Syllabus
(2022)

For

Master of Computer Application
(MCA)

DEPARTMENT OF COMPUTER APPLICATION
SCHOOL OF TECHNOLOGY
NORTH-EASTERN HILL UNIVERSITY
MEGHALAYA

Semester wise Course Content of the 2 Years MCA Syllabus -2022

Paper Code Nomenclature:-

Core Papers

XXX- αβ γ

- Two digit paper number of that particular year
- **0:** Theory, **1:** Practical
- One digit Year Number (e.g. , MCA. 1st Year- 5) Teaching Subject code
- Teaching course code

Elective Papers

XXX- αβ γ. x*/y*/z*

- Two digit paper number of that particular year
- **0:** Theory, **1:** Practical
- One digit Year Number (1st Year- 5) Teaching Subject code
- Teaching course code

x*/y*/z*: Represents Elective Paper Serial number from the respective Elective Paper Group

First Semester

SUBJECT CODE	SUBJECT NAME	PERIODS			EVALUATION SCHEME			CREDITS
THEORY PAPERS		L	T	P	INTERNAL MARKS	ESE	TOTAL	
MCA-CC-5000	Digital Logic and Design	4	0	0	25	75	100	4
MCA-CC-5001	Data Structures and Algorithms	4	0	0	25	75	100	4
MCA-DSEC-5002.x*	Discipline-Specific Elective Course - **Elective-I**	4	0	0	25	75	100	4
MCA-DSEC-5003.y*	Discipline-Specific Elective Course - **Elective-II**	4	0	0	25	75	100	4
MCA-GEC-5004	Programming and Problem Solving through C	4	0	0	25	75	100	4
PRACTICAL PAPERS								
MCA-CC-5101	Data Structures and Algorithms-Lab	0	0	4	12	38	50	2
MCA-GEC-5104	Programming and Problem Solving through C-Lab	0	0	4	12	38	50	2
TOTAL		20	0	8			600	24

L- Lecture **T-**Tutorial **P-**Practical **ESE-**End Semester Examination

CC- Core Course DSEC- Discipline Specific Elective Course

First Semester x* and y* represent the Sl. No. of the respective elective paper from Discipline-Specific Elective Course-**Elective-I** group and Discipline-Specific Elective Course-**Elective-II** group.

DSEC-Elective-I

Serial No. (x*)	SUBJECT CODE (MCA-DSEC-5002.x*)	SUBJECT NAME
1	MCA-DSEC-5002.1	Theory of Computation
2	MCA-DSEC-5002.2	Computer Graphics

DSEC-Elective-II

Serial No. (y*)	SUBJECT CODE (MCA-DSEC-5003.y*)	SUBJECT NAME
1	MCA-DSEC-5003.1	Discrete Mathematics
2	MCA-DSEC-5003.2	Computer Oriented Numerical Methods

Second Semester

SUBJECT CODE	SUBJECT NAME	PERIODS			EVALUATION SCHEME			CREDITS
THEORY PAPERS		L	T	P	INTERNAL MARKS	ESE	TOTAL	
MCA-CC-5005	Operating System	4	0	0	25	75	100	4
MCA-CC-5006	Computer Organization and Architecture	4	0	0	25	75	100	4
MCA-DSEC-5007.x*	Discipline Specific Elective Course - **Elective-III**	4	0	0	25	75	100	4
MCA-DSEC-5008.y*	Discipline Specific Elective Course - **Elective-IV**	4	0	0	25	75	100	4
MCA-RM-5009	Research Methodology & Proposal Writing	4	0	0	25	75	100	4
MCA-SEC-5010	Internet Technology & Its Application	3	1	0	25	75	100	4
PRACTICAL PAPERS								
MCA-DSEC-5107.x*	**Elective-III Lab**	0	0	4	12	38	50	2
MCA-SEC-5110	Internet Technology & Its Application-Lab	0	1	3	12	38	50	2
TOTAL		23	2	7			700	28

L- Lecture **T-**Tutorial **P-**Practical **ESE-**End Semester Examination

CC- Core Course DSEC- Discipline Specific Elective Course RM-Research Methodology
SEC-Skill Enhancement Course

Second Semester x* and y* represent the Sl. No. of the respective elective paper from Discipline Specific Elective Course**-Elective-III** group and Discipline Specific Elective Course**-Elective-IV** group**.**

List of Elective Papers of Second Semester:

DSEC-Elective-III (Theory)

Serial No. (x*)	**SUBJECT CODE (** MCA-DSEC-5007.x***)**	**SUBJECT NAME**
1	MCA-DSEC-5007.1	Object Oriented Programming and C++
2	MCA- DSEC-5007.2	Java Programming
3	MCA- DSEC-5007.3	Python Programming

DSEC-Elective-III (Practical)

Serial No. (x*)	**SUBJECT CODE (**MCA-5107.**x*)**	**SUBJECT NAME**
1	MCA- DSEC-5107.1	Object Oriented Programming and C++ Lab
2	MCA- DSEC-5107.2	Java Programming Lab
3	MCA- DSEC-5107.3	Python Programming Lab

N.B. x* represents the Serial No. of the respective elective paper from Discipline Specific Elective Course-Elective-III (Theory/ Practical) group and that must have same value for Theory and Practical**.**

DSEC-Elective-IV

Serial No. (y*)	**SUBJECT CODE (** MCA-5008.y*)	**SUBJECT NAME**
1	MCA- DSEC-5008.1	Soft Computing
2	MCA- DSEC-5008.2	Operations Research
3	MCA- DSEC-5008.3	System Programming

Third Semester

SUBJECT CODE	SUBJECT NAME	PERIODS			EVALUATION SCHEME			CREDITS
THEORY PAPERS		**L**	**T**	**P**	**INTERNAL MARKS**	**ESE**	**TOTAL**	
MCA-CC-6000	Database Management System	4	0	0	25	75	100	4
MCA-CC-6001	Data Communication and Computer Networks	4	0	0	25	75	100	4
MCA-CC-6002	Compiler Design	4	0	0	25	75	100	4
MCA-DSEC-6003.**x***	Discipline Specific Elective Course - **Elective-V**	4	0	0	25	75	100	4
MCA-DSEC-6004.**y***	Discipline Specific Elective Course - **Elective-VI**	4	0	0	25	75	100	4
MCA-DSEC-6005.**z***	Discipline-Specific Elective Course - **Elective-VII**	4	0	0	25	75	100	4
PRACTICAL PAPERS								
MCA-CC-6100	Database Management System-Lab	0	0	4	12	38	50	2
MCA-CC-6101	Data Communication and Computer Networks-Lab	0	0	4	12	38	50	2
TOTAL		24	0	8			700	28

L- Lecture **T**-Tutorial **P-**Practical **ESE-**End Semester Examination

CC- Core Course DSEC- Discipline Specific Elective Course

x*, y*, z* represent the Serial No. of the respective elective paper from Discipline Specific Elective Course- **Elective-V**, Discipline-Specific Elective Course -**Elective-VI** and Discipline-Specific Elective Course -**Elective-VII** group respectively**.**

List of Discipline Specific Elective Course Elective (DSEC) Papers of Third Semester:

N.B. Students may opt to choose Discipline Specific Elective Course Elective papers as MOOC (Massive Open Online Course) course through SWAYAM (https://swayam.gov.in/) with the approval of the department (through faculty meeting) for credit transfer as per the norms of the university **OR** may opt to choose from the Discipline Specific Elective Course Elective groups course offered from the department from the following Elective lists.

DSEC Elective-V

Serial No. (x*)	**SUBJECT CODE (**MCA-DSEC-6003.**x***)	**SUBJECT NAME**
1	MCA-DSEC-6003.1	Artificial Intelligence
2	MCA-DSEC-6003.2	Data Mining
3	MCA-DSEC-6003.3	Digital Image Processing

N.B. x* represents the Serial No. of the respective elective paper from Discipline Specific Elective Course Elective-**V** group.

DSEC Elective-VI

Serial No. (y*)	**SUBJECT CODE (**MCA-DSEC-6004.**y*)**	**SUBJECT NAME**
1	MCA-DSEC-6004.1	Cryptography and Network Security
2	MCA-DSEC-6004.2	Machine Learning
3	MCA-DSEC-6004.3	Mobile Computing

N.B. y* represents the Serial No. of the respective elective paper from Discipline Specific Elective Course Elective-**VI** group.

DSEC Elective-VII

Serial No. (z*)	**SUBJECT CODE (**MCA-DSEC-6005.**z*)**	**SUBJECT NAME**
1	MCA-DSEC-6005.1	Software Engineering
2	MCA-DSEC-6005.2	Internet of Things
3	MCA-DSEC-6005.3	Natural Language Processing

N.B. z* represents the Serial No. of the respective elective paper from Discipline Specific Elective Course Elective-**VII** group.

Fourth Semester

SUBJECT CODE	SUBJECT NAME	PERIODS			EVALUATION SCHEME			CREDITS
PRACTICAL/PROJECT		L	T	P	INTERNAL MARKS	ESE	TOTAL	
MCA-DSEC-6106	Dissertation	0	2	30	150 (3 Internal Assessment)	100	250	20
TOTAL		0	2	30			250	20

L- Lecture **T-**Tutorial **P-**Practical **ESE-**End Semester Examination

DETAILED SYLLABUS

MCA-CC-5000: Digital Logic Design

Subject Code: ***MCA-CC-5000***
Subject Name: ***Digital Logic Design***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to organization of digital computer: Block diagram of a computer: Input Unit, Output Unit, Storage Unit, CPU. Control Unit, Arithmetic Logic Unit, System bus, Stored program concept, Number systems: Binary Arithmetic, Floating point number representation, Fixed point number representation, Signed-magnitude representation, overflow, underflow, Computer codes: Error detection and correction codes, parity, parity generator, parity checker. *Memory:* Memory Hierarchy, Main Memory, Memory Address Map. Semiconductor Memory, Different types of semiconductor memory; Different types of Cache Memory: Levels of Cache, Locality of reference, Magnetic Memory; Different types Optical Memory, Different types of magnetic memory.

UNIT-II

Boolean Algebra and Simplification of Boolean Functions: Boolean Algebra: Various Boolean operations; Postulates, Theorems, Duality, Boolean functions, Canonical forms, Representation of Boolean expressions using truth tables, logic gates. Boolean expressions, Karnaugh map, Don't Care Conditions- problems using Don't care conditions, benefit of using Don't care conditions. Tabulation method / Quine- McKluskey method, prime implicants.

UNIT-III

Combinational Logic: Brief introduction integrated circuits, Positive and negative logic. Digital devices: Different Logic gates, Boolean function implementation using logic gates, deviation of Boolean function, truth table, block diagram transformation.

Combinational Circuits: Half-adder, Full-adder, Binary Adder, Half-subtractor, Half-subtractor, magnitude comparator.; Encoders, Decoders, Multiplexers, Demultiplexers, Code conversion, BCD-to-Excess 3 Code converter.

UNIT-IV

Sequential Circuits: Flip-flops: Different types of flip-flops (R-S, J-K, T, and D Flip Flops), Flip-flop excitation tables, characteristic equations, truth tables, Triggering of Flip-flops. Registers, Counters.

Suggested Readings:

Text Books:

1. M. M. Mano, *Digital Logic and Computer Design*, New Delhi: Pearson Education, 2016
2. T. L. Floyd, *Digital Fundamentals*(11th Edition), New Delhi: Pearson Education, 2017.

Reference Books:

1. S. Salivahanan, *Digital Circuits and Design* (4th Edition), New Delhi, Vikas Publication, 2012.

MCA-CC-5001: Data Structures and Algorithms

Subject Code: ***MCA-CC-5001***
Subject Name: ***Data Structures and Algorithms***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Abstract data type, Introduction to linear and non-linear data structure. Introduction to analysis of algorithms, asymptotic notations, analysis of non-recursive and recursive programs, Introduction to algorithm design Techniques. Implementation details of different types of linked lists. Analysis of operations on Linked List: Insertion, Deletion, Searching, Traversal.

UNIT-II

Stacks and Queues ; implementation of stacks and queues using arrays and linked lists; Application of stacks: Conversion of infix to postfix and prefix expressions. Basic terminologies of tree, binary tree, Representation of trees using arrays and linked lists, tree traversal methods, Binary search trees (creation, insertion, searching and deletion of node), Basic terminologies of Graph, Depth-first search, Breadth-first search, strongly connected components.

UNIT-III

Greedy Approach: Minimum Spanning trees, Prim's algorithm, Kruskal's algorithm, Huffman codes, Hill climbing algorithm, shortest path problems, Dijkstra's algorithm, Knapsack problem. Divide & Conquer approach: structure of divide-and-conquer algorithms, quick sort, merge sort, binary search problem, strassen's matrix multiplication problem.

UNIT-IV

Dynamic programming: Overview, differences between dynamic programming, divide & conquer and greedy approaches, longest Common sub-sequence problem, Floyd-Warshall's algorithm. Backtracking: 8-Queen Problem, graph coloring, Hamiltonian cycles, Introduction to Branch and bound. Intractable problems, Examples of NP-Hard and NP-Complete problems, Problem Reduction.

Suggested Readings:

Text Books:

1. Y. Langsam, J,M. Augenstein, and M.A. Tenenbaum, *Data Structures Using C and C++*(2nd Edition), Pearson Education India, 2015.
2. R. Thareja, *Data structure using C*(2nd Edition), Oxford India, 2014.
3. T. H.Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein,*Introduction to Algorithms* (3rd Edition), New Delhi: MIT Press, 2010.
4. A.V. Aho, J. E. Hopcroft, and J. D. Ullman,*The Design and Analysis of Computer Algorithms*,New Delhi: Addison Wesley, 2002.
5. H.P.Dave, and B.H. Dave,*Design and analysis of algorithms*, (2nd Edition), Pearson India, 2013.

Reference Books:

1. D. Samanta, *Classic data structure*(2nd Edition), PHI, India, 2009.
2. K. Narasimha, *Data Structures and Algorithms Made Easy*(5th Edition), CareerMonk Publications, India,2016.

MCA-GEC-5004: Programming and Problem Solving through C

Subject Code: ***MCA-GEC-5004***
Subject Name: ***Programming and Problem Solving through C***
No. of Credits: ***4***
No.of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to Programming Concepts: Types of programming languages, Modular Programming, Structured Programming, Compilers and interpreters, Algorithms and Flowcharts *Overview of C Language:* History of C, Character set, C tokens, Identifiers, Keywords, Data types, Variables, Constants, Operators in C, I/O functions, Control statements, The C Preprocessor

UNIT-II

Functions: Overview, defining a function, accessing a function, function prototypes, call by value, call by reference, recursion, String functions, Storage classes.
Arrays and Pointers: Defining an array, array initialization, processing an array, passing array to a function, multidimensional arrays, arrays and strings, pointer declarations, passing pointer to a function, pointers and one dimensional arrays, Operation on pointers, pointers and multidimensional arrays, array of pointers, functions returning pointers.

UNIT-III

Structures and Unions: Defining a structure, processing a structure, user defined data types, structures and arrays, structures and pointers, passing structures to a function, self referential structures, bit fields in structures, Union, Union of structures, Enumerated data type.*Data files:* Standard File opening modes, Character I/O, String I/O, Formatted console I/O, text mode versus binary mode, Unformatted console I/O functions - record I/O, Data Record operations.

UNIT-IV

Graphics Programming: Library file- graphics.h, 2-D Coordinate system, Simple Graphics Functions (initgraph(), line(), circle(), arc(), rectangle(), ellipse(), drawpoly(), closegraph(), restorecrtmode(), setfillstyle(), putpixel(), getmaxx(), getmaxy(), outtextxy(), setcolor(), fillcolor(), settextstyle(), moveto(), lineto(), moverel(), linerel())
Mouse Programming: GUI and mouse, dos.h, mouse initialization, show and hide mouse pointer, restrict mouse movement, Cursor Position and button status.

Suggested Readings:

Text Books:

1. Y. Kanetkar, *Let us C* (16th Edition), BPB Publications, New Delhi 2018.
2. E. Balagurusamy, *Programming in ANSI C* (8th Edition), Tata McGraw-Hill Publication, New Delhi, 2019.

Reference books:

1. B. S. Gottfried, *Programming with C* (3rd Edition), McGraw Hill Education, 2017.
2. B. W. Kernighan and D. M. Ritchie, *The C Programming Language* (2ndEdition), Pearson Education India, 2015.

MCA-CC-5101: Data Structures and Algorithms-Lab

Subject Code: ***MCA-CC-5101***
Subject Name: ***Data Structures and Algorithms-Lab***
No. of Credits:*2*
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. Perform various operations on Array.
2. Demonstrate the utilization of dynamic memory allocation.
3. Perform various operations (insertion, deletion, searching, merging, reversing etc.) on different types of linked list.
4. Implement the concept of different operations on stack with static and dynamic memory representations.
5. Implement different operations on general queue and circular queue with static and dynamic memory representations.
6. Binary Tree creation with various operations (insertion, deletion, searching, traversing).
7. Implement Graph Traversal algorithms with directed and non-directed graph.
8. Demonstrate the merits and demerits of different sorting methods with large input data.
9. Demonstrate the merits and demerits of different searching methods with large input data.
10. Implement any spanning tree algorithm with a weighted graph.
11. Implement any shortest path finding algorithm with a weighted graph.

Suggested Readings:

Text Books:

1. Y. Langsam, J,M. Augenstein, and M.A. Tenenbaum, *Data Structures Using C and C++*(2nd Edition), Pearson Education India, 2015
2. R. Thareja, *Data structure using C*(2nd Edition), Oxford India, 2014.

Reference Books:

1. D. Samanta, *Classic data structure*(2ndEdition), PHI, India, 2009.
2. K. Narasimha, *Data Structures and Algorithms Made Easy*(5th Edition), CareerMonk Publications, India,2016.

MCA-GEC-5104: Programming and Problem Solving through C-Lab

Subject Code: ***MCA-GEC-5104***
Subject Name: ***Programming and Problem Solving through C-Lab***
No. of Credits: 2
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. Write C programs using operators and expressions.
2. Write C programs using control statements.
3. Write C programs using array (1D and 2D).
4. Write C programs using function. Demonstration of call-by-value, call-by-address, passing array (1D and 2D) to a function and programs related to recursive function.
5. Write C programs using string standard library functions in C for string manipulation.
6. Write C programs using pointer. Demonstration of operation on pointers, array of pointers, functions returning pointers.
7. Write C programs using Structure & Union. Demonstration of difference between structure and union.
8. Write C programs involving opening, closing, reading and writing a file. Copy content of one file to another file using commands line arguments.
9. Write C programs to draw line, circle, arc, rectangle, ellipse & polygon and color its using graphics function.
10. Write C programs to show and hide mouse pointer, restrict mouse movement, cursor position and button status.

Suggested Readings:

Text Books:

1. Y. Kanetkar, *Let us C* (16th Edition), BPB Publications, New Delhi 2018.
2. E. Balagurusamy, *Programming in ANSI C* (8th Edition), Tata McGraw-Hill Publication, New Delhi, 2019.

Reference books:

1. B. S. Gottfried, *Programming with C* (3rd Edition), McGraw Hill Education, 2017.
2. B. W. Kernighan and D. M. Ritchie, *The C Programming Language* (2nd Edition), Pearson Education India, 2015.

MCA-CC-5005: Operating System

Subject Code: ***MCA-CC-5005***
Subject Name: ***Operating System***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT- I

Operating system as an Extended Machine and as a Resource Manager, The evolution of Operating Systems, Introduction to Processes (The Process Model, Process Creation, Process Termination, Process Hierarchies, Process States, Implementation of Processes, Process Control Block), Threads, Inter-process Communication (Race conditions, Critical Sections, Mutual Exclusion with Busy Waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message Passing), Classical IPC problems (The Dining Philosophers Problem, The Sleeping Barber Problem), Process Scheduling.

UNIT- II

Introduction, Deadlock (Conditions for Deadlock, Deadlock modeling), Deadlock detection and recovery, Deadlock avoidance, Swapping, Virtual Memory (Paging, Page Tables), Page Replacement Algorithms, Modeling Paging Algorithms (Belady's Anomaly, Stack Algorithms, Predicting page fault rates), Design issues for Paging Systems, Implementation issues, Segmentation.

UNIT -III

Principles of I/O hardware (I/O devices, Device Controllers, Direct memory access), Principles of I/O software, I/O Software Layers, Disks (Disk hardware, disk formatting, disk arm scheduling algorithms, Error handling) Clocks (Clock hardware, Clock software), Files (File Naming, File structure, File types, File access, File attributes, File operations, Memory mapped files), Directories, File System layout (Implementing files, Implementing directories, Shared files), Security (Generic Security Attacks, User Authentication), File Systems (FAT, VFAT, FAT32, NTFS).

UNIT -IV

Overview of UNIX, Processes in UNIX (Fundamental Concepts, Process Management System Calls in Unix, Implementation of Processes in Unix), Memory Management in Unix, Input/output in Unix, The Unix File System, Security in Unix.

Suggested Readings:

Text Books:

1. A. S. Tenenbaum,*Modern Operating Systems*(4th Edition*),* Pearson, 2014.
2. A. Silberschatz, P. B. Galvin, and G. Gagne *Operating System Concepts* (8th Edition), New York: John Wiley and Sons 2017.
3. S. Das, *Unix Concepts and Applications* (3rdEdition), New Delhi: Tata McGraw-Hill,2017

Reference Books:

1. W. Stallings, *Operating Systems: Internals and Design Principles*(9th Edition), Pearson, 2018.

MCA-CC-5006: Computer Organization and Architecture

Subject Code: ***MCA-CC-5006***
Subject Name: ***Computer Organization and Architecture***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT- I

Integer Representation; Addition and Subtraction (Addition and Subtraction with Signed-Magnitude Data, Hardware Implementation, Addition and Subtraction with Signed-2's Complement Data); Booth's Multiplication Algorithm; Division Algorithm; Floating-Point Arithmetic Operations.

UNIT -II

Major Components of a CPU; General Register Organization; Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation); Subroutine Call and Return; Interrupts; Characteristics of Complex Instruction Set Computer (CISC) and Reduced Instruction Set Computer (RISC)

Microoperations, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations; Microprogrammed Control and Hardwired Control; Control Memory, Control Word, Microinstruction, Microprogram, Mapping of Instructions; Instruction Formats (viz., Three-Address Instructions, Two-Address Instructions and Zero-Address Instructions); Addressing modes.

UNIT- III

Parallel Processing; Flynn's Classification of computers; Pipelining, Data Dependency, Handling of Branch Instructions, Delayed Load, Delayed Branch; Vector Processing, Array Processors.

Multiprocessors; Introduction and types; Interconnection Structures; Interprocessor Arbitration; Interprocessor Communication and Synchronization, Mutual Exclusion with a Semaphore.

UNIT- IV

Hardware Organization for Associative Memory; Different Mapping methods for Cache Memory, Different Writing Policies, Cache Initialization, Cache Coherence; Virtual Memory.

Input Output Interface, I/O Bus, Memory Bus, Isolated I/O, Memory-Mapped I/O; Modes of Transfer (viz., Direct Memory Access (DMA), Programmed I/O, and Interrupt-Initiated I/O); Input-Output Processor.

Suggested Readings:

Text Books:

1. M. M. Mano,*Computer System Architecture*(3rd Edition), Pearson Education, 2007.
2. V. C. Hamacher, Z. G. Vranesic, and S. G. Zaky,*Computer Organization*(5th Edition), New Delhi: Tata McGraw-Hill, 2011.

Reference Books:

1. W. Stallings**,** *Computer Organization and Architecture* (9th Edition), Pearson Education, 2013.

MCA-RM-5009: Research Methodology & Proposal Writing

Subject Code: ***MCA-RM-5009***
Subject Name: ***Research Methodology & Proposal Writing***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Research Problem Formulation and Data Collection: Research methods, types of research, Development of research problem, Identify research gap, literature review- primary and secondary sources, methods of data collection, sampling methods, data processing and hypothesis testing.

UNIT-II

Statistical Analysis: Descriptive Statistics and Probability, Statistical Practical's using MS– Excel, Use of statistical tools and software.

UNIT-III

Research Ethics and Indexed Publishing: Ethical issues, Ethical clearance, Intellectual Property Rights (IPR), Patent laws, Copyright, Design, Royalty, citation, plagiarism check, authenticity and accountability of research.

UNIT-IV

Result Interpretation and Proposal Writing: Interpretation, Techniques for interpretation, report writing and its significance, layout of research report, presentation of report, precautions in writing report, conclusion and discussions, use of tools like LaTeX.

Suggested Readings:

Text Books:

1. C. R. Kothari. *Research Methodology*. New Age International Publisher, New Delhi, 3rd edition, 2013.
2. E. M. Phillips and D S Pugh. *How to get a Ph.D.: A handbook for students and their supervisors.* Milton Keynes: Open University Press, 2005.

Reference Books:

1. Patrick Dunleavy. *Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis Or Dissertation*. Palgrave Macmillan, 2003.
2. Loraine Blaxter, Christina Hughes and Malcolm Tight. *How to Research*. Open University Press, Milton Keynes, 3rd edition, 2006.

MCA-SEC-5010: Internet Technology & Its Application

Subject Code: ***MCA-SEC-5010***
Subject Name: ***Internet Technology & Its Application***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Two Hours.***

UNIT-I

Introduction: History of the Internet; History of the World Wide Web; W3C (World Wide Web Consortium); Levels of Internet Connectivity (Dial-up, Leased Line, DSL, VSAT); Requirements for Internet connectivity; Use of Browsers; Different types of browsers (IE, Opera, Netscape, Crome); Search engines; FTP; Electronic Mail; Instant Messaging; DHCP; DNS; HTTP; URL; Proxy Servers.

UNIT-II

XHTML: Introduction; Components of XHTML; Elements of XHTML (Headers, Linking, Images, Special Characters, Lists, Tables, Forms, Framesets, canvas, Semantic and structural elements).
Cascading Style Sheets (CSS)*:* types, properties, box model, Use of CSS (Positioning Elements, Backgrounds, Text flow).
XML: Introduction; Document Type Definitions andSchemas; XML Vocabularies, Document Object Model (DOM and its methods), Extensible StyleSheet Language (XSL).
.

UNIT-III

Web servers: Introduction; HTTP Request Types;Client-side Scripting versus Server-side Scripting; Accessing Web servers.
Scripting Languages: Javascript, Operators, Data Types, Control Structures, Functions, Arrays, String Manipulation,VBScript,ASP: Working of ASP; Setup; ASP Objects. JSP: Introduction; JSP Overview; Scripting; Standard Actions; Directives.
Databases: Introduction to each one of the following: SQL, MYSQL, DBI.

UNIT-IV

Web Site Design Considerations: Using Logical Design: Planning website, drawing a map, using a top-down approach, flexibility, other web design metaphors. Creating templates, Creating a Compatible Design: Designing for different color depths, AJAX, JSON, Node.Js, SpringBoot.
PHP: Introduction to PHP; Data Types; Control Structures; Functions; Strings; Arrays; Querying

Web Databases using PHP; Writing to Web Databases; Errors, Debugging and Deployment; Reporting in PHP; Validation Techniques in PHP.

Suggested Readings:

Text Books:

1. H. M .Deitel, and P. J. Deitel, *Internet and World Wide Web: How to Program*(4th Edition), Pearson Education India,2009.
2. T. Powell, *Web Design: The Complete Reference*, McGraw-Hill, 2002. New Delhi: Prentice-Hall India, 2002.
3. H. E .Williams, and D. Lane, *Web Database Applications With PHP and MySQL* (2nd Edition), New Delhi: O'Reilly, 2004.

Reference Books:

1. T. Brown, and S. Bonnelli, *Internet Complete*(2ndEdition), New Delhi: BPB Publications, 2000.
2. D.E. Comer, *The Internet Book: Everything you need to know about Computer Networking and how the Internet works*(4thEdition),PearsonEducation India, 2006.
3. P.BrianandHogan, *HTML5 and CSS3: Level Up with Today's Web Technologies*,Pragmatic Bookshelf(2nd Edition), 2013.

MCA-SEC-5110: Internet Technology & Its Application-Lab

Subject Code: ***MCA-SEC-5110***
Subject Name: ***Internet Technology & Its Application-Lab***
No. of Credits: ***2***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. Design a simple XHTML file to demonstrate the use of different elements of XHTML.
2. Implement forms using XHTML, frames and CSS.
3. **Implementation of CSS with different styles to design a XHTML file.**
4. **Implementation of various event handling in XHTML.**
5. Design of XHTML file to demonstrate the CSS box model with various properties.
6. Design a XML catalog and perform the validation and formatting.
7. Validation of XHTML forms using JavaScript.
8. Write JavaScript to illustrate different in-built string functions.
9. Demonstrate the use of various JS objects.
10. Demonstrate the conversion of JavaScript object into JSON string.
11. Implementation of form handling using PHP.
12. Implementation of file operations and arrays in PHP.
13. Perform manipulation in databases using PHP.

Suggested Readings:

Text Books:

1. H. M .Deitel, P. J. Deitel, *Internet and World Wide Web: How to Program*(4th Edition), Pearson Education India,2009

Reference readings:

1. A. Iskandar, *Web development with Angular and Bootstrap* (3rd Edition), Packet Publishing, 2019.
2. A.W.West, *Practical PHP 7, MySQL 8, and MariaDB Website Databases(2nd Edition)*,Apress, 2018.

MCA-CC-6000: Database Management System

Subject Code: ***MCA-CC-6000***
Subject Name: ***Database Management System***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction: Introduction to databases, characteristics of the database approach, database users and designers, role of a DBA, advantages of using a DBMS, data models, schemas, instances, DBMS architecture (Three-Schema Architecture).

Conceptual Data Modeling: Phases of database design, entity type, entity set, attributes, keys, value sets, relationships, relationship types, relationship sets, relationship instances, relationship degree, role names, recursive relationships, constraints on relationship types, attributes of relationship types, weak entity types, ER Diagram, naming conventions and design issues, EER concepts.

UNIT-II

Relational model concepts: Domain, attribute, tuple, relation, characteristics of relations, relational databases, relational database schemas, relational constraints, entity integrity, referential integrity, foreign keys. ER to Relational mapping algorithm, Case study.

Relational Algebra: basic relational algebra operations, Relational Calculus: Tuple Relational Calculus, Domain Relational Calculus

SQL: Characteristics of SQL, Data types in SQL, Different Types of SQL commands.

UNIT-III

*Functional Dependencies and Normalization:*Functional Dependencies, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Multivalued Dependencies, Join Dependencies, Fourth Normal Form, Fifth Normal Form.

UNIT-IV

File Organization: Storage hierarchies, hardware descriptions of disk devices, Magnetic Tape Storage Devices, RAID technology, Organization of file records on disk, Operations on Files, primary methods of file organization

Transaction Processing: Transaction, ACID properties of transaction, transaction states, schedules, serializability, recoverability.

Concurrency Control: Concurrent execution of transaction, Lock-based techniques for

concurrency control, Graph-based protocol, Timestamp based protocol, Deadlock.
Recovery system: Types of failure, types of storage, recovery and atomicity, Log-based recovery, shadow paging, transaction rollback, checkpoints.
Security: Security and Integrity-security violations, authorization and views, granting of privileges.

Suggested Readings:

Text Books:

1. R. Elmasri, S. B. Navathe, *Fundamentals of Database Systems* (7thEdition), New Delhi: Addison Wesley, 2017.
2. A.Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts* (6th Edition),New Delhi: Tata McGraw-Hill, 2011.
3. B. Desai, An Introduction to Database Systems (Revised Edition), New Delhi: Galgotia Publications, 2012.

Reference Books:

1. D. M. Kroenke, *Database Processing: Fundamentals, Design and Implementation* (8th Edition), New Delhi: Prentice-Hall of India, 2002.
2. T. M. Connolly, C. E. Begg, Database Systems, A Practical Approach to Design, Implementation and Management (4th Edition), New Delhi: Addison Wesley, 2008.

MCA-CC-6001: Data Communications and Computer Networks

Subject Code: ***MCA-CC-6001***
Subject Name: ***Data Communications and Computer Networks***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to Computer Networks: Uses of Computer Networks, Types of Networks, Network Topology, OSI Reference Model, TCP-IP Reference Model.
Physical Layer: Data and Signal, Transmission impairment, Baseband and Broadband, Transmission Media, Digital Transmission, Analog Transmission, Frequency Division and Time Division Multiplexing, Switching techniques.

UNIT-II

Data Link Layer: Design Issues, Framing, Error Control, Flow Control; Error Detection and Correction, Data Link Protocols – Simplex protocol, Simplex Stop-and-Wait protocol, Protocol for Noisy Channel; Examples- HDLC, PPP.
Medium Access Control Sublayer: Channel Allocation Problem – Static and Dynamic channel allocation; Multiple access – Aloha, Slotted Aloha, CSMA; Collision free protocols; Wireless LAN protocols; IEEE Standard 802.3 – Ethernet, Fast and Gigabit Ethernet; IEEE Standard 802.11 and 802.16. – Protocol Stack, Physical Layer, MAC Sublayer, Frame Structure.

UNIT-III

Network Layer: Design Issues, Connection Oriented and Connectionless services, Virtual Circuits and Datagram Subnets, Routing Algorithms – Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts.
Congestion Control Algorithms – General Principles, Congestion Prevention Policies, Load Shedding, Jitter Control, QoS, Leaky and Token Bucket Algorithms, Internet Protocol – IP addresses, Subnets, CIDR; Internet Control Protocol – ICMP, ARP, RARP, DHCP.

UNIT-IV

Transport Layer: Design Issues, Transport Service Primitives, Addressing, Connection Establishment and Release, Flow Control and Buffering, Multiplexing, Crash Recovery; Internet Transport Protocols: UDP, TCP – Header, Connection Establishment and Release, Connection Management, Transmission Policy, Congestion Control, Timer Management.

Application Layer: Domain Name System, DNS Name Space, Domain Resource Records, Name Servers; Electronic Mail- Architecture and Services, User Agent, Message Formats – MIME, Message Transfer -SMTP, Message Delivery – POP3 and IMAP, Web mail.

Suggested Readings:

Text Books:

1. A. S. Tenenbaum, *Computer Networks* (5th Edition), Pearson Education India, 2013.
2. B. A. Forouzan, *Data Communication and Networking* (4th Edition), Tata McGraw-Hill Education, 2017.
3. W.Stallings, *Data and Computer Communications* (10thEdition), Pearson Education India, 2017.

Reference Books:

1. P. C. Gupta, *Data Communications and Computer Networks* (2ndEdition), Prentice Hall India, 2013.
2. W.R. Stevens, *UNIX Network Programming*– Volume I (3rdEdition), New Delhi: Prentice-Hall India, 2010.

MCA-CC-6002: Compiler Design

Subject Code: ***MCA-CC-6002***
Subject Name: ***Compiler Design***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Compilers & translators, Phases of a compiler, compiler-writing tools; High-level programming languages, Definition of programming languages, Lexical & syntactic structure of a language, Data elements, Data structure, Operators, Assignment, Statements, Program units, Data environments, Parameter transmission, Storage management. The role of the lexical analyzer, a Simple approach to the design of lexical analyzers.

UNIT-II

Regular expression, Finite automata; Context-free grammars, Derivations & parse trees, Capabilities of context-free grammars. Parsers, Shift-reduce parsing, operator-precedence parsing, Top-down parsing, Predictive parsers; LL(1), LL(K) Grammar, Construct LR, SLR & LALR parsers.

UNIT-III

Syntax-directed translation schemes, Implementation of syntax-directed translators, Intermediate code, Postfix notation, Parse trees and Syntax trees, Three-address code, quadruples and triples, Boolean translations, Case statements; The contents of a symbol table, Data structure for symbol tables, Representing scope information; Implementation of a simple stack allocation scheme; Lexical & Syntactic-phase errors, Semantic errors.

UNIT-IV

The principal sources of optimization, loop optimization, the DAG representation of basic blocks, value numbers and algebraic laws, Global data-flow analysis; Issue in the design of a code generator (input to the code generator, Target programs, Memory management, Instruction selection, Register allocation.

Suggested reading:

Text Book:

1. A. V. Aho, M. S. Lam, R. Sethi, and J. D. Ullman, *Compilers Principles Techniques & Tools* (2nd Edition), Pearson,2013.
2. A.V. Ahoand, and J. D. Ullman, *Principles of Compiler Designs*(1st Edition), New Delhi: Narosa Publishing House, 2003

Reference Books:

1. W. A. Appel, and M. Ginsburg , *Modern Compiler Implementation in C*, Cambridge University Press (1stPaperback Edition),2004.
2. J.R. Levine, *Lex & Yacc*,O'Reilly Publications, 2005.

MCA-CC-6100: Data Base Management System Lab

Subject Code: ***MCA-CC-6100***
Subject Name: ***Data Base Management System Lab***
No. of Credits: ***2***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. To learn writing and executing basic SQL commands.
2. Create and configure a database.
3. Backup and restore a database.
4. Create and configure User Accounts.
5. Create, manage and assign Roles to users.
6. To understand the fundamentals of PL/SQL.
7. To understand the concept of exception handling in PL/SQL.
8. To understand the use of cursors.
9. Implement procedure and function program units.
10. Create and execute Package Specification and Package Body.
11. To understand the concept of trigger.

Suggested Readings:
Text Books:

1. J. Casteel, Oracle 12c: *SQL* (3rd Edition),Cengage Learning, 2015.
2. S. Feuerstein, and B. Pribyl, *Oracle PL/SQL Programming: Covers Versions Through Oracle Database 12c* (6th Edition), O'Reilly Media, 2014.

Reference Books:

1. P. Koletzke, *Oracle Developer Advanced Forms and Reports* (1st Edition), McGraw-Hill Osborne Media, 1999.

MCA-CC-6101: Data Communications and Network Programming Lab

Subject Code: ***MCA-CC-6101***
Subject Name: ***Data Communications and Network Programming Lab***
No. of Credits: ***2***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. Implement Network programming (client-server socket programming in C/Java).
2. Packet Monitoring and Analysis using WireShark.
3. Demonstrate the use of TELNET.
4. Demonstrate the use of FTP.
5. Configuring and testing Open Source Network Simulators.
6. Simulation experiments for protocol performance.
7. Network management experiments.
8. Software Defined Network (SDN) controller based network management.
9. Implement ping command using TCP/UDP socket.
10. Implementation of Echo-back Server using TCP/UDP socket.

Suggested Readings:

Text Books:

1. W. R. Stevens, *Unix Network Programming Volume -I* (3rd Edition), Pearson Education India, 2015.
2. R. Petersen, *Linux: The Complete Reference* (6th Edition), McGraw-Hill Education, New Delhi, 2011.
3. J. Edelman, S. S. Lowe, M. Oswalt, *Network Programmability and Automation* (1st Edition), Shroff Publishers & Distributers Private Limited, Mumbai, 2018.

Reference Books:

1. N. Matthew, R. Stones, *Beginning Linux Programming* (4th Edition), Wrox, 2007.

MCA-DSEC-6106: Dissertation

Subject Code: ***MCA-DSEC-6106***
Subject Name: ***Dissertation***
No. of Credits: ***20***
No. of Hours Per Week: ***32***
Marks Distribution: ***Internal Exam*** **= 150** ***(Based on 3 Internal Presentations)*****,**

End Semester Examination **= 100** ***(Based on*** **viva, project report, software/ hardware/product/ results evaluation*****).***

Duration of End Semester Examination: ***30 minutes presentation and viva.***

Specifications for Dissertation/ Project are given in the Appendix-I.

DSEC Elective-I

MCA-DSEC-5002.1: Theory of Computation

Subject Code: ***MCA-DSEC-5002.1***
Subject Name: ***Theory of Computation***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction of Automata: Definition of an Automaton, Description of a Finite Automaton, Transition Systems, Properties of Transition Functions, Acceptability of a String by a Finite Automaton, Nondeterministic Finite State Machines, The Equivalence of DFA and NDFA, Mealy and Moore Models, Minimization of Finite Automata.

UNIT-II

Formal Languages: Definition of formal languages, Chomsky Classification of Languages, Languages and Their Relation, Recursive and Recursively Enumerable Sets, Operations on Languages, Languages and Automata.
Regular Expressions: Basic concept of Regular Expressions, Finite Automata and Regular Expressions, Pumping Lemma for Regular Sets, Application of Pumping Lemma.

UNIT-III

Context-free Grammars and Languages: Context-free Languages, Derivation tree, Ambiguity in Context-free Grammars, Simplification of Context-free Grammars, Normal Forms for Context-free Grammars, Pumping Lemma for Context-free Languages, Decision Algorithms for Context-free Languages Exercises.
Pushdown Automata: Basic Definitions, Acceptance by Pushdown Automata, Pushdown Automata and Context-free Languages, Parsing and Pushdown Automata.

UNIT-IV

Turing Machine and Linear Bounded Automata: Turing machine Model, Representation of Turing Machine, Language Acceptability by Turing Machines, Design of Turing Machines, Universal Turing Machine,The Model of Linear Bounded Automaton, Turing Machines and Type 0 Grammars, Linear Bounded Automata and Languages, Halting Problem of Turing Machines, NP-Completeness.

Suggested Readings:

Text Books:

1. K. L. P. Mishra and N. Chandrasekaran, *Theory of Computer Science* (3rd Edition), Prentice-Hall of India, 2006.
2. J. E. Hopcroft, R. Motwani, and J. D. Ullman, *Introduction to Automata Theory*, Languages and Computation (3rd Edition), Pearson Education India, 2008.

Reference Books:

1. H. R. Lewis, and C. H. Papadimitriou, *Elements of the Theory of Computation* (2nd Edition), Pearson Education India, 2015.

MCA- DSEC-5002.2: Computer Graphics

Subject Code: ***MCA*- DSEC-*5002.2***
Subject Name: ***Computer Graphics***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction and Overview of Graphics Systems and Output Primitives: Video Display Devices, Raster Scan Display, Random Scan Display, Video Controller, GPU Workstations, Input Devices, Graphics Software, Coordinate Representations, Graphics Functions.

Concept of Points and Lines, Line drawing algorithms, Loading the Frame Buffer, Line Functions, Circle drawing algorithms, Ellipse-generating algorithms, Filled-Area Primitives, Boundary fill algorithm, Flood fill algorithm.

UNIT-II

Two-Dimensional Geometric Transformations: Basic Transformations: Translations, Rotations, Scaling; Matrix Representations and Homogeneous Coordinates, Composite Transformations: Translations, Rotations, Scaling, General Pivot Point Rotations, General Fixed Point Scaling, General Scaling Directions, General Composite Transformations, Other Transformations: Reflections, Shearing, Transformations Between Coordinate Systems, Affine Transformations.

UNIT-III

Two-Dimensional Viewing and Clipping: Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to-Viewport Coordinate Transformations.
*Clipping Operations:*Point Clipping, Line Clipping algorithms, Polygon Clipping algorithms, Text Clipping.

UNIT-IV:

Three Dimensional Concept and Some Object Representation: Three-Dimensional Display Methods, Parallel Projections, Perspective Projections, Depth Cueing, Visible Line and Surface, Identification, Surface Rendering, Exploded and Cutway Views, Three-dimensional and Stereoscopic Views.
Spline Representations: Interpolations and Approximations Splines, Spline Specifications, Cubic Spline IntepolationMethods, Natural Cubic Splines, Hermite Interpolations,
Bezier Curves, CubicBezier Curves, Bezier Surfaces.

Suggested Readings:

Text Books:

1. D. D. Hearn, M. P. Baker, *Computer Graphics* (2nd Edition) Sixteen Impression, New Delhi: Prentice- Hall India, 2012.
2. R. Plastock, G. Kalley, *Theory and Problems of Computer Graphics* (2n Indian Edition), Schaum's Series, New Delhi: Tata McGraw-Hill, 2015.
3. R. K. Maurya, Computer Graphics, 1st Edition, Wiley India, 2013.
4. D. D. Hearn, M. P. Baker, W. Carithers, *Computer Graphics with OpenGL*(4th Edition), PearsonEducation India, 2013.
5. G. Sellers, R. S. Wright Jr. ,and N.Haemel, *OpenGL Superbible: Comprehensive Tutorial and Reference* (7th Edition), Pearson Education, 2016.

Reference Books:

1. J. D. Foley, A. v. Dam, S. K. Feiner, andF. H. Huges, *Computer Graphics: Principles and*Practice(3rd Edition), New Delhi: Addison Wesley, 2018.
2. D. Rogers, J. Adams, *Mathematical Elements for Computer Graphics* (2nd Edition), New Delhi: Tata McGraw-Hill, 2017.

DSEC Elective-II

MCA- DSEC-5003.1: Discrete Mathematics

Subject Code: ***MCA-DSEC-5003.1***
Subject Name: ***Discrete Mathematics***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, tautology, equivalence implication, Normal forms, Quantifiers, universal quantifiers. Propositional and Predicate logic.

Sets, Relations and Functions: Sets, set operations; binary relations, types of relations, partitions; partial order relations, Hasse and lattice diagrams for posets; functions, types of functions, composition of functions.

UNIT-II

Combinatorics: Basics of counting, Combinations & Permutations, Binomial Coefficients, principles of Inclusion-Exclusion.

Recurrence relations: Generating Functions, Function of Sequences, Calculating Coefficients of generating functions, solutions of recurrence relations by substitution and generating functions, solution of non-recurrence relations by conversion to linear recurrence relations.

UNIT-III

Graph Theory: Introduction to graphs, representation of graphs, graph isomorphism and homeomorphism, subgraphs, types of graph: directed and undirected graphs; Euclidean paths and circuits; Hamiltonian paths and circuits; graph coloring.

UNIT-IV

*Introduction to Probability Theory***:** Sample space and events, random variables, probabilities of events and combinations of events, conditional probability, expectation, mean and variance of random variables.

*Probability distributions***:** Binomial and Poisson distributions, properties and occurrence; normal distribution, properties, examples, relation to Poisson approximation.

Suggested Readings:

Text Books:

1. J. P.Trembly, and P.Manohar, *Discrete Mathematical Structures with Applications to Computer Science* (3rd edition),New Delhi: Tata McGraw-Hill, 2015.
2. R. Johnsonbaugh, *Discrete Mathematics*(8th Edition), Pearson, 2017.
3. W. Feller, *An Introduction to Probability Theory and its Application* (2nd edition), Wiley, 2008.

Reference Book:

1. S. Lipschutz, and M. Lipson, *Discrete Mathematics* (3rd edition),McGraw-Hill Education; 2009.
2. N. Deo, *Graph Theory with Application to Engineering and Computer Science*, PHI, 2004.

MCA-DSEC-5003.2: Computer Oriented Numerical Methods

Subject Code: ***MCA-DSEC-5003.2***
Subject Name: ***Computer Oriented Numerical Methods***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Computational Basics: Floating-point representation of numbers normalization and its consequences, arithmetic operations with normalized floating-point numbers, types of errors and its measurements, Absolute and Relative error.
Iterative Methods for the solution of a Single Equation: Method of Successive Bisection, Method of False Position, Newton-Raphson Method, Secant Method.

UNIT-II

Solution of sets of Algebraic Equations: Gaussian Elimination Method, Gauss-Jordan Elimination Method, Jacobi's Method, Pivoting, III-conditioned Equations, Refinement of Solution obtained by Gaussian Elimination, Gauss-Seidel Iterative Method.
Solution of Differential Equations: Euler's Method, Taylor Series Method, Runge-Kutta Methods, Predictor-Corrector Method.

UNIT-III

Interpolation: Finite Difference Operations, Newton's Forward and Backward Interpolation Formulae, Lagrange's Interpolation Formula.
Curve Fitting: Method of Group Averages, Least Squares Method, Fitting a Straight Line, Fitting a Parabola, Fitting a curve, Fitting an Exponential Curve, method of Moments.

UNIT-IV

Numerical Differentiation: Differentiation using Difference Operations, Differentiation using Interpolation.
Numerical Integration: Numerical Integration, Newton-Cotes Integration Formulae, Trapezoidal Rule, Simpson's $1/3^{rd}$ Rule, Simpson's $3/8^{th}$ Rule, Gaussian Quadrature Formulae.

Suggested Readings:

Text Books:

1. V. Rajaraman, Computer Oriented Numerical Analysis (Fourth Edition), New Delhi: Prentice-Hall India, 2019
2. K.S. Rao, Numerical Methods for Scientists and Engineers (Second Edition), New Delhi: Prentice-Hall India, 2004

Reference Book:

1. S.S. Sastry, Introductory Methods of Numerical Analysis (Fifth Edition), New Delhi: Prentice-Hall India, 2012.
2. K. Sankara, E. Balagurusamy, Computer Oriented Statistical and Numerical Analysis (Third Edition), New Delhi: Prentice-Hall India

DSEC Elective-III (Theory)

MCA-DSEC-5007.1: Object Oriented Programming and Design using C++

Subject Code: ***MCA-DSEC-5007.1***
Subject Name: ***Object Oriented Programming and Design using C++***
No. of Credits: 4
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Basics of C++: Variables and Data Types, Constants, Operators, Basic Input/Output, Control Statements, Functions, Arrays, Strings, Pointers, References, Differences between C and C++.

Introduction to OOP: Basic Concepts of OOP (Classes, Objects, Abstraction, Encapsulation, Inheritance, Polymorphism), Comparison of Procedural Programming and OOP, Member Access Operators, Static Members, Arrays of Objects, Returning Objects from Functions, Pointers to Members, Inline Function, Friend Functions, Friend Class, Dynamic Memory Allocation, Constructors: Default Constructor, Parameterized Constructor, Copy constructor, Overloaded Constructors, Dynamic Constructor, Destructors.

UNIT-II

Templates: Function Template, Function Templates with Multiple Parameters, Overloading of Function Template, Class Template, Class Templates with Multiple Parameters, Member Function Templates, Non-Type Template Arguments. Introduction to Standard Template Library (STL): Containers, Algorithms and Iterators.

Exception Handling: Basics of Exception Handling, Throwing and Catching Exceptions, Catch All, Rethrowing an Exception, auto_ptr, Exceptions in Constructors and Destructors, Uncaught Exception, Standard Exceptions.

UNIT-III

Inheritance: Base and Derived Classes, Types of Inheritance, Access Control in Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Classes, Derived Class Constructor with Arguments, Classes within Classes.

Polymorphism: Overloading: Operator Overloading, Operator Function as Member Function and Friend Function, Type Conversions, Function Overloading; Virtual Functions, Calling Virtual Functions from Constructors, Pure Virtual Functions, Abstract Classes, *this* Pointer, Static and Dynamic Binding, Object Slicing, Virtual Destructors, Calling Virtual Functions from Destructors, Virtual Base Classes.

UNIT-IV

File/Stream Input and Output: Stream and Files, Stream Classes, Stream Errors, Opening and Closing Files, Read/Write from File, Sequential and Random Access to File, Dealing with Binary Files, Command-Line Arguments.

Object Oriented Design: Object Oriented Methodology, Overview of Object Design, Unified Modeling Language (UML): UML Class Diagram, Use Case Diagram, Sequence Diagram, State Diagram.

Suggested Readings

Text Books:

1. E. Balagurusamy, *Object-Oriented Programming with C++* (7th Edition), McGraw Hill Education, 2017.
2. S.B. Lippman, *C++ Primer*(4th edition), Pearson Education India, 2007.
3. M. R. Blaha, and J.R. Rumbaugh, *Object - Oriented Modeling and Design With UML* (2nd Edition), Pearson Education India, 2007.

Reference Books:

1. H. Schildt, *C++: The Complete Reference*(4th Edition),McGraw Hill Education, 2017.

MCA-DSEC-5007.2: Java Programming

Subject Code: ***MCA-DSEC-5007.2***
Subject Name: ***Java Programming***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Java Basics: History and Features of Java; C++ versus Java; Understanding JDK, JRE and JVM; Variables; Data Types; Operators; Comments; Control Statements; Type Conversion and Casting; Arrays; IDEs.

Classes and Objects: Concepts of Classes, Objects, Access Modifiers, Constructors, Constructor Overloading, Constructor Chaining, Methods, Using Object as Parameters, Returning Objects, Object class, Object cloning, *this* keyword, Garbage Collection, *static* keyword, *final* keyword, Wrapper class, Class class, System class, Command-line Argument, *strictfp* keyword, Package, Sub-packages.

String Handling and Nested Classes: String class, String Comparison, String Concatenation, Substring , Methods of String class, StringBuffer class, StringBuilder class , toString method, StringTokenizer class, Nested and Inner classes, Static Nested class.

UNIT-II

Inheritance: Use of *extends* and *super* keywords, instanceof operator, Types of inheritance, Using final with Inheritance, Method Overloading, Method Overriding, Dynamic Method Dispatch, Abstract classes, Interface, Setting Classpath.

Exception Handling: Exception Handling Mechanism, Built-in Exceptions, Checked and Unchecked Exceptions, *throw* and *throws* keywords, User defined Exceptions.

Multithreading: Thread Creation, Life Cycle of a Thread, Synchronization, Inter-Thread Communication, Thread Priorities, Thread Group, Deadlock and its Prevention.

UNIT-III

Exploring java.util: Collection Framework**;** List, Set and Map Interfaces**;** Utility Classes: Vector, ArrayList, HashSet, HashMap, Random, Date, Calender.

I/O Stream: Streams, Types of Streams, Reading Console Input, Writing Console Output, Using File class, FileOutputStream and FileInputStream, Reading from Keyboard by InputStreamReader and BufferedReader, PrintStream and PrintWriter, BufferedInputSream and BufferedOutputStream, DataInputStream and DataOutputStream, RandomAccessFile, Serialization and Deserialization, transient and volatile modifiers.

Networking: Socket Programming Basics, Working with URLs, INetAddress class, ServerSocket and Socket class, DatagramSocket and DatagramPacket class, Connection-oriented and Connectionless Client/server Interaction.

UNIT-IV

Applets: Concepts of Applets, Differences Between Applets and Applications, Life Cycle of an Applet, Creating and Running Applets, Passing Parameters from HTML to Applet, AppletContext and AudioClip interfaces, Graphics class and methods for drawing lines, rectangles, polygons and ovals.

Swing: Component and Container classes, Layout Managers, Handling Events, Adapter classes; Swing GUI components, Menus.

JDBC: Introduction to JDBC, Drivers, Loading a Driver Class File, Steps to Connect to the Database, Execution SQL Queries by ResultSet, Statement, Prepared Statement interfaces.

Servlets: Introduction to Servlet, Servlet Life Cycle, Servlet Interface, HttpServlet Class, HttpServletRequest and HttpServletResponse Interfaces, Handling HTTP get Requests, Setting up the Apache Tomcat Server, Deploying a web application, Handling HTTP get requests containing data, Handling HTTP post requests.

Suggested Reading

Text Books:

1. H. Schildt, *Java - The Complete Reference* (10th Edition), McGraw Hill Education, 2017.
2. E. Balagurusamy,*Programmingwith Java*(5th Edition), McGraw Hill Education, 2017.

Reference Books:

1. C. S. Horstmann, *Core Java Volume II - Advanced Features*(10th Edition), Pearson Education, 2017.

MCA-DSEC-5007.3: Python Programming

Subject Code: ***MCA-DSEC-5007.3***
Subject Name: ***Python Programming***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Two Hours.***

UNIT-I

*Introduction to Python :*Python overview, Python identifiers, keywords, variables, standard data types, numbers(integers, floating point numbers, complex numbers), operators, statement and expression, string operations, Boolean expression, control expressions, Iteration- while statement, Input from keyboard.

UNIT-II

Functions: Built-in functions, composition of functions, user defined functions, parameters and arguments, Function calls, The return statement, Python recursive statement, the anonymous functions, writing Python scripts.

UNIT-III

Built-in Data structures in Python: Strings, Lists, Ranges, Tuples, Dictionaries, Text files, Directories, Exceptions, Exception with arguments, User defined exception, modules and packages.

UNIT-IV

The object oriented approach: Class definition, creating objects, objects as arguments, object as return values, Built-in Class attributes, Inheritance, method overriding, data encapsulation, data hiding.

Python libraries: Introduction to different python libraries; Tensor Flow, Numpy, Keras, scikit-learn, PyTorch, SciPy, Pandas etc., and their uses.

Suggested Readings:

Text Books:

1. R.Thareja, *Python Programming: Using Problem Solving Approach*, First Edition, Oxford University Press, 2019.
2. E. Balaguruswamy , *Introduction to Computing And Problem Solving Using Python*, 1st Edition, McGraw Hill, 2016.

Reference Books:

1. S. Gowrishankar, A. Veena , *Introduction to Python Programming***,** 1st Edition,CRC Press/Taylor & Francis, 2018.
2. J. W. Chun, *Core Python Programming*, Second Edition, Pearson, 2010.
3. M. C. Brown, *Python: The Complete Reference*, Osborne/McGraw-Hill, 4th Edition, 2018.

DSEC Elective-III (Practical)

MCA-DSEC-5107.1: Object Oriented Programming using C++ Lab

Subject Code: ***MCA-DSEC-5107.1***
Subject Name: Object Oriented Programming using C++ Lab
No. of Credits:*2*
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. To implement Arrays, Pointers and References in C++.
2. To demonstrate the significances of constructors and destructors.
3. Implement an array of objects and pointers to members.
4. To understand dynamic memory allocation in C++.
5. To demonstrate the use of Friend function and Friend class.
6. To demonstrate the use of function template and class template.
7. To understand the concept of exception handling mechanism.
8. To demonstrate different types of inheritance.
9. To demonstrate the significance of virtual base class.
10. To understand overloading of function and operator.
11. To demonstrate data conversion from:
    i) class type to basic type and vice versa.
    ii) class type to class type.
12. To demonstrate the use of abstract class.
13. To study file handling.

MCA-DSEC-5107.2: Java Programming Lab

Subject Code: ***MCA-DSEC-5107.2***
Subject Name: ***Java Programming Lab***
No. of Credits: ***2***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of Suggested Practical Experiments:

1. Implement programs to understand the role of static variable, class, object and scope resolution operators.
2. To demonstrate the utilization of different types of access specifiers and constructors.
3. Program to understand the core concepts of different types of Inheritance.
4. Program to demonstrate the dynamic method dispatch using abstract classes.
5. Implementation of Exception handling cases for various scenarios.
6. To apply built-in classes and functions for method synchronization and inter-thread communication.
7. Demonstrate the uses of Java String class and Java I/O operations.
8. Implementation of program to understand the utility of java applets.
9. Demonstrate the utilization of Java swing class.
10. Small application by combining various swing GUI components.
11. To understand the concept of Java Beans.

Suggested Readings:

Text books:

1. H. Schildt, *Java - The Complete Reference*(10th Edition),McGraw Hill Education, 2017.
2. S. Saxena, *Java - A complete practical solution*(1st Edition), BPB Publications, 2018.

Reference Books:

1. C. S. Horstmann, *Core Java Volume II - Advanced Features* (10th Edition), Pearson Education, 2017.

MCA-DSEC-5107.3: Python Programming Lab

Subject Code: ***MCA-DSEC-5107.3***
Subject Name: ***Python Programming Lab***
No. of Credits: ***2***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 12, End Semester Examination = 38.***
Minimum no. of Practical to be carried out: ***Eight***
Duration of End Semester Examination: ***Three Hours.***

List of suggested practical experiments to be performed:

1. Write Python programs to demonstrate the use of operators and expressions
2. Write Python programs to demonstrate the use of control statements
3. Write Python programs to demonstrate the use of integers, floating point and complex numbers
4. Write Python programs to demonstrate the use of built-in functions
5. Write Python programs to demonstrate the use of user defined functions
6. Write Python programs to demonstrate the use of Lists and ranges
7. Write Python programs to demonstrate the use of dictionaries
8. Write Python programs to demonstrate the use of strings
9. Write programs to demonstrate object creations and usage in Python
10. Write programs to demonstrate the concept of inheritance in Python
11. Write programs to demonstrate the concept of method overriding in Python
12. Write programs to implement the concept of data encapsulation
13. Write programs to demonstrate the concept operator overloading in Python
14. Write programs to demonstrate the usage of a few Python libraries (NumPy, Scikit-Learn etc.).

Suggested Readings:

Text Books:

1. R.Thareja, *Python Programming: Using Problem Solving Approach*, First Edition, Oxford University Press, 2019.
2. E. Balaguruswamy , *Introduction to Computing And Problem Solving Using Python*, 1st Edition, McGraw Hill, 2016.

DSEC Elective-IV

MCA-DSEC-5008.1: Soft Computing

Subject Code: ***MCA-DSEC-5008.1***
Subject Name: ***Soft Computing***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to Soft Computing: Soft Computing Introduction, different tools and techniques.
Fuzzy sets and Fuzzy logic: Fuzzy sets versus crisp sets, operations on fuzzy sets,
Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Applications.
Rough Set: Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

UNIT-II

Neural Networks: Artificial Neural Network: basic models, Hebb's learning, Adaline, Perceptron, Multilayer feed forward network, Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

UNIT-III

Evolutionary Algorithms: Evolutionary and Stochastic techniques: Genetic Algorithm (GA), Simulated annealing and Stochastic models, Boltzmann Machine, Applications.

UNIT-IV

Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks,
Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

Suggested Readings:

Text Books:

1. D. E. Goldberg, *Genetic Algorithms in Search of Optimization and Machine Learning* (4th Edition), Pearson Education, New Delhi, India, 2009.
2. S. Haykin, *Neural Networks and Learning Machines* (3rd Edition), Pearson-Prentice Hall, 2008.
3. D. K. Pratihar,*Soft Computing: Fundamentals and Applications*, NarosaPublishingHousePvt. Ltd., New Delhi, 2013.
4. G. J. Klirand, and B. Yuan. *Fuzzy Sets and Fuzzy Logic: Theory and Applications (1st Edition)*. Prentice Hall, 1995.

Reference Books:

1. Z. Pawlak,*Rough Sets: Theoretical Aspects of Reasoning about Data*, Kluwer Academic Publisher, 1991.
2. D. Ruan, *Intelligent Hybrid Systems*, Kluwer Academic Publisher, 1997.

MCA-DSEC-5008.2: Operations Research

Subject Code: ***MCA-DSEC-5008.2***
Subject Name: ***Operations Research***
No. of Credits:*4*
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Operations research: Its scope, methods and applications, Models and modeling concepts. *Linear Programming* : Linear programming models; linear programming methods-simplex and dual simplex methods; duality and sensitivity analysis.
Assignment problem : The zero-one programming model for assignment problem, types of assignment problem, Hungerian method and Branch and bound technique for the solution of the assignment problem.

UNIT-II

Introduction to Non Linear Programming: Non-linear optimization, affine and convex sets, operations that preserve convexity, generalized inequality, separating and supporting hyperplanes, dual cones and generalized inequalities, Convex functions: basic properties, conjugate and quasiconvex functions, log-concave and log-convex functions, basic norm approximation problem.

UNIT-III

Network Models: Shortest route model, minimum spanning tree problem and maximum flow model.
Project Management: Phases of project management, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT), crashing of project network and project scheduling with constrained resources.

UNIT-IV

Decision Making: Decision making under certainty, analytical Hierarchy Process; decision making under risk and its study using probability distributions.
Probabilistic Inventory Models: Continuous review models, single period model and multiperiod model.

Suggested Readings:

Text Books:

1. R. Panneerselvam, *Operations Research* (2nd Edition), New Delhi: Prentice-Hall India, 2004.
2. H.A. Taha, *Operations Research: An Introduction* (9th Edition), New Delhi: Prentice-Hall India, 2014.

Reference Books:

1. K. Swarup, P. K. Gupta, M. Mohan, *Operations Research*, New Delhi: S. Chand and Sons, 2014.
2. R. L. Ackoff, M. W. Sasieni, *Fundamentals of Operations Research*, New York: John Wiley and Sons Inc., 1968.

MCA-DSEC-5008.3: System Programming

Subject Code: ***MCA-DSEC-5008.3***
Subject Name: ***System Programming***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction, Software Hierarchy, System Software, Views of System Software; Language Processing Activities, Fundamental of Language Processing and Specification, Symbol Table; Search and Allocation Data Structures; Scanning, Parsing.

UNIT-II

Elements of Assembly Language Programming, A Simple Assembly Scheme, Pass Structure of Assemblers, Design of Two-Pass Assembler, A Single Pass Assembler for Intel x86 Family Processors.

UNIT-III

Macro Definition and Call, Macro Expansion, Nested Macro Calls, Advanced Macro Facilities, Design of Macro Preprocessor; Phases of the Compilers, Aspects of Compilation, Memory Allocation, Compilation of Expressions, Compilation of Control Structures, Code Optimization; Interpreters: Benefits and Overview of Interpretation, Pure and Impure Interpreters.

UNIT-IV

Introduction, Relocation of Linking Concepts, Design of a Linker, Self-Relocating Programs, Linking of Overlay Structured Programs, Dynamic Linking, Loaders; Software Tools for Program Development, Editors, Debug Monitors, Programming Environments, User Interface.

Suggested Readings:

Text Books:

1. D.M. Dhamdhere, Systems Programming and Operating Systems (1st Edition), Tata Delhi, 2011.
2. L. L. Beck and D. Manjula, System Software: An Introduction to Systems Programming (3rd Edition), Pearson Education, 2002.

Reference Books:

1. A. V. Aho, M. S. Lam, R. S. and J. D. Ullman, Compilers: Principles, Techniques, and Tool (2nd Edition), Pearson Education India, 2013.
2. R. Love, Linux System Programming (2nd Edition), Shroff Publishers & Distributers, Mumbai, 2014.

DSEC Elective-V

MCA-DSEC-6003.1: Artificial Intelligence

Subject Code: ***MCA-DSEC-6003.1***
Subject Name: ***Artificial Intelligence***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to AI: Foundations of Artificial Intelligence; History ofAI, Types of AI (weak, strong, symbolic, non-symbolic), AI techniques, Expert Systems. Representation of problem as a state space tree, production systems.

UNIT-II

Heuristic Search Techniques: Introduction to heuristics and Hill Climbing, Steepest-Ascent Hill Climbing, Simulated Annealing, Best-First Search, OR-Graphs, the A* Algorithm, Problem Reduction, AND-OR Graphs, AO* Algorithm.

Game Playing: Overview, mini-max search procedure, alpha-beta prunning, additional refinements, iterative depending.

UNIT-III

*Knowledge Representation and Reasoning:*Representations and mappings, Approaches to knowledgeRepresentation, Procedural versus Declarative knowledge; Predictate Logic**:** RepresentingSimple facts, Instance and Is-a relationships in Logic, Proposition versus Predicate Logic,Rules of Inferences, Conversion to Clause Form , Basics of Resolution, Forwardversus Backward Reasoning, Logic Programming and Horn Clauses. Weak slot and FillerStructure**:** Semantic nets, Frames.

Basic of fuzzy sets, fuzzy set operations and fuzzy relations.

UNIT-IV

Advanced AI:Overview of Natural Language Processing , Morphological Analysis, Syntactic Analysis, Semantic Analysis, Parsing Techniques, Top-Down Parsing, Bottom-Up Parsing.

Basic notions of machine learning- supervised, unsupervised, semi-supervised,

Introduction to neural network- basic models, perceptron, multilayer feed forward network.

Suggested Readings:

Text Books

1. E. Rich, and K. Knight,*Artificial Intelligence*, (2nd Edition), New Delhi: Tata McGraw-Hill, 2009
2. S. Russell, and P. Norvig, *Artificial Intelligence: A Modern Approach* (2nd Edition), NewJersey: Prentice-Hall, 2015
3. D. Khemani,*A first course in Artificial Intelligence*, McGraw Hill India, (1st Edition), 2013.

Reference Books:

1. A. Srinivasaraghavan, *Machine learning*, Wiley, 2018.
2. N.J. Nilson,*Principles of Artificial Intelligence*,New Delhi: Narosa Publishing House, 2002.

MCA-DSEC-6003.2: Data Mining

Subject Code: ***MCA-DSEC-6003.2***
Subject Name: ***Data Mining***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to data mining; Definition, Importance and major issues in data mining.
Data Warehouse and OLAP Technology; Introduction to Data Warehouse, Data Warehouse Architecture and Components, Guidelines for Data Warehouse Implementation, Data Warehouse Metadata.
Characteristics of OLAP systems, Typical OLAP Operations, OLAP and OLTP, Multidimensional Data Model and Data cube, Data Cube Implementations, Data Cube operations.

UNIT-II

Data Pre-processing**;** Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.
Data mining primitives, Languages and system architecture; Data mining primitives: Task relevant data, the kind of knowledge to be mined, Background knowledge, Interestingness measures, Presentation and visualization of discovered pattern.
Concept Description: Data generalization and summarization based Characterization: Attribute-Oriented induction. Analytical characterization: attribute-relevance analysis. Mining class comparisons: Class comparison methods, implementation, and Presentation and class description. Statistical measures in large databases: Measuring the central tendency

UNIT-III

Association Rules Mining; Mining Frequent Patterns, Associations and Correlations, Mining Methods.
Classification and Prediction: Issues regarding classification and prediction: Preparing the data, comparing the classification methods. Classification by decision tree Bayesian Classification: Bayes theorem, Naïve Bayesian classification, Bayesian Belief network. Other classification methods: k-Nearest neighbour classifiers, cased-based reasoning, Genetic algorithms, Rough set approach, fuzzy set approach.
Cluster Analysis; Types of data in cluster analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods. Model-based clustering methods: Statistical approach, Neural network approach.

UNIT-IV

Mining Complex Types of Data; Multidimensional analysis: Generalization of structured data, Generalization of Object identifiers and class/subclass hierarchies, Mining Text databases: Text data analysis and information retrieval, Text mining. Mining World Wide Web, Web usage mining, Data mining for biomedical and bioinformatics analysis, Recent trends in data mining: Big data analysis overview, Introduction to Hadoop technology and Microsoft's OLEDB for data mining.

Suggested Readings:

Text Books:

1. J. Han, and M. Kamber,*Data Mining: Concepts and Techniques*(3rd Edition), San Fransisco: Morgan Kaufman Publisher, 2011.
2. A. K.Pujari,*Data Mining Techniques (4th Edition),* Hyderabad: Univeristy Press, 2016.

Reference readings:

1. D. Hand, H. Mannilaand P. Smyth,*Principles of Data Mining,* New Delhi: Prentice-Hall India, 2005.
2. N. Dasgupta, *Practical Big Data Analytics* (1st Edition),Packet publications, 2018.

MCA-DSEC-6003.3: Digital Image Processing

Subject Code: ***MCA- DSEC-6003.3***
Subject Name: ***Digital Image Processing***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction: Digital Image representation, fundamental steps in image processing, and elements of digital image processing.

Fundamentals: A simple image model, sampling and quantization, some basic relationships between pixels (neighbors of pixels, connectivity, labeling of connected components, relations, equivalence, transitive closure, distance measures, arithmetic/logical operations), Image geometry (basic transformation, perspective transformations).

UNIT-II

Image transformation: Introduction to the Fourier transform, discrete Fourier transform, some properties of the two-dimensional Fourier transform, The Fast Fourier Transform (FFT Algorithm, The inverse FFT), Walsh transform.

Image enhancement: spatial domain methods, frequency domain method, enhancement by point processing, spatial Filtering, high pass filtering, color image processing (color fundamentals, color models).

UNIT-III

Image restoration: degradation model, circulant matrices, block-circulant matrices, algebraic approach to restoration, inverse filtering, least mean square (wiener) filter, constraint least squares restoration, interactive restoration, restoration in the spatial domain.

Image compression: Fundamentals (coding redundancy, interpixel redundancy, pyschovisual redundancy), image compression models , error-free compression, lossy compression, Image compression standards.

UNIT-IV

Image segmentation: Detection of discontinuities (point detection, line detection, edge detection, combined detection), edge linking and boundary detection (local processing, global processing via the hough transform, threshold (foundation, the role of illumination, simple global thresholding, optimal thresholding, threshold selection based on boundary characteristics,

thresholds based on several variables, region-oriented segmentation (basic formulation, region growing by pixel aggregation, region splitting and merging.

Representation and description: representation schemes, boundary descriptors, regional descriptors, morphology (dilation and erosion, basic morphological algorithms), Recognition and interpretation: Elements of image analysis, patterns and pattern classes, decision-theoretic methods, structural methods, interpretation.

Suggested Readings:

Text Books:

1. R. C. Gonzalez and R. E. Woods. *Digital Image Processing*. Prentice Hall, New Delhi, 3rd edition, 2008.
2. A. K. Jain. *Fundamentals of Digital Image Processing*. New Delhi: PHI, 2004.
3. B. Chanda and D. DuttaMajumdar. *Digital Image Processing and Analysis*. Prentice-Hall India, New Delhi, 2nd edition, 2011.

Reference Books:

1. M. Petrou and C.Petrou. *Image Processing: The Fundamentals*. Wiley, 2nd edition 2010.
2. C. Solomon, T. Breckon, *Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab.* Wiley, *2010*.

DSEC Elective-VI

MCA-DSEC-6004.1: Cryptography and Network Security

Subject Code: ***MCA-DSEC-6004.1***
Subject Name: ***Cryptography and Network Security***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Basic Objective of Cryptography, Secret Key and Public Key Cryptography, Security threats, Attacks, Various security attack models, Security architecture; Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques.

UNIT-II

Block Cipher, DES, Block Cipher Design Principles, Modes of Block Cipher, Blowfish, Various Cryptanalytic attacks on Block Cipher, Stream Cipher, Attacks on Stream Cipher, Confidentiality: Placement of Encryption Function, Traffic Confidentiality, Key Distribution; AES.

UNIT-III

Public Key Cryptosystems, Applications, Requirements, Cryptanalysis, RSA Algorithm, Diffie-Hellman Key Exchange; Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security; Message Authentication Codes, Message Authentication Requirements, Authentication Functions, Requirements of Message authentication codes, Security of MACs.

UNIT-IV

Digital Signatures; Key Management and Distribution; Network Security Applications: Kerberos – Version 4 and Version 5; Internetwork Security, SSL, PGP, Intruders and Viruses, Firewalls, Cloud Security, Introduction to Blockchain and Bitcoin.

Suggested Reading:

Text Books:

1. W.Stallings, *Cryptography & Network Security Principles & Practices* (7th Edition), Pearson Education, 2017.
2. D. R. Stinson, *Cryptography: Theory & Practice* (3rdEdition), CRC Press, 2006.

Reference Books:

1. B. L. Menezes, *Network Security & Cryptography* (1st Edition), Cenegage Learning, 2011.
2. A. M. Antonopoulos,*MasteringBitcoin:Programming the Open Blockchain* (2ndEdition),Shroff/O'Reilly, 2017.

MCA-DSEC-6004.2: Machine Learning

Subject Code: ***MCA-DSEC-6004.2***
Subject Name: ***Machine Learning***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to Machine Learning: Human Learning, Machine Learning (Types, Applications, and Issues), Well-posed learning problem.

*Linear Algebra (Basics):*Scalars, Vectors, Matrices (Diagonal, Symmetric and Orthogonal); Multiplying Matrices and Vectors; Identity and Inverse Matrices; Linear Dependence and Span; Norms; Eigen decomposition.

Preparing to model: Basic Data types, exploring numerical data, exploring categorical data, exploring relationship between variables, data issues and remediation, data pre-processing.

Modelling and Evaluation: Selecting a model, training a model-holdout, k-fold cross validation, bootstrap sampling, model representation and interpretability- under-fitting, over-fitting, bias-variance tradeoff, model performance evaluation- classification, regression, clustering.

UNIT-II

Feature Engineering: Feature construction, Feature extraction, Feature Selection.

Supervised Learning- Classification: Basics of supervised learning- classification, *k*-Nearest neighbor, decision tree, random forest, support vector machines.

UNIT- III

Supervised Learning- Regression: Simple linear regression, Multiple Linear Regression, Polynomial Regression Model, Logistic Regression.

Unsupervised Learning: Basics of unsupervised learning, clustering techniques; Association rules.

UNIT-IV

*Neural Networks:*Understanding biological neuron and artificial neuron, types of activation functions, early implementations- McCulloch Pitt's, Rosenblatt's Perceptron, ADALINE, architectures of neural network, learning process in ANN, backpropagation.

*Introduction to Deep Learning:*Definition of a convolutional neural network (CNN) and recurrent neural network (RNN).

Suggested Readings:

Text Books:

1. S. Dutt, S. Chandramouli, and A. K. Das, *Machine Learning*, Pearson India Education Services Pvt. Ltd, 2019.
2. T. M. Mitchell,*Machine Learning*, Indian Edition, McGraw Hill Education, 2013.

Reference Books:

1. E.Alpaydin, *Introduction to Machine Learning*,(Adaptive Computation and Machine Learning), Third Edition, MIT Press, 2014
2. C. M Bishop, *Pattern Recognition and Machine Learning*, Information Science and Statistics, Springer, 2006.
3. J. Grus, *Data Science from Scratch*, 2nd Edition, O'Reilly, 2019.
4. Goodfellow, Y. Benjio, and A. Courville, *Deep Learning*, (Adaptive Computation and Machine Learning), MIT Press, 2016.

MCA-DSEC-6004.3: Mobile Computing

Subject Code: ***MCA-DSEC-6004.3***
Subject Name: ***Mobile Computing***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction: Mobile Communications, Mobile Computing – Paradigm, Applications, Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices. UMTS-System Architecture, Radio Interface, UTRAN, Core Network, Handover, Introduction to LTE Network Architecture, Introduction to 5G Network Architecture.

UNIT-II

*Medium Access Control(MAC):*MAC (Hidden and exposed terminals), SDMA, FDMA, TDMA, CDMA, Wireless LAN/(IEEE 802.11).

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP.

UNIT-III

*Mobile Transport Layer:*Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks. Database Issues: Database Hoarding & Caching Techniques, Client-Server Computing & Adaptation, Transactional Models, Query processing, Data Recovery Process &QoS Issues.

UNIT-IV

Data Dissemination and Synchronization: Communications Asymmetry, Classification of Data Delivery Mechanisms, Data Dissemination, Broadcast Models, Selective Tuning and Indexing Methods, Data Synchronization – Introduction, Software,and Protocols.

*Mobile Adhoc Networks:*Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc.Mobile Agents, Service Discovery. Protocols and Platforms for Mobile Computing: WAP, Bluetooth, XML, J2ME, Linux for Mobile Devices, Android.

Suggested Readings:

Text Books:

1. J. H. Schiller, *Mobile Communications*(2nd Edition), Addison-Wesley, 2009.
2. R. Kamal, *Mobile Computing*(3rd Edition), Oxford University Press, 2007.

Reference Books:

1. P. K.Pattnaik, R. Mall, *Fundamentals of Mobile Computing*(2nd Edition), PHI Learning Pvt. Ltd, New Delhi, 2012.
2. R. Behravanfar, *Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML*(1stEdition) Cambridge University Press, 2004.
3. A.Ghosh, J. Zhang, J. G. Andrews, R.Muhamed, *Fundamentals of LTE*, (1stEdition) Pearson Education Inc, USA, 2011.

DSEC Elective-VII

MCA-DSEC-6005.1: Software Engineering

Subject Code: ***MCA-DSEC-6005.1***
Subject Name: ***Software Engineering***
No. of Credits:*4*
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Product and Process; Evolving Role of Software, Software Characteristics;
Software Engineering: A Layered Technology, Software Process, Software Process Models, Fourth Generation Techniques;
Software Projects' Process, Metrics and Planning; Project Management Concepts
Software Process and Project Metrics – Measures, Metrics and Indicators, Metrics in the Process and Project Domains, Software Measurement.
Software Project Planning; Project Planning Objectives, Software Scope, Resources, Project Estimation Technique; Empirical estimation techniques (Expert Judgement Technique, Delphi Cost Estimation), Heuristic estimation techniques (COCOMO Model).

UNIT-II

Risk Management; Reactive Vs. Proactive Risk Strategies, Software Risk, Risk Identification, Risk Projection, Risk (Mitigation, Monitoring and Management), The RMMM Plan;
Project Scheduling and Tracking; Basic Concepts, The Relationship between People and Effort, Defining a Task set for the Software Project, Selecting Software Engineering Tasks, Defining a Task Network, Scheduling, The Project Plan;
Software Quality Assurance; Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Quality Assurance, Software Reliability, The SQA Plan, The ISO 9000 Quality Standards;

UNIT-III

Analysis and Design; Basic Concepts and Principles: Requirements Analysis, Communication Techniques, Analysis Principles, Specification, Specification Review; Analysis Modeling; Elements of the Analysis Model, Data Modeling, Functional Modeling and Information Flow, The Data Dictionary;
Design Methods; Data Design, Architectural Design, Architectural Design Process, Interface Design, Human-Computer Interface Design, Interface Design Guidelines;

Software Reuse: Management Issues, Reuse Process, Economics of Software Reuse; Reengineering: Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering, Economics of Reengineering.

UNIT-IV

Software Testing; Different Software Testing Methods: Software Testing Fundamentals, Test Case Design, White Box Testing, Black Box Testing.

Software Testing Strategies; A Strategic Approach to Software Testing, Strategic Issues, Unit Testing, Integration Testing, Validation Testing, System Testing, The Art of Debugging.

Suggested Readings:

Text Books:

1. R. Mall, *Fundamentals of Software Engineering* (5th Edition), Prentice-Hall India, 2018.
2. R. S. Pressman, *Software Engineering A Practitioner's Approach* (7thEdition), Tata McGraw-Hill, 2014.

Reference Books:

1. I. Somerville, *Software Engineering* (9th Edition), New Delhi: Addison Wesley, 2011.

MCA-DSEC-6005.2: Internet of Things

Subject Code: ***MCA-DSEC-6005.2***
Subject Name: ***Internet of Things***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Introduction to IoT: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT-II

Elements of IoT: Hardware Components-Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components-Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT-III

Application Development: Solution framework for IoT applications-Implementation of Device integration, Data acquisition and integration, Device data storage-Unstructured data storage on cloud/local server, Authentication, authorization of devices.

UNIT-IV

Case Studies: Case studies on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation, Control blinking of LEDs

Suggested Readings:
Text Books:

1. V. Madisetti, A.Bahga, *Ïnternet of Things-A Hands on Approach*, University Press, 1st Edition, 2015.
2. S.R.N. Reddy, R. Thukral and M. Mishra, *Introduction to Internet of Things: A practical Approach*, ETI Labs, 2016.
3. P. Raj and A. C. Raman, *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press, 1st Edition, 2017.

Reference Books:

1. J. Jose, *Internet of Things*, Khanna Publishing House, Delhi, 1st Edition, 2018.
2. R. Kamal, *Internet of Things: Architecture and Design*, McGraw Hill, 1st Edition, 2017.

MCA-DSEC-6005.3: Natural Language Processing

Subject Code: ***MCA-DSEC-6005.3***
Subject Name: ***Natural Language Processing***
No. of Credits: ***4***
No. of Hours Per Week: ***4***
Marks Distribution: ***Internal Exam = 25, End Semester Examination = 75.***
Duration of End Semester Examination: ***Three Hours.***

UNIT-I

Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms, Language, Thought, and Understanding, The state of the art and the near-term future, brief history.
Representations and Understanding, Organization of Natural language Understanding Systems.
Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc.

UNIT-II

Survey of English Morphology-inflectional, derivational, Finite state morphological parsing, the lexicon and morphotactics, morphological parsing with finite-state transducers.N-grams and their sensitivity to the training corpus, Smoothing.
Grammars and sentence Structure, Parsing as search, Top-down, bottom-up parsing and their comparison, A basic top-down parser, adding bottom-up filtering, problems with the basic top-down parser, left-recursion, ambiguity, repeated parsing of subtree. The Earley Algorithm, Finite-state Parsing methods, Transition Network Grammars, Augmented Transition Networks.Part of Speech tagging: Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions.

UNIT-III

Word Sense Disambiguation:Selectional restriction, machine learning approaches, dictionary based approaches.Discourse: Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.

UNIT-IV

Applications of NLP: Dealing with spelling errors. Spelling error patterns, Detecting Non-word Errors, Probabilistic Models, Applying the Bayesian Method to Spelling, Minimum Edit Distance.
Text Summarization, Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.
Machine Translation: Overview, Language Similarities and Differences The Transfer Metaphor Syntactic Transformations.

Suggested Readings:

Text Books:

1. D. Jurafsky, and J. H. Martin**,** *Speech and language Processing* (Second edition), New Delhi: Pearson Education, 2009.
2. J. Allen, *Understanding Natural Language Processing* (2nd Edition), New Delhi: Pearson Education, 2004.

Reference Books:

1. A.V. Aho, J. D. Ullman**,** *The theory of parsing, translation and compiling, Vol I,* Massuchussettes: Addison Wesley.

2. T. Siddiqui, U.S. Tiwary, *Natural language processing and Information retrieval*, OUP, 2008

APPENDIX-I

Guidelines for Dissertation

Objective

The objective of the dissertation / project work is to consolidate the concepts and practices that were learned during the course and to serve as a record of competence. It should enable a student to apply concretely in a small package the concepts gained from Software Engineering.

Guidelines

Overview: Every student should do a dissertation / project individually or in some cases it may be in a group of two students. The type of dissertation / project can be either of application oriented with latest technologies or research based.

Platform: The project can be in any platform e.g., WINDOWS, UNIX, LINUX, Mac OS etc.
Language and package: The dissertation/ project can be done using any language or package learned within or outside the course such as C, C++, Java, .NET, Python, etc.
Venue: The dissertation/ project can be done in the University/College itself or in a reputed organization/IT-company.

Guides: Internal Guides from within the University/College should be assigned to each student or to a group of students. If the project is to be done in a reputed organization, an External Guide from that organization is also required as Co-Guide.

Final Examination: For the final external evaluation a brief summary of the project in the form of hard and soft copy report along with the developed codes, output, results, software, hardware (as applicable) etc. should be submitted to the university at least one week prior to the date of the examination for the benefit of the external examiner(s).

Monitoring of Dissertation: The progress of the dissertation should be monitored through seminars/ internal assessment and each of the seminars should be evaluated, a record of which should be maintained. The number of seminars should not be less than three.