: Theory of Computation/ Sensor Network & IoT

CMS-A-SEC-A-3-1-TH: Theory of Computation
Skill Enhancement Course: SEC-A: Choice -1: Theory: 02 Credit: 40 hours

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

CMS-A-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 (10 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 (12 hours)
Basic components, source coding, channel encoding, Modulation and signal properties.

Medium Access control (08 hours)
Wireless MAC protocols, characteristics of MAC protocols in sensor networks, contention free MAC protocols, contention based MAC protocols, Hybrid MAC protocols.

Network layer (03 hours)
Data centric routing, proactive routing and on-demand routing, hierarchical routing, location based routing.

Node and network Management (10 hours)
Power Management: local power, Dynamic power, conceptual architecture. Time synchronization: clock and synchronization problem, Time synchronization & Protocols:
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. Wireless Sensor Network: from theory to application by Ibrahiem, Ramakrishnan, CRC Press.
5. Wireless Sensor Network by H Mahmoud Ahmed Fahmy, Springer.
6. Internet Of Things by Bahga, Madishetty, Orient Blackswan pvt Ltd.
7. IOT fundamentals, David, Pearson Education.
8. Internet Of Things by Tripathy and Anuradha, CRC Press.

Computer Science (Honours) CMSA - CBCS Syllabus

SEMESTER – IV

Semester	*Courses*	*Topics*	*Credit*
IV	**CMS-A-CC-4-8-TH (Core Course – 8) Theory**	**Data Communication, Networking and Internet Technology**	**4**
	CMS-A-CC-4-8-P (Core Course – 8) Practical	**Computer Networking and Web Design**	**2**
	CMS-A-CC-4-9-TH (Core Course – 9) Theory	**Introduction to Algorithms & its Applications**	**4**
	CMS-A-CC-4-9-P (Core Course – 9) Practical	**Algorithms Lab.**	**2**
	CMS-A-CC-4-10-TH (Core Course – 10) Theory	**Operating Systems**	**4**
	CMS-A-CC-4-10-TH (Core Course – 10) Practical	**Operating Systems Lab. (Shell Programming)**	**2**
	Generic Elective, GE – 4	**Mathematics and any one subject from Physics/Electronic Science/ Statistics**	**4**
	Generic Elective GE – 4 Practical	**As above**	**2**
	Skill Enhancement Course, SEC-B (Candidate has to opt any one topic from the under mentioned courses)		**2**
	CMS-A-SEC-B-4-1-TH Skill Enhancement Course, SECB1	**Information Security**	**2**
	CMS-A-SEC-B-4-2-TH Skill Enhancement Course, SECB2	**E-Commerce**	**2**

SEMESTER – IV

CMS-A-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

CMS-A-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.

CMS-A-CC-4-9-TH: Introduction to Algorithms & its Applications
Core Course- 9: Theory: 04 Credit: 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).

CMS-A-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
8. Combinational Algorithms- Theory and Practice, E.M.Reingold, J.Nievergelt and N.Deo, PHI, 1997

CMS-A-CC-4-10-TH: Operating System
Core Course- 10: Theory: 04 Credit: 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.

CMS-A-CC-4-10-P: Operating System
Core Course- 10: Practical: 02 Credit: 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.
13. Write a program to implement first-fit, best-fit and worst-fit allocation strategies.

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
7. D. P. Bovet and M. Cesati. Understanding the Linux Kernel. Third Edition, O'Reilly

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

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

Overview (05 hours)
Overview of Security Parameters: Confidentiality, Integrity and availability-security violation, Assumptions and Trust- Security assurance, OSI security architecture,

Cryptography (20 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: (05 hours)
Groups, Rings, Fields-Modular, Prime numbers, Fermat's and Euler's Theorem, Chinese remainder Theorem, Discrete Logarithm.

Hash Functions and Digital Signatures (10 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.
5. Understanding Cryptography, Paar and Pelzi, Springer.
6. Cryptography and Network Security, Behrouz A Forouzan, McGraw Hill Education.
7. Information Security Principles and Practices by M. Merkow, J. Breithaupt,, Pearson Education.
8 .Computer Security: Concepts, Issues and Implementation by A. Basta, W.Halton, Cengage Learning India.

CMS-A-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.

Planning for Electronic Commerce: (10 hours)

Planning Electronic Commerce initiates, Linking objectives to business strategies, Measuring cost objectives, Comparing benefits to Costs, Strategies for developing electronic commerce web sites.

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.

Computer Science (Honours) CMSA - CBCS Syllabus
SEMESTER – V & VI

Semester	*Courses*	*Topics*	*Credit*
V	**CMS-A-CC-5-11-TH (Core Course – 11) Theory**	**Data Base Management System (DBMS)**	**4**
	CMS-A-CC-5-11-P (Core Course – 11) Practical	**RDBMS Lab using My SQL & PHP**	**2**
	CMS-A-CC-5-12-TH (Core Course – 12) Theory	**Object Oriented Programming System (OOPs)**	**4**
	CMS-A-CC-5-12-P (Core Course – 12) Practical	**OOPs Lab using Java**	**2**
VI	**CMS-A-CC-6-13-TH (Core Course – 13) Theory**	**Software Engineering**	**4**
	CMS-A-CC-6-13-P (Core Course – 13) Practical	**Software Engineering Lab**	**2**
	CMS-A-CC-6-14-TH (Core Course – 14) Theory	**Computer Graphics**	**4**
	CMS-A-CC-6-14-P (Core Course – 14) Practical	**PROJECT**	**2**
DSE-A	**Discipline Specific Elective Courses- DSE-A** **Candidates have to opt any one topic in Semester-V & another topic in Semester-VI from the following courses**		
	CMS-A-DSE-A--1-TH Discipl.Sp.Elec.DSEA1,Theory	**Digital Image Processing**	**4**
	CMS-A-DSE-A--1-P Discipl.Sp.Elec.DSEA1, Pract.	**Image Processing Lab.**	**2**
	CMS-A-DSE-A--2-TH Discipl.Sp.Elec.DSEA2,Theory	**Data Mining & its Applications**	**4**
	CMS-A-DSE-A--2-P Discipl.Sp.Elec.DSEA2, Pract.	**Data Mining Lab.**	**2**
	CMS-A-DSE-A--3-TH Discipl.Sp.Elec.DSEA3,Theory	**Embedded Systems**	**4**
	CMS-A-DSE-A--3-P Discipl.Sp.Elec.DSEA3, Pract.	**Embedded Systems Lab.**	**2**
	CMS-A-DSE-A--4-TH Discipl.Sp.Elec.DSEA4,Theory	**Multimedia and its Applications**	**4**
	CMS-A-DSE-A--4-P Discipl.Sp.Elec.DSEA4, Pract.	**Multimedia and its Applications Lab.**	**2**
DSE-B	**Discipline Specific Elective Courses- DSE-B** **Candidates have to opt any one topic in Semester-V & another topic in Semester-VI from the following courses**		
	CMS-A-DSE-B--1-TH Discipl.Sp.Elec.DSE-B-1,Theory	**Operation Research (O.R.)**	**4**
	CMS-A-DSE-B--1-P Discipl.Sp.Elec.DSE-B-1, Pract.	**Operation Research (O.R.) Lab. using C/ Python**	**2**
	CMS-A-DSE-B--2-TH Discipl.Sp.Elec.DSE-B-2,Theory	**Programming using Python**	**4**
	CMS-A-DSE-B--2-P Discipl.Sp.Elec.DSE-B-2, Pract.	**Programming using Python**	**2**
	CMS-A-DSE-B--3-TH Discipl.Sp.Elec.DSE-B-3,Theory	**Introduction to Computational Intelligence**	**4**
	CMS-A-DSE-B--3-P Discipl.Sp.Elec.DSE-B-3, Practical	**Computational Intelligence Laboratory**	
	CMS-A-DSE-B--4-TH Discipl.Sp.Elec.DSE-B-4, Theory	**Advanced Java**	**4**
	CMS-A-DSE-B--4-P Discipl.Sp.Elec.DSE-B, Practical	**Advanced Java Laboratory**	**2**

SEMESTER – V: Core Courses

CMS-A-CC-5-11-TH: Database Management System
Core Course- 11: 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.

CMS-A-CC-5-11-P: Relational Database Management System
Core Course- 11: 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

CMS-A-CC-5-12-TH: Object Oriented Programming System (OOPs)
Core Course- 12: 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.

CMS-A-CC-5-12-P: Object Oriented Programming Lab.

Core Course- 12: Practical: 02 Credit: 40 hours

OOPs Lab 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, Gilad Bracha, 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.

SEMESTER – VI: Core Courses

CMS-A-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.

CMS-A-CC-6-13-P: Software Engineering Lab.
Core Course- 13: Practical: 02Credit: 40 hours
Based on some real life problems design: SRS, DFD, ERD

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.

CMS-A-CC-6-14-TH: Computer Graphics
Core Course-14: 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

CMS-A-CC-6-14-P: PROJECT
Core Course-14: Practical: 02 Credit: 40 hours

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

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

CMS-A-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.

CMS-A-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.

CMS-A-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.

CMS-A-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.
8. Data Mining Concepts, Methods and Algorithms by Mehmed Kantardzic, John Wiley and Sons.

CMS-A-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.

CMS-A-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

CMS-A-DSE-A--4-TH: Multimedia and its Applications
DSE-A: Choice-4: Theory: 04 Credit: 60 hours

Multimedia: (04 hours)
Introduction to multimedia, Components, Uses of multimedia.

Making Multimedia: (06 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: (04 hours)
Fonts & Faces, Using Text in Multimedia, Font Editing & Design Tools, Hypermedia & Hypertext**.**

Images: (06 hours)
Still Images – Bitmaps, Vector Drawing, 3D Drawing & rendering, Natural Light & Colors, Computerized Colors, Color Palletes, Image File Formats.

Sound: (06 hours)
Digital Audio, MIDI Audio, MIDI vs Digital Audio, Audio File Formats.

Video: (06 hours)
How Video Works, Analog Video, Digital Video, Video File Formats, Video Shooting and Editing.

Animation: (08 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: (10 hours)
Video conferencing, networking support, Trans-coding

CMS-A-DSE-A--4-P: Multimedia and its Applications Lab.
DSE-A: Choice-4: Practical: 02 Credit: 40 hours
Sample practical problems can be included related to theory.

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.

Discipline Specific Elective Course B: DSE-B:
Operation Research/ Programming using Python/ Introduction to Computational Intelligence/ Advanced Java

CMS-A-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.

CMS-A-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

CMS-A-DSE-B--2-TH: Programming using Python
DSE-B: Choice-2: Theory: 04 Credit: 60 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.

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

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

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

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

Strings and Lists: (15 hours)
String as a compound data type, Length, Traversal and the 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: (05 hours)
Introduction to Classes, Objects and Methods, Standard Libraries.

CMS-A-DSE-B--2-P: Python Programming Lab.
DSE-B: Choice-2: Practical: 02 Credit: 40 hours
Open Source Computer Programming Language Python

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. Python Programming Fundamentals, Authors: Lee and Kent D.

CMS-A-DSE-B--3-TH: Introduction to Computational Intelligence
DSE-B: Choice-3: 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,

CMS-A-DSE-B-3-P: Computational Intelligence Laboratory
DSE-B: Choice 3: 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.

CMS-A-DSE-B--4-TH: Advanced Java
DSE-B: Choice-4: 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.

CMS-A-DSE-B-4-P: Advanced Java Laboratory
DSE-B: Choice 4: 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