

*Placed at the meeting of
Academic Council
held on 20.11.2020*

APPENDIX - G
MADURAI KAMARAJ UNIVERSITY
(University with Potential for Excellence)

Revised Syllabus for
Master of Computer Application (M.C.A.)
Two Years Programme (CBCS – Semester Pattern)
(With effect from the Academic Year 2020-2021 onwards)

REGULATIONS AND SCHEME OF EXAMINATIONS

1. Introduction of the Programme: The course was designed to meet the growing demand for qualified professionals in the field of Information Technology. It is a postgraduate course that can be taken up after obtaining a Bachelor's Degree. Master of Computer Application (MCA) beset the study and application of computers and any form of data that store, retrieve and send information. The MCA programme is inclined more toward application development and thus has more emphasis on latest programming language and tools to develop better and faster applications. It includes a combination of hardware and software used together to perform the essential functions people need and use everyday.

2. Eligibility for Admission: Admission Criteria as fixed by the AICTE.

Duration of the Programme : 2 Years

Medium of instructions : English

3. Objective of the programme:

- To prepare students to excel in the computing profession by providing solid technical foundations in the field of computer applications.
- To provide students various computing skills like the analysis, design and development of innovative software products to meet the industry needs.
- To motivate the students to pursue lifelong learning and to take up industrial research in computer application and other streams.

4. Outcome of the Programme

- To apply the knowledge of mathematics and computing fundamentals to various real life applications for any given requirement.
- To identify, critically analyze, formulate and develop computer applications. • To select modern computing tools and techniques and use them with dexterity.
- To design a computing system to meet desired needs within realistic constraints such as safety, security and applicability.
- To devise and conduct experiments, interpret data and provide well informed conclusions
 - To understand the impact of systems solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

- To function effectively both as a team leader and team member on multi-disciplinary projects to demonstrate computing and management skills with positive attitude.
- To communicate effectively and present technical information in oral and written reports.
- To appreciate the importance of goal setting and to recognize the need for life-long learning.
- To apply the inherent skills with absolute focus to function as a successful entrepreneur.

5. Core subject papers : The following are the various categories of the courses suggested for M.C.A Computer Application programme.

- Core Subjects (CS) – 14
- Elective Subjects (ES) – 3
- Practical subjects - 6
- Project - 1
- EES - Enhanced Employability Subject
- CSNME-Non Major Elective subject

6. Subject Elective Papers : The University shall provide all information related to the Elective Subject in M.C.A. to all the students so as to enable them to choose their Elective Subjects in each semester. The list of elective papers in each semester is displayed under the Programme structure.

7. Unitization : Each subject contains five units which are interrelated to each other. Not only core subjects, but elective and non-major elective also contain the same.

8. Pattern of Semester Exam: See Annexure- PCA2

9. Scheme for Internal Assessment: See Annexure- PCA2

10. External Exam : See Annexure- PCA2

- There shall be external examinations at the end of each semester, odd semesters in the month of October/ November and even semesters in April / May.
- A candidate, who has not passed the examination, may be permitted to appear in such failed subjects in the subsequent examination to be held in October/ November or April/May. A candidate should get registered for the first semester examination. If registration is not possible, owing to shortage of attendance beyond condonation limit/regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after the completion of the programme.
- Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance have to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance have to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate.
- Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after the completion of the programme.

The results of all the examinations will be published through the controller of examination where the students underwent the course as well as through University Website. In the case of private candidates, the results will be published through the Controller of Examination in which they took the examinations as well as University Website.

11. Question Paper Pattern: See Annexure- PCA2

12. Unitization :

Each subject contains five units which are interrelated each other. Not only core subjects, but elective and non-major elective also contain the same.

Pattern of Semester Exam : See Annexure- PCA2

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The results of all the examinations will be published through the controller of examination where the students underwent the course as well as through University Website. In the case of private candidates, the results will be published through the Controller of examination in which they took the examinations as well as University Website.

12. Question Paper Pattern: See Annexure- PCA2

13. Scheme of Evaluation :

The performance of a student in each course is evaluated in terms of percentage of marks with a provision of conversion to grade points. Evaluation of each course shall be done by a continuous internal assessment by the concerned Course Teacher as well as by an end semester examination and both will be consolidated at the end of the course.

$$CCPA = \frac{\text{A mark statement with Credits}}{\text{Marks X Credits}}$$

Where the summations cover all the papers appeared up to the current semester.

14. Passing Minimum : A candidate passes the M.C.A., by scoring a minimum of 50% (internal+external) in each paper of the course. No minimum marks for internal assessment. External minimum for external assessment is 45% i.e., 34 out of 75.

14.1 Classification:

S.No	Range of CCPA	Class
1	50 & above but below 60	II
2	60 & Above	I

15. Model Questions : One Model question paper is displayed at the end of the regulation.

16. Teaching Methodology : Each subject is designed with lectures/tutorials/seminar/Peer-Team-Teaching/ ICT presentation/assignments etc., to meet the effective teaching and the learning requirements. 10 % of the course content must be taught through peer team teaching methodology.

17. Text Books : List of all the text books is quoted at the end of the syllabus of each subject.

18. Reference Books : The list of all the reference books is followed by the list of text books. This list contains at least two books for each subject.

19. Re-totaling and Revaluation Provision : Candidates may apply for re-totaling and revaluation within ten days from the date of the result published in the university website along with the required forms and fees.

20. Transitory Provision : The candidates of previous schemes may be permitted to write exams in their own schemes up to the examinations of April 2023 as a transitory provision.

21. Subjects and Paper related websites : All the subject details along with syllabus may be downloaded from the university website www.mkuniversity.org.

Annexure–PCA1

Semester	Subjects								Total Hours	Total Credits
I	CS1(4) [4]	CS2(4) [4]	CS3(4) [4]	CS4(4) [4]	CS5(4) [4]	CSP1(4) [3]	CSP2(4) [3]	EES1(2) [1]	30	27
II	CS6(4) [4]	CS7(4) [4]	CS8(4) [4]	CS9(4) [4]	ES1(4) [4]	CSP3(5) [3]	CSP4(5) [3]		30	26
III	CS10(4) [4]	CS11(4) [4]	CS12(4) [4]	CS13(4) [4]	ES2(4) [4]	CSP5(5) [3]	CSP6(5) [3]		30	26
IV	CS14(4) [4]	ES3(4) [4]	EES [12]						8	20
Total									98	99
Extra Credit										4

Subject/Structure of Course Study

Abbreviations:

- () – Number of Hours
- [] – Number of Credits
- CS- Core Subject
- EES - Enhanced Employability Subject
- ES - Elective Subject
- EES - Enhanced Employability Subject
- NME Non Major Elective

Extra Credit for Advanced Learners : Online Courses (SWAYAM/NPTEL/Moocs)

Extra Credit per paper = 2 - Maximum of 2 papers can be awarded.

ISEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS1	Mathematical Foundations of Computer Applications	4	4	25	75
2	CS2	Object Oriented Programming and Design	4	4	25	75
3	CS3	Data Structures and Computer Algorithms	4	4	25	75
4	CS4	Relational Database Management Systems	4	4	25	75
5	CS5	Operating Systems	4	4	25	75
6	CSP1	LAB: Data Structures and Computer Algorithms	5	3	40	60
7	CSP2	LAB: Relational Database Management	4	2	40	60
8	EES 1	LAB: Communication Skill	2	1	40	60
Total			32	27		

II SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS6	SoftwareEngineering	4	4	25	75
2	CS7	JavaProgramming	4	4	25	75
3	CS8	Data Communication and Computer Networks	4	4	25	75
4	CS9	Web Technology	4	4	25	75
5	ES1	Elective I	4	4	25	75
6	CSP3	LAB:Object Oriented Programming usingC++	5	3	40	60
7	CSP4	LAB: Web Technology	5	3	40	60
Total			30	26		

III SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS10	SoftwareTestingandQuality Assurance	4	4	25	75
2	CS11	Python Programming	4	4	25	75
3	CS12	Mobile Computing	4	4	25	75
4	CS13	Information Security	4	4	25	75
5	ES2	Elective II	4	4	25	75
6	CSP5	LAB: Pyhton Programming	5	3	40	60
7	CSP6	LAB: Mobile Computing	5	3	40	60
Total			30	26		

III SEMESTER - NON - MAJOR ELECTIVE

S.No	Code	Subject	Hours	Credits	IntMa rks	ExtMa rks
1	NME	Problem Solving and Programming in C	5	5	25	75

IV SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS14	Cloud Computing	4	4	25	75
2	ES3	Elective III	4	4	25	75
3	EES	Project Work and VivaVoce		12	40	60
Total			8	20		

Elective Subjects

S.No	Code	Subject	Hours	Credits	IntMa rks	ExtMa rks
ES I – Elective I						
1	ES11	Digital Image Processing	4	4	25	75
2	ES12	Artificial Intelligence	4	4	25	75
3	ES13	Compiler Design	4	4	25	75
4	ES14	Data Mining & Data Warehousing	4	4	25	75
ESI II Elective II						
5	ES21	Soft Computing	4	4	25	75
6	ES22	Network Programming	4	4	25	75
7	ES23	Optimization Techniques	4	4	25	75
8	ES24	Big Data Analytics	4	4	25	75
ES III- Elective III						
9	ES31	Software Project Management	4	4	25	75
10	ES32	Internet of Things	4	4	25	75
11	ES33	Machine Learning	4	4	25	75
12	ES34	Computational Intelligence	4	4	25	75

Annexure–PCA2
Scheme of Examination/Question Paper Pattern Scheme of Evaluation

I-Theory Subjects:(Total Marks: 100 (Internal: 25 Marks, External: 75 Marks))

Parameters	
Internal	External
i Average of two tests 10 Marks	i. Part -A(10*1) 10 Marks
ii. Assignment 5 Marks	ii. Part –B(5*7) 35 Marks
iii. Seminar / Group discussion 5 Marks	iii. Part –C (3*10) 30 Marks
iv. Peer-Team-Teaching 5 Marks	Total 75 Marks
Total: 25 Marks	

Note: Peer-Team-Teaching shall be conducted by forming a group according to the strength of the class, with representation of both slow learners and fast learners. At least 10% of the syllabus may be allotted with proportional allocation of teaching hours and be evaluated.

External Examination Question Pattern:

Time: 3 Hours

Max. Marks : 75

Part–A

Answer all the questions :

(10*1=10)

Ten Questions, two questions from every unit: *Multiple Choice questions.*

Part–B

Answer all the questions :

(5*7=35)

Five Questions, one question set from every unit: *Either ... Or ... type*

Part–C

Answer any three questions

(3*10=30)

Five Questions, one question from every unit.

II-Practical Subjects : (Total Marks: 100 (Internal: 40 marks, External: 60 Marks))

- A candidate has to prepare Algorithm / Procedure for both the questions covering both the parts.
- The following list of parameters taken into account for the evaluation of practical examination.

Parameters	
Internal Marks	External Marks
i. Average of two tests: 25	i. Aim, Procedure / Algorithm and Program: 15
ii. Record Work: 10	ii. Coding and Compilation: 10
iii. Seminar / Quiz / Viva-Voce :5	iii. Debugging : 15
	iv. Results: 10
	v. Viva-Voce : 10
Total: 40	Total: 60

Note: The External Examiner can fix exercises also other than those found in the list (*Syllabus*) in consultation with the Internal Examiner without violating the scope of the prescribed syllabus.

III–Mini Project and Project Work:

(Total Marks: 100 (Internal:40 marks, External: 60Marks))

The following list of parameters taken into account for the evaluation of the Project work.

Parameters	
Internal Marks	External Marks
Start-up Review: 5.0 Marks	i. Project Report: 20 Marks
Design Review : 7.5 Marks	ii. Project demo & Presentation : 30 Marks
Implementation and Validation Review : 7.5 Marks	iii. Viva-Voce: 10 Marks
Final Review: 10.0 Marks Overall Performance: 10.0 Marks Total	
40.0 Marks	Total 60 Marks

Annexure–PCA3

CS1: Mathematical Foundations of Computer Applications (4 Hours–4 Credits)

Unit - I : Mathematical Logic: Statements and notations, Connectives, Well-formed formulas, Truth Tables, Tautology, equivalence implication, Normal forms, Theory of inference for the statement calculus; Rules of inference, Consistency of promises and indirect method of proof, Automatic Theorem Proving; Predicate calculus; Predicates, statement functions, variables and quantifiers, predicate formulas, free & bound variables, universe of discourse, inference theory of predicate calculus.

Unit - II: Set theory & Relation: introduction, Relations and ordering, Properties of binary Relations, Equivalence, Compatibility Relations, Partial Ordering; Elementary Combinatorics: Basis of counting, Enumeration of Combinatins and Permutations, Enumeration of Combinations and Permutations with repetitions and constrained repetitions, Binomial Coefficients, Binomial Multinomial theorems, principles of Inclusion– Exclusion.

Unit - III: Recurrence Relations: Generating Function of Sequences, Calculating Coefficient of generating functions, Recurrence relations, Solving recurrence relation by substitution and Generating functions, The method of Characteristic roots, Solution of Inhomogeneous Recurrence Relation.

Graph Theory: Representation of Graph, Spanning Trees, BFS, DFS, Kruskals Algorithm, Binary trees, Planar Graphs Graph Theory and Applications, Basic Concepts, Isomorphism and Sub graphs, Multigraphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers.

Unit - IV: Probability Theory: Random experiment-Conditional probability–independent event. Bayes theorem–Random variable, continuous and discrete and continuous distributions, Two Dimensional Random Variable, Joint probability density, cumulative distribution, marginal probability, conditional probability.

Unit-V: Tests of hypothesis: parameter and statistic, sampling distribution, Estimation and testing of hypothesis, critical region and level of significance, Errors in testing of hypothesis, one-tailed and two-tailed test, procedure for testing hypothesis, confidence interval, tests of significance of large and small samples, Student's t distribution, Snedecor's F distribution.

Reference Books:

1. Discrete Mathematical Structures with Applications to CS; Trembley, R. Manohar, TMH.
2. Discrete Mathematics for Computer Scientists & Mathematicians, Molt, Kandel, Baker, PHI.
3. T. Veerarajan- Probability, Statistics and Random process (Third edition), TMH.
Sundarapandian- Probability, Statistics and Queueing theory, PHI.
4. Purna Chandria Biswal – Probability and Statistics, PHI.
5. Elements of Discrete Mathematics, C.I. Liu, D. P. Mohanpatra, TMH.
6. Discrete Mathematical Structures, Kolman, Busby, Ross, 6th ed. PHI, 2009.

CS 2: Object Oriented Programming and Design (4 Hours – 4 Credits)

Unit-I : Programming Paradigms- Introduction to OOP – Overview of C++- Classes – Structures – Union – Friend Functions – Friend Classes – Inline functions – Constructors – Destructors – Dynamic Initialization of Objects- Static Members – Passing objects to functions – Function returning objects- Arrays of Objects, Object as Function Arguments.

Unit-II : Arrays – Pointers – this pointer – References – Dynamic memory Allocation – functions Overloading – Default arguments – Overloading Constructors – Pointer to Functions – Operator Overloading - Type Conversion.

Unit-III : Inheritance – Types – Derived Class Constructors – Issues in Inheritance – Virtual base Class – Polymorphism – Virtual functions – Pure virtual functions.

Unit-IV : Class templates and generic classes – Function templates and generic functions – Overloading function templates – power of templates – Exception Handling – Derived class Exception – over handling generic functions – Exception handling Functions.

Unit-V: Streams – Formatted I/O with IOS class functions and manipulators – File I/O – Namespaces – Array based I/O – Error handling during file operations – Formatted I/O – STL: Overview – Container Classes Lists – Maps – Algorithms Using Functions and Objects – String Class – Sequence Containers, Iterators – Specialized Iterators – Associative Containers. Storing User- Defined Objects – Function Objects.

Reference Books:

1. Stephen Prata, "C++ Primer Plus", 6th Edition, Addison-Wesley Professional, 2011.
2. Bjarne Stroustrup, "Programming: Principles and Practice Using C++", 1st Edition, Addison-Wesley Professional, 2008.
3. Andrew Koenig and Barbara E. Moo, "Accelerated C++: Practical Programming by Example", 1st Edition, Addison-Wesley Professional, 2000.
4. Bruce Eckel, "Thinking in C++: Introduction to Standard C++: Volume One" 2nd Edition, Prentice Hall, 2000.

5. Andrei Alexandrescu, "Modern C++ Design: Generic Programming and Design Patterns Applied", 1st Edition, Addison-Wesley Professional, 2001.

CS 3: Data Structures and Computer Algorithms (4 Hours – 4 Credits)

Unit-I: Fundamental Concepts: Introduction to Programming, Introduction to Data Structures, Types of Data Structures, Introduction to Algorithms, Pseudocode, Relationship among data, data structures, and algorithms, Implementation of data structures, Flowcharts, Analysis of Algorithms. **Linear Data Structure:** Sequential Organization, Linear Data Structure Using Sequential Organization: Arrays, Array as an Abstract Data Type, Memory Representation and Address Calculation, Multidimensional Arrays.

Unit-II: Stacks : concept of Stacks, Stack Abstract Data Type, Representation of Stacks Using Sequential Organization (Arrays). **Queues:** Concept of Queues, Queue as Abstract Data Type, Realization of Queues Using Arrays, Circular Queue, Deque. **Linked Lists:** Introduction to Linked List, Realization of Linked Lists, Dynamic Memory Management, Linked List Abstract Data Type, Doubly Linked List, Circular Linked List.

Unit-III: Trees: Introduction, Types of Trees, Binary Tree, Binary Tree Abstract Data Type, Realization of a Binary Tree, Insertion of a Node in Binary Tree, Binary Tree Traversal, Binary Search Tree. **Graphs:** Introduction, Graph Abstract Data Type, Representation of Graphs, Graph Traversal. **Searching and Sorting:** Searching, Search Techniques, Sorting, Types of sorting, General sort concepts, Bubble sort, Insertion sort.

Unit-IV: Hashing: Introduction, Key Terms and Issues, Hash Functions, Dictionary, Skip List. **Heaps:** Basic Concepts, Implementation of Heap, Heap as Abstract Data Type, Operations on heaps, Heap Applications, Heap Sort. **Indexing:** Indexing techniques. Abstract Data Type.

UNIT-V: Algorithm Analysis and Design: Introduction, Divide-and-Conquer, Dynamic Programming, Pattern Matching, Tries.

Reference Books:

1. Data structure using C++, VARSHA H. PATIL, Publisher: Oxford Higher Education/Oxford University Press, First edition, 2012.
2. Fundamentals of Data structures In C++, Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, University press, 2007.
3. Data Structures using C, Tanaenbaum A.S., Langram Y. Augestein M.J, Pearson Education , 2004.
4. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson Education 2003.
5. Computer Algorithms/C++, E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition, University Press, 2007.

CS 4: Relational Database Management Systems (4 Hours – 4 Credits)

Unit-I: File System versus DBMS – Advantages – Database Languages – ER-Model: Entities – Relationships – Additional Features of ER Model – Conceptual Design with ER Model.

Unit-II: Relational Model – Keys – Constraints – Querying – Views – Relational Algebra – Relational Calculus – SQL – QBE.

Unit-III: File Organization – Organization of records in files – Indexing – Ordered Indices – B+ Tree Index files – Hashing – Static – Dynamic – Query Optimization – Transformation of Relational Expressions – Choice of evaluation plans.

Unit-IV: Database Design – Pitfalls in Relational Database Design – Functional Dependencies – Decomposition – Normalization – I to V Normal Forms.

Unit-V: DB Tuning – Security – Transaction Management – Transactions – Transaction state – Concurrent executions – Serializability – Concurrency Control – Protocols – Crash Recovery.

Reference Books:

1. Ragu Ramakrishnan and Johannes Gehrke, "Data Base Management Systems", 3rd Edition, McGraw-Hill, 2014.
2. Ragu Ramakrishnan and Johannes Gehrke, "Data Base Management Systems", 3rd Edition, McGraw-Hill, 2007.
3. Silberschatz, Korth and Sudarshan, "Data Base System Concepts", McGraw-Hill, 6th Edition, 2010.
4. C.J. Date, "An Introduction to Database Systems", 8th Edition, Addison-Wesley, 2003.
5. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 5th Edition, Pearson Education/Addison Wesley, 2007.
6. SQL, PL/SQL The programming Language of Oracle (3rd Edition) – Ivan Bayross.
7. Peter Rob, Carlos coronel, "Database System Concepts", Ceange Learning.

CS 5: Operating Systems (4 Hours – 4 Credits)

Unit-I: Operating Systems Overview: Computer System Overview – Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview – objectives and functions, Evolution of Operating System. – Computer System Organization – Operating System Structure and Operations – System Calls, System Programs, OS Generation and System Boot.

Unit-II: Process Management: Processes – Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; Threads – Overview, Multicore Programming, Multithreading Models; Windows 7 – Thread and SMP Management. Process Synchronization – Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks.

Unit-III: Storage Management: Main Memory – Contiguous Memory Allocation, Segmentation, Paging, 32 and 64 bit architecture Examples; Virtual Memory – Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

Unit- IV: I/O Systems: Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory Structure, Allocation Methods, Free Space Management, I/O Systems.

Unit-V: Mobile Operating Systems: Introduction to mobile devices, characteristics of mobile devices, mobile OS, Android OS.

MULTIMEDIA OPERATING SYSTEM:

multimedia, multimedia OS, process scheduling, file system, file allocation, disk scheduling, memory management.

CASE STUDY: Linux System- Basic Concepts; System Administration- Requirements for Linux System Administrator, Setting up a LINUX Multifunction Server, Domain Name System, Setting up Local Network Services;

Reference Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. Naresh Chauhan, "Principles of operating systems", Oxford University Press, 2014.
3. William Stallings, "Operating Systems- Internals and Design Principles", 7th Edition, Prentice Hall, 2011.
4. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.
5. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education, 1996.
6. D.M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education, 2007.

CSP1: LAB: Data Structures and Computer Algorithms (5 Hours-3 Credits)

List of Experiments:

Section- A

1. Implementation of Application using array of structures.
2. Implementation of Array Implementation of Stack.
3. Implementation of Array Implementation of Queue.
4. Implementation of Infix to postfix conversion.
5. Implementation of Singly Linked List operations.
6. Implementation of doubly linked lists.
7. Implementation of doubly linked lists.
8. Implementation of Polynomial manipulation- addition, subtraction.
9. Implementation of Binary Tree Traversal.
10. Implementation of Binary Search.
11. Implementation of Graph Traversals.
12. Implementation of Dictionary application using any of the data structure.

Section B

1. Implementation of Quick Sort.

2. Implement Heap sort.
3. Implementation of Shortest Path using Dijkstra's Algorithm.
4. Implementation of Minimum Spanning Tree using Prim's Algorithm.
5. Implementation of Divide and Conquer Method-Merge Sort.
6. Implementation of Backtracking- 8-Queen's Problem.

CSP

2:LAB:Relational Database Management Systems(5Hours-3Credits)

Relational Database Schema-COMPANY

- A. Create tables with relevant foreign key constraints.
- B. Populate the tables with data.

Section A: Perform the following queries on the database:

1. Display all the details of all employees working in the company.
2. Display ssn, lname, fname, address of employees who work in particular department.
3. Retrieve the birthdate and address of the employee whose name is 'Franklin T. Wong'.
4. Retrieve the name and salary of every employee.
5. Retrieve all distinct salary values.
6. Retrieve all employee names whose address is in 'Bellaire'.
7. Retrieve all employees who were born during the 1950s.
8. Retrieve all employees in department 5 whose salary is between 50,000 and 60,000 (inclusive).
9. Retrieve the names of all employees who do not have supervisors
10. Retrieve SSN and department name for all employees.
10. Retrieve the name and address of all employees who work for the 'Research' department
11. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate.
12. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
13. Retrieve all combinations of Employee Name and Department Name.
14. Make a list of all project numbers for projects that involve an employee whose last name is 'Narayan' either as a worker or as a manager of the department that controls the project.
15. Increase the salary of all employees working on the 'Product X' project by 15%.
16. Retrieve employee name and increased salary of these employees.
17. Retrieve a list of employees and the project name each works in, ordered by the employee's department, and within each department ordered alphabetically by employee first name.
18. Select the names of employees whose salary does not match with salary of any employee in department 10.
19. Retrieve the name of each employee who has a dependent with the same first name and same sex as the employee.
20. Retrieve the employee numbers of all employees who work on project located in Bellaire, Houston, or Stafford.
21. Find the sum of the salaries of all employees, the maximum salary, the minimum salary, and the average salary. Display with proper headings.

22. Find the sum of the salaries and number of employees of all employees of the "Marketing" department, as well as the maximum salary, the minimum salary, and the average salary in this department.
23. Select the names of employees whose salary is greater than the average salary of all employees in department 10.
24. For each department, retrieve the department number, the number of employees in the department, and their average salary.
25. For each project, retrieve the project number, the project name, and the number of employees who work on that project.
26. Change the location and controlling department number for all projects having more than 5 employees to 'Bellaire' and 6 respectively.
26. For each department having more than 10 employees, retrieve the department no, no of employees drawing more than 40,000 as salary.
27. Insert a record in Project table which violates referential integrity constraint with respect to Department number. Now remove the violation by making necessary insertion in the Department table.
28. Delete all dependents of employee whose ssn is „123456789“.
29. Delete an employee from Employee table with ssn = „12345“ (make sure that this employee has some dependents, is working on some project, is a manager of some department and is supervising some employees). Check and display the cascading effect on Dependent and Works on table. In Department table MGRSSN should be set to default value and in Employee table SUPERSSN should be set to NULL.
30. Perform a query using alter command to drop/add field and a constraint in Employee table.

Section B

1. Write a PL/SQL code to calculate total and percentage of marks of the students in four subjects.
2. Write a PL/SQL code to calculate the total salary of first n records of employee table. The value of n is passed to cursor as parameter.
3. Write a PL/SQL code to update the salary of employees who earn less than the average salary.
4. Write a row trigger to insert the existing values of the salary table in to a new table when the salary table is updated.
5. Write a PL/SQL procedure to find the number of students ranging from 100-70%, 69-60%, 59-50% & below 49% in each course from the student_course table given by the procedure as parameter.
6. Write a PL/SQL code to create,
 - a) Package specification
 - b) Package body.
7. For the insert, retrieve, update and delete operations on a student table.
8. To Perform Banking Operations Using Procedures.

EES 1: LAB: Communication Skill

(2 Hours – 1 Credit)

List of Experiments:

I. PC based session (Weightage 40%) A. English Language Lab (6 Hours)

1. Listening Comprehension: Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

1. Reading Comprehension: Filling in the blanks - Close exercises– Vocabulary building – Reading and answering questions.

2. Speaking: Phonetics: Intonation–Ear training - Correct Pronunciation–Sound recognition exercises – Common Errors in English. Conversations: Face to Face Conversation – Telephone conversation– Role play activities.

A. Discussion of audio-visual materials (10 Hours) (*Samples to learn and practice*)

1. Resume / Report Preparation / Letter Writing

Structuring the resume / report - Letter writing / Email Communication - Samples.

2. Presentation skills:

Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples.

3. Soft Skills:

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples.

4. Group Discussion:

Why is GD part of selection process? - Structure of GD – Moderator – led and other GDs Strategies in GD – Team work - Body Language - Mock GD – Video samples.

5. Interview Skills:

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews- Video samples.

II. Practice Session (Weightage – 60%) (12 + 2 Hours)

1. Resume / Report Preparation / Letterwriting:

2. Soft Skills : Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills persuasive skills – sociability skills – interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills.

3. Presentation Skills : Preparing slides with animation related to the topic – organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentation.

4. Group Discussion Skills : Participating in group discussions – understanding group dynamics - brainstorming the topic — questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mockGD.

5. Interview Skills : Interview etiquette – dress code – body language – mock interview —attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview & panel interview– FAQs related to job interview- Emotional and cultural intelligence.

II SEMESTER

CS 6:SoftwareEngineering (4Hours–4Credits)

Unit- I: INTRODUCTION:SoftwareEngineeringParadigms–WaterfallLifeCycleModel – SpiralModel–PrototypeModel–AgileProcessModel–UnifiedProcessModel-Planning– SoftwareProjectScheduling – SRS-CaseStudy:Project Planand SRS.

Unit– II : SOFTWAREDESIGN:Designing Concepts- Abstraction–Modularity–Software Architecture–Cohesion–Coupling–DataflowOrientedDesign-JacksonSystem Development- RealtimeandDistributedSystemDesign–DesigningforReuse—Case Study: Design for anyApplication Oriented Project.

Unit–III: SOFTWARETESTINGANDMAINTENANCE:SoftwareTestingFundamentals – SoftwareTestingStrategies–BlackBoxTesting–WhiteBoxTesting–SystemTesting– ObjectOrientationTesting–StateBasedTesting–TestingTools–TestCase Management– Types of Maintenance –CaseStudy: TestingTechniques.

Unit– IV : SOFTWAREMETRICS:Scope–Classificationofmetrics–MeasuringProcess andProductattributes–DirectandIndirectmeasures–CostEstimation-Reliability– SoftwareQualityAssurance – Standards – Case StudyforCOCOMO model.

Unit– V : SCM&WEBENGINEERING:NeedforSCM–VersionControl–SCMprocess – SoftwareConfigurationItems–Taxonomy–ReEngineering–ReverseEngineering-Web Engineering-CASE Repository–Features.

ReferenceBooks:

- 1 . AliBehforroz,FrederickJ.Hudson,“SoftwareEngineeringFundamentals”,OxfordIndian Reprint,2012.
2. JibiteshMishra,AshokMohanty,“SoftwareEngineering”,PearsonEducation,FirstEdition, 2011.
3. KassemA. Saleh, “SoftwareEngineering”, First Edition,J.RossPublishing, 2009.
4. PankajJalote,“AnIntegratedapproachtoSoftwareEngineering”,ThirdEdition,Narosa Publications, 2011.
5. RogerS.Pressman,DavidLowe,“WebEngineering:APractitioner’sApproach”,Special Indian edition,McGrawHill, 2008.
6. Richard Fairley, “SoftwareEngineering Concepts”,Tata McGraw HillEdition,2008.
7. RogerS.Pressman,“SoftwareEngineering:APractitionerApproach”,SeventhEdition, TataMcGraw HillInternational Edition, 2009.
8. Sommerville, “Software Engineering”, TenthEdition,Pearson, 2015.

CS 7:JavaProgramming (4Hours–4Credits)

Unit–I:IntroductiontoJava-Introduction-OverviewofJavatechnology-Developmentof java- JavaasanewParadigminprogramming-FeaturesofJava-Comparingjavaandother Languages- ApplicationsandAppletsJavaDevelopmentkit-JavaSourceFileStructure-Prerequisites forCompiling and RunningJavaPrograms.

JavaasanOOPLanguage-DefiningClasses-CreatinginstanceandClass Variables- DefiningMethods-Knowingthis-Variableslopeandmethoddefinitions-

Passing arguments to methods- Class methods- Overloading methods- inheritance, Polymorphism, and Abstract classes- Overriding methods- Finalizer methods- Modifiers- Controlling access to methods and variables- Method protection and Inheritance- Creating access or methods- Class variables and methods- Finalizing classes, methods and variables- Abstract classes and methods- Packages- Using Packages- Using package and Class names in full- The import command- Name conflicts- Creating packages- Packages and class Protection- Interfaces- Interfaces and classes- Creating and extending interfaces- Other uses of interfaces.

Unit- II: Exception Handling–Introduction-Basics of Exception handling in java-Exceptions Hierarchy-Throwable class hierarchy-Constructors and Methods in Throwable class-Constructors- Methods-Unchecked and Checked Exceptions-Handling exceptions in java-Try block-Catch block-Finally block-Multiple catch blocks-Nested try statements-The keyword throw-Exception and Inheritance-Throwing User-defined Exceptions- Redirecting exceptions using throws-Rethrowing an exception-Advantages of the Exception Handling Mechanism.

Multithreading-Introduction:An Overview of threads-Creating Threads-Creating a new thread extending Thread-Creating a thread implementing Runnable interface-Stopping threads:the join() method-Naming a thread-Thread lifecycle-The newborn state-The runnable state-The running state-The dead state-The blocked state-Manipulating threads-Thread Priorities and Thread Scheduling-Set priority and get priority-Time slicing-The scheduler-Thread Synchronization-Synchronized methods-Synchronized statements-Deadlocks-Daemon threads- Thread groups- Communication of threads.

Unit-III: Files and I/O Streams-An Overview of I/O Streams-Java I/O-Character Streams-Byte Streams-Working with the I/O superclasses-File Streams-FileInputStream and FileOutputStream- Filter Streams-DataInputStream and DataOutputStream-PushbackInputStream- Random Access File- Serialization.

Applets-Introduction- Java Applications Versus Java Applets-Applet lifecycle-The init() method-The start() method-The stop() method-The destroy() method-The paint() method-Working with Applets-Running the applet using Applet Viewer-Running the applet using the web browser-The HTML Applet tag-Attributes in the Applet tag-Passing parameters to the applets- The Java.Applet package.

Database Handling using JDBC-An Overview of DBMS-Database operations-Database applications architecture-JDBC architecture-Interfaces in JDBC API-Types of database driver-Working with JDBC-Accessing a database using JDBC-Registering the driver-Connecting to the database-Processing queries-Statement class-Accessing rows returned from a query-Accessing column data-The method PreparedStatement-The method CallableStatement-Handling Exceptions-Mapping database type to java-Java format types-Accessing Metadata-Methods in the class ResultSetMetadata-The Class DatabaseMetadata-Sample programs to handle databases.

Unit- IV: The Abstract Window Toolkit-Introduction-Basic classes in AWT-The class Graphics-Colours-Font-Drawing with graphic classes-Class Hierarchy of AWT-Event Handling-Adapter classes-AWT controls-Labels-Buttons-Checkbox- CheckboxGroup for creating RadioButtons-Choice controls-List Controls-TextField control-Scrollbars-Layout Managers-The Flow Layout Manager-The Grid Layout Manager-The BorderLayout Manager-The Card Layout Manager-Java 2D API-Java 2D Shapes-Texture paint and gradient paint.

Swings-Introduction-TheSwingpackages-theHierarchyofSwingclasses-JPopupMenu-JdesktopPaneandJInternalFrame-AdvancedLayoutManagers-The BoxLayoutManager-TheGridBagLayoutManager-AdditionalSwingcomponents-The Jlistclass-TheJcomboboxclass-Constructingmenus-TheJTextAreaClass-TheJTable Control-Customizingtheframeanditslook-and-feel-TheJToolBarclass-TheJSlider control-TheJProgressBar control-Borders.

Unit- V: Servlets-Introduction-Advantagesofservlets-Writing servlets-Howtorunservlets-RunningHTMLtoservlets-TheLifecycleoftheservlet-InstantiatingandInitializinga servlettheinit()method-Handlingclientrequestandresponsetheservice()method-Destroyingtheservletthedestroy()method-ServletAPI-Interfaces-Classes-The GenericServletclasses-TheHttpServletclasses-MultitierApplicationsusingJDBCfroma servlet-Writing JDBC/Servlet-AsampleJDBC/Servletapplications-Additionalcapabilities of HTTP servlets-Objects of theHttpServletRequest class-Objects of the HttpServletResponse class- Exampleof GET and POST Requests- Session Management.

NetworkingandRemoteMethodInvocation-IntroductiontoNetworking-UnderstandingPorts-NetworkingClassesintheJDK-BasicsofSockets-SimpleClient serverprogram-Readingfromandwritingtoasocket-IntroductiontoRMI-RMI Architecture-Proxylayerorstub/skeletonlayer-Remotereferencelayer-Transportlayer-ImplementingRemoteClassandInterface-ProgrammingaClient-ProgrammingaServer-Security.

NewLanguageFeaturesofJava1.5-Introduction-Generics-TheEnhancedfor loop-AutoboxingandUnboxing-TypeSafeEnumerations-VariablelengthArguments-FormattedI/O-Static import- Metadata.

ReferenceBooks:

- 1.ObjectOrientedProgrammingThroughJAVA-P.RadhaKrishna,UniversityPress, 2007.
- 2.JavaandObject-OrientedProgrammingParadigm,DebasishJana,PHI,FifthPrint, 2010.
- 3.JavaHowTo Program, Paul Deitel, HarveyDeitel, PHI, Ninth Edition,2013.
- 4.TheCompleteReference,Java2,HerbertSchildt,TataMcGrawHill,FifthEdition, 2002.
- 5.Introduction to JavaProgramming,K.Somasundaram, Jaico Publications, 2013.
- 6.CoreJava-Vol.I-Fundamentals,CayS.Horstmann,PearsonEducation;Tenth edition, 2016.

CS

8:DataCommunicationandComputerNetworks(4Hours -4Credits)

Unit- I: IntroductiontoDataCommunications:Componentsofdatacommunication,Data representation,Transmission , Impairments,Switching,Modulation,Multiplexing,Review of NetworkHardware:LAN,MAN,WAN,Wirelessnetworks,Internetworks,ReviewofNetworkSoftware:Layer,Protocols,Interfacesandservices.ReferenceModels:OSI,TCP/IPandtheir comparison.

Unit- II : PhysicalLayer:TransmissionMedia:Twistedpair,Coaxialcable,Fiberoptics, Wirelesstransmission(Radio,Microwave,Infrared).IntroductiontoATM,ISDN,Cellular RadioandCommunicationSatellites.DataLinkLayer-ServicesprovidedbyDLL; FRAMINGERRORCONTROL,FLOWCONTROL,MEDIUMACCESS,MediumAccess Sublayer;ChannelAllocation,MACprotocols-ALOHA,CSMAprotocols,Collisionfree

protocols, Limited Contention Protocols, Wireless LAN protocols, IEEE 802.3, 802.4, 802.5 standards and their comparison.

Unit– III : Network Layer Design Issues, Routing Algorithms (Shortest Path, Flooding, Distance Vector Hierarchical, Broadcast, Multicast), congestion Control Algorithms (Leaky bucket, Token bucket, Load shedding), Internetworking, IP Protocol, ARP, RARP, Network Trouble Shooting Using Ping, Traceroute, IPconfig, Netstat, nslookup.

Unit- IV: Transport Layer Addressing, Establishing and Releasing Connection, Flow Control, Buffering, Internet Transport Control (TCP and UDP), Application Layer – DNS – TELNET – FTP – SMTP – POP – SNMP – HTTP – IP Over ATM – Mobile IP – Multimedia: audio and video compression – stream – stored audio/video – streaming live audio/video – real-time interactive audio/video – voice over IP – SIP – H.323 – skype – virtual private network. Public key and Secret key DNS, Resource Records, Name Service, Email – Architecture and services, TELNET, File Transfer Protocol (FTP), Simple Network Management Protocol (SNMP) Simple Mail Transfer Protocol (SMTP), Hyper Text Transfer Protocol (HTTP), World Wide Web (WWW).

Unit- V: Cryptography: symmetric key cryptography – asymmetric key cryptography – security services: Message confidentiality – message integrity – message authentication – entity authentication – digital signature key management – security in internet: IPsec – SSL/TLS – PGP – Firewalls. Introduction to MPLS – VPN – Traffic Engineering – RSVP (reservation protocol) – Tunneling – QoS.

References Books:

1. Behrooz A. Forouzan, "Data Communication and Networking", The McGraw Hill Education Private Limited, New Delhi.
2. Behrooz A. Forouzan, "TCP/IP Protocol Suite", The McGraw Hill Edition, New Delhi.
3. "Data Communication and Computer Networks", ISRD group, TMH Publications.
4. Larry L. Peterson Bruce S. Davie, "Computer Networks – a system approach", Morgan Kaufmann Publishers.
5. Andrews S Tanenbaum, "Computer Networks", Prentice Hall.

CS

9: Web Technology (4 Hours – 4 Credits)

Unit– I : **Introduction to WWW:** Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol – Overview of HTTP, HTTP Request – response – Generation of dynamic web pages.

Unit- II: **Markup Language (HTML5):** Basics of HTML – Syntax and tags of HTML – Introduction to HTML5 – Semantic/Structural Elements – HTML5 style Guide and Coding Convention – HTML5 and Canvas – HTML APIs – Audio & Video – Drag/Drop – Local Storage – Web socket API – Debugging and validating HTML. **Cascading Style Sheet (CSS3):** The need for CSS – Basic syntax and structure – Inline Styles – Embedding Style Sheets – Linking External Style Sheets – Introduction to CSS3 – Backgrounds – Manipulating text – Margins and Padding – Positioning using CSS – Responsive Web Design – Introduction to LESS/SASS.

Unit- III: **Overview of Javascript:** Introduction – Core features – Data types and Variables – Operators, Expressions, and Statements – Functions – Objects – Array, Date and Math Related Objects –

DocumentObjectModel-EventHandling-ControllingWindows&Framesand Documents - Form validations.

Unit- IV: AdvancedFeaturesofJavascript:Browser Management and Media Management–Classes–Constructors–Object-OrientedTechniquesinJavaScript–Objectconstructorand Prototyping-SubclassesandSuperclasses–IntroductiontoJSON–JSONStructure– Introduction to jQuery–Introduction to AJAX-Bootstrap - Bootstrapcomponents.

Unit- V: Django:IntroductiontoDjango-Djangomodellayer–Viewlayer–TemplateLayer – Forms–Automatedadmininterface–DjangoSecurity–Internationalizationand localization– DjangoWebapplicationtools–Corefunctionalities–Geographic Framework.

ReferenceBooks:

- 1.DavidFlanagan,“JavaScript:TheDefinitiveGuide,SixthEdition”,O’Reilly Media,2011.
- 2.AymanHourieh, “LearningWebsiteDevelopmentwithDjango”,Packt Publishing, 2008.
- 3.Harvey&PaulDeitel&Associates,Harvey DeitelandAbbey Deitel,“Internetand World WideWeb - HowTo Program”,Fifth Edition, Pearson Education, 2011.
- 4.JamesLee,BrentWare,“OpenSourceDevelopmentwithLAMP:UsingLinux, Apache, MySQL, Perl, and PHP” AddisonWesley, Pearson 2009.
- 5.Thomas A. Powell, “HTML&CSS: The Complete Reference”, Fifth Edition, 2010
- 6.ThomasAPowell,FritzSchneider,“JavaScript:TheCompleteReference”,Third Edition, Tata McGraw Hill, 2013.
- 7.Thomas A Powell, “Ajax: The Complete Reference”, McGraw Hill, 2008.

CSP 3:LAB:JavaProgramming (5Hours–3Credits)

1. WritingJavaprogramsbymakinguseofclass,interface,package,etcforthe following
 - Different types of inheritancestudy
 - Uses of this“keyword”.
 - Polymorphism.
 - Creation of userspecificpackages. • Creation of jar filesandusingthem • User specific exception handling.
2. Writingwindow based GUIapplications using frames and applets such asFahrenheit to Centigrade conversion, life cycle, digital clock,Calculator application, graphicalbarchart bypassingparametersetc. 3. Application of threadsexamples.
4. Create aPersonalInformation System usingSwing.
5. Event Handlingin Swing.
6. Reading and writingtext files.
7. Writing an RMIapplication to accessa remote method.
8. WritingaServletprogramwithdatabaseconnectivityforawebbasedapplication such as students result status checking, PNR number enquiry etc.
9. Creation and usageof Javabean.
10. Create anApplication to search PhoneNumber using contact Name Using Hash Map.
11. Create anApplication which finds the Duplicatesin E-mail usingSetInterface.

12. FTP UsingSockets.

CSP
4:LAB:WebTechnology(5Hours–3Credits)SectionA

1. Createyour own ResumeusingHTML5 Tags andCSS 3 Properties.
2. DebugandvalidateyourHTMLdocument(Resume)usingW3Cvalidatorandfix the issues.(https://validator.w3.org/#validate_by_upload).
3. (a)Addfunctionalitiesthatuseany2ofHTML5API"s.(b)Createastudent Registration formforJob Application and validate the form fields usingJavaScript.
4. (a)CreateaCGPACalculatorinWebBrowerusingHTML,CSSandJavaScript.Use functionsinJavaScript.(b)CreateaQuizProgramwithadaptivequestionsusing JavaScript.
5. Createa Pan Card Validation form using Object Oriented JavaScript, consider the 10thcharacter tobeanalphabet.(a)Gettheuser"sFirstName,LastNameandother requiredfieldsasinput(b)AssumethelastdigitofthePanNumbertobeanalphabet (c)Validate thePANNumber.
6. Create an online Event Registration formand validate usingjQuery.
7. CreateanonlinevideoPlayerwhichwillallowyoutoplayvideosfromthesystem and also createcustom playlist usingjQuery.
8. Construct a JSON Structurefora bookstore andvalidate it usingJSON Validator such as<http://jsonlint.com/>andparsetheJsonfiletolistthebooksunderthecategory "Fiction". Use Javascriptor JQueryfor parsing.
9. BuildanapplicationthatusesSpring"sRestTemplatetoretrievearandomSpring Boot quotation at <http://gturnquist-quoters.cfapps.io/api/random>.
10. Createweatherserviceusingspring/strutswhichwillreturnthetempinJSONformat and XML format.

SectionB

11. CreateaSinglePageapplicationallowingtosearchforamovieanddisplayingthe trailer, poster for variousmovies.
 - (a)Createanadminlogintouploadthetrailer,poster,keywordand details of themovie.
 - (b)Use Bootstrapand JQueryfor designingthe UserInterface. (c)Form Submission shouldbehandled through Ajax.
12. DevelopaSocialMediaWebApplicationusingHTML5,CSS3,JQuery,AJAX and PHP, MySqli.

ESI - Elective I
ES 11:DigitalImageProcessing
(4Hours–4Credits)

Unit–I:DigitalImageProcessing:OriginsofDigitalImageProcessing,FundamentalSteps inDigitalImageProcessing,ComponentsofanImageProcessingSystem.DigitalImage Fundamentals:ElementsofVisualPerception,LightandtheElectromagneticSpectrum, ImageSensingandAcquisition,ImageSamplingandQuantization,BasicRelationships between Pixels, Mathematical Tools used in DigitalImageProcessing.

Unit-II: Image Transformation and Spatial filters: Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement methods, Fuzzy techniques for Intensity Transformation and Spatial Filtering. Filtering in the Frequency Domain: Preliminary Concepts, Sampling and the Fourier Transforms of Sampled Functions, The Discrete Fourier Transform (DFT), Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Sharpening using Frequency Domain Filters, Selective Filtering.

Unit- III: Image Restoration and Reconstruction: A model of the Image Degradation/ Restoration Process, Noise Models, Restoration in the presence of Noise only- Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Square Filtering, Geometric Mean Filter, Image Reconstruction from Projections. Image Segmentation: Fundamentals, Point, Line and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation.

Unit- IV: Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Full Color Image Processing, Color Transformation, Smoothing and Sharpening, Image Segmentation Based on Color, Noise in Color Images. Wavelets and Multiresolution Processing: Background, Multiresolution Expansion, Wavelet Transforms in One Dimension, The Fast Wavelet Transform, and Wavelet Transforms in Two Dimensions, Wavelet Packets. Image Compression: Fundamentals, Basic Compression Methods, Digital Image Watermarking.

Unit- V: Morphological Image Processing: Erosion and Dilation, Opening and Closing, The Hit-Or-Miss Transformation, Basic Morphological Algorithms, Gray-Scale Morphology. Object Recognition: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

Reference Books:

1. Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson Education, 2008.
2. Digital Image Processing using MATLAB Rafael C. Gonzalez, Richard E. Woods, 2nd Edition, Prentice Hall of India, 2002.
3. Fundamentals of Digital Image Processing A. Jain, Prentice Hall of India.

ES

12: Artificial Intelligence (4 Hours – 4 Credits)

Unit- I : **Introduction:** Introduction to Artificial Intelligence, Intelligence Problems and AI techniques, Solving problems by searching, Problem Formulation. Intelligent Agents: Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. Uninformed Search Techniques: DFS, BFS, Uniform cost search,

Unit- II : Depth Limited Search, Iterative Deepening, Bidirectional search, Comparing Different Techniques. Informed Search Methods: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*, IDA*, SMA*, Crypto Arithmetic Problem,

Backtracking for CSP, Performance Evaluation. 6 Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning.

Unit– III : Knowledge and Reasoning: A Knowledge Based Agent, WUMPUS 08 WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining, Resolution. , Introduction to PROLOG.

Unit- IV: Planning: Introduction to Planning, Planning with State Space Search, Partial Ordered planning, Hierarchical Planning, Conditional Planning, Planning with Operators. Uncertain Knowledge and Reasoning: Uncertainty, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bay's theorem, Belief Networks, Simple Inference in Belief Networks.

Unit- V: Learning: Learning from Observation, General Model of Learning Agents, Inductive Learning, Learning Decision Trees, Rote Learning, Learning by Advice, Learning in Problem Solving, Explanation based Learning. Expert Systems: Representing and using Domain Knowledge, Expert System-shell, Explanation, Knowledge Acquisition.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
2. Elaine Rich, Kevin Knight, Artificial Intelligence, Tata McGraw Hill, 2nd Edition. University of Mumbai, Information Technology).
3. George Luger, .AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
4. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
5. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
6. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication.

ES13: Compiler Design (4 Hours–4 Credits)

Unit– I : Compilers and Translators-Why Do We Need Translators?-The Structure Of A Compiler-Lexical Analysis-Syntax Analysis-Intermediate Code Generation-Optimization Code Generation-Book Keeping-Error Handling-Compiler- Writing Tools-Getting started. The role of the lexical analyzer-Simple approach to design of a lexical analyzer-Regular Expressions-Finite Automata-From regular expression to finite automata-Minimizing the number of states of a DFA-A language for specifying lexical analyzer-Implementing a lexical analyzer-The scanner generator as a Swiss army Knife.

Unit- II: The Syntactic Specification of Programming Languages-Derivation and Parse Trees-Capability of context free Grammars.Parsers-Shift-reduce Parsing-Operator-precedence parsing-Top-down parsing-Predictive Parsers.

Unit– III : LR parsers-The canonical collection of LR(0) items-constructing SLR parsing tables – constructing canonical LR parsing tables-constructing SLR parsing tables-constructing LALR parsing tables–Using Ambiguous grammars-An automatic parse generator Implementation of LR parsing Tables–constructing LALR set of items.Syntax directed translation schemes–Implementation if syntax directed schemes-Intermediate Code- Parse Tree and Syntax Trees–Three Address code, quadruples, and triples- Translation of assignment

statements-Boolean Expression-Statements that alter the flow of control-postfix translations- Translation with a top-down parser.

Unit– IV : The contents of a symbol table-Data structure for a symbol table-Representing Scope information.Errors-Lexical-phase errors-syntactic-phase errors-Semantic errors. The principal sources of optimization-Loop optimization-The DAG representation of basic blocks- Value numbers and algebraic laws-Global data-flow analysis.

Unit- V: Dominators-Reducible Flow graphs-Depth-first search-Loop-invariant computations – Induction variable elimination-Some other loop optimization.Code Generation-Object Programs- A machine Model-A simple code generator-Register allocation and assignment-Code generation from DAG's-Peephole Optimization.

Reference Books:

- 1.Principles of Compiler Design, Alfred V.Aho and Jeffrey D.Ullman.25th Reprint, 2002.
- 2.Compiler Design in C, Allen I. Holub Prentice Hall of India, 2003.
- 3.Crafting a compiler with C, C. N. Fischer and R. J.LeBlanc, Benjamin Cummings, 2003.

ES14:Data Mining and Data Warehousing (4Hours–4Credits)

Unit- I: Introduction-Why Data Mining?-What is Data Mining?-What Kinds of Data Can Be Mined?-What Kinds of Patterns Can Be Mined?-Which Technologies Are Used? Which Kinds of Applications Are Targeted?Major Issues in Data Mining. Getting to Know Your Data:Data Objects and Attribute Types-Basic Statistical Descriptions of Data -Data Visualization –Measuring Data Similarity and Dissimilarity.

Unit- II: Data Preprocessing:Data Preprocessing An Overview-Data Cleaning-Data Integration-Data Reduction-Data Transformation and Data Discretization.Data Warehousing and Online Analytical Processing:Data Warehouse:Basic Concepts-Data Warehouse Modeling:Data Cube and OLAP-Data Warehouse Design and Usage-Data Warehouse Implementation- Data Generalization by Attribute-Oriented Induction.

Unit- III: Mining Frequent Patterns, Associations, and Correlations:Basic Concepts and Methods-Frequent Itemset Mining Methods-Which Patterns Are Interesting?-Pattern Evaluation Methods.Advanced Pattern Mining:Pattern Mining:A Road Map-Pattern Mining in Multilevel, Multidimensional Space-Constraint-Based Frequent Pattern Mining - Mining High-Dimensional Data and Colossal Patterns-Mining Compressed or Approximate Patterns - Pattern Exploration and Application.

Unit- IV: Classification:Basic Concepts-Decision Tree Induction-Bayes Classification Methods-Rule-Based Classification-Model Evaluation and Selection-Techniques to Improve Classification Accuracy.

Unit- V: Cluster Analysis Basic Concepts and Methods:Cluster Analysis-Partitioning Methods-Hierarchical Methods-Density Based Methods-Grid Based Methods-Evaluation of Clustering.

Reference Books:

1. Data Mining Concepts and Techniques - Third Edition, Jiawei Han, Micheline Kamber, Jian Pei
2. Insight into Data Mining Theory and Practice K.P. Soman, Shyam Diwakar and V. Ajay, Easter Economy Edition, Prentice Hall of India, 2006.
3. Introduction to Data Mining with Case Studies, G.K. Gupta, Easter Economy Edition, Prentice Hall of India, 2006.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2007.
5. Modern Data Warehousing, Mining, and Visualization, MARAKAS, GEORGE M, Pearson Education, 2011.

III SEMESTER

CS 10: Software Testing and Quality Assurance

(4 Hours – 4 Credits)

Unit- I: TESTING TECHNIQUES & TEST CASE DESIGN: Using White Box Approach to Test design- Test Adequacy Criteria – Static Testing Vs. Structural Testing – Code Functional Testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Their Role in Whitebox Based Test Design – Code Complexity Testing – Evaluating Test Adequacy Criteria. Test Case Design Strategies – Using Black Box Approach to Test Case Design – Random Testing – Requirements based testing – Boundary Value Analysis – Decision tables – Equivalence Class Partitioning – State-based testing – Cause-effect graphing – Error guessing – Compatibility testing – User documentation testing – Domain testing – Case study for Control Flow Graph and State-based Testing.

Unit- II: LEVELS OF TESTING: The Need for Level of Testing - Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording Results – Integration Tests – Designing Integration Tests – Integration Test Planning – Scenario Testing – Defect Bash Elimination. System Testing – Acceptance testing – Performance testing – Regression Testing - Internationalization testing - Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility Testing – Configuration Testing – Compatibility Testing – Testing the documentation – Website Testing – Case Study for Unit and Integration Testing.

Unit- III: TESTING FOR SPECIALIZED ENVIRONMENT: Testing Client/Server Systems – Testing in a Multiplatform Environment - Testing Object-Oriented Software – Object Oriented Testing – Testing Web based systems – Web based system – Web Technology Evolution – Traditional Software and Web based Software – Challenges in Testing for Web-based Software – Quality Aspects – Web Engineering – Testing of Web based Systems. Case Study for Web Application Testing

Unit- IV: TEST AUTOMATION: Selecting and Installing Software Testing Tools - Software Test Automation – Skills needed for Automation – Scope of Automation – Design and Architecture for Automation – Requirements for a Test Tool – Challenges in Automation – Tracking the Bug – Debugging – Case study using Bug Tracking Tool.

Unit- V: SOFTWARE TESTING AND QUALITY METRICS: Six-Sigma – TQM - Complexity Metrics and Models – Quality Management Metrics - Availability Metrics - Defect Removal Effectiveness - FMEA - Quality Function Deployment – Taguchi Quality Loss Function – Cost of Quality. Case Study for Complexity and Object Oriented Metrics.

Reference Books:

1. Adithya P. Mathur, "Foundations of Software Testing—Fundamentals algorithms and techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.
2. Boris Beizer, "Software Testing Techniques", Dream Tech Press, 2009.
3. Dale H. Besterfield, "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2011).
4. Edward Kit, "Software Testing in the Real World—Improving the Process", Pearson Education, 1995.
5. Glenford J. Myers, Tom Badgett, Corey Sandler, "The Art of Software Testing", 3rd Edition, John Wiley & Sons Publication, 2012
6. Illene Burnstein, "Practical Software Testing", Springer International Edition, Chennai, 2003.
7. Naresh Chauhan, "Software Testing Principles and Practices" Oxford University Press, New Delhi, 2010.
8. Ron Patton, "Software Testing", Second Edition, Pearson Education, 2009.
9. Renu Rajani, Pradeep Oak, "Software Testing—Effective Methods, Tools and Techniques", Tata McGraw Hill, 2004.
10. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing—Principles and Practices", Pearson Education, 2009.
11. Stephan Kan, "Metrics and Models in Software Quality", Addison–Wesley, Second Edition, 2004.
12. William Perry, "Effective Methods of Software Testing", Third Edition, Wiley Publishing.

CS 11: Python Programming

(4 Hours—4 Credits)

Unit – I : Introduction to Python: Python—Features of Python—Execution of a Python Program—Viewing the Byte Code – Flavors of Python – Python Virtual Machine (PVM) – Frozen Binaries – Memory Management in Python – Garbage Collection in Python.

Datatypes in Python: How Python Sees Variables—Datatypes in Python—Built-in datatypes – bool datatype – Sequences in Python - Sets – Literals in Python – Determining the datatype of a variable – What about characters – User-defined Datatypes – Constants in Python – Identifiers and Reserved words – Naming Conventions in Python.

Operators in Python: Operator—Arithmetic Operators—Using Python Interpreter as Calculator – Assignment Operators – Unary Minus Operator – Relational Operators – Logical Operators – Boolean Operators – Bitwise Operators – Membership Operators – Identity Operators – Operator Precedence and Associativity.

Unit – II : Control Statements: Control Statement—The if Statement—A word in Indentation—The if..else Statement – The if..elif..else Statement – The while Loop – The for Loop – Infinite Loops – Nested Loops – The else suite – The break statement – The Continue Statement.

Arrays in Python: Array—Advantages of Arrays—Creating an array—Importing the Array Module – Indexing and Slicing on Arrays – Processing the Arrays – Types of Arrays – Working with Arrays using numpy – Creating Arrays using array() – Creating Arrays using linspace – Creating Arrays using logspace – Creating Arrays using arrange () function – Creating Arrays using zeros() and ones() Functions – Mathematical Operations on Arrays – Comparing Arrays – Aliasing the Arrays – Viewing and Copying Arrays.

Strings and Characters: Creating Strings—Length of a String—Indexing in Strings—Slicing the Strings – Repeating the Strings – Concatenation of Strings – Checking Membership –

Comparing Strings – Removing Spaces from a String – Finding Sub Strings – Counting Substrings in a String – Strings are Immutable.

Unit-III – Functions: Difference between a Function and a Method–Defining a Function– Calling aFunction – Returning Results from a Function – Returning Multiple Values from a Function – Functions are First Class Objects – Pass by Object Reference – Formal and Actual Arguments – Positional Arguments – Keyword Arguments – Default Arguments – Variable Length Arguments – Local and Global Variables – The Global Keyword – Passing a Group of Elements to a Function – Recursive Functions.

Classes and Objects: Creating a Class–The Self Variable–Constructor–Types ofVariables – Namespaces – Types of Methods – Method Resolution Order.

Unit-IV : Inheritance and Polymorphism: Constructors in Inheritance–Overriding Super ClassConstructors and Methods – The Super() Method – Types of Inheritance.

Exceptions: Errors in a Python Program–Exceptions–Exception Handling–Types ofExceptions – The Except Block – The assert Statement – User-Defined Exceptions – Logging the Exceptions.

Unit-V: Python’s Database Connectivity: DBMS–Advantages of a DBMS over Files–Types ofDatabases used with Python – Installation of MySQL Database Software – Setting the path to MySQL Server – Verifying the MySQL in the Windows Operating System – Installing MySQL Connector – Verifying the Connector Installation – Working with MySQL Database. – Using MySQL from Python – Retrieving All Rows from a Table – Inserting Rows into a Table – Deleting Rows from a Table – Updating Rows from a Table – Creating Database Tables through Python – Installation of Oracle 11g – Verifying Oracle Installation in Windows Operating System – Installing Oracle Database Driver – Verifying the Driver Installation – Working with Oracle Database – Using Oracle Database from Python – Stored Procedures.

Text Books :

Core Python Programming – Dr.R.Nageswara Rao, Dreamtech Press, 2017.

Unit I – Page No. : Chapters 1(1-15), 3(49-69),4(71-88).

Unit II Page No. : Chapters 6(117-138), 7(151-182), 8(207-221).

Unit III –Page No. : Chapters 9(237-264),13(351-367),14(388-390)

Unit IV –Page No. : Chapters 14(373-388), 16(421-439)

Unit V - Page No. : Chapters 24(649-697).

Reference Book :Core python programming - Wesley j.chun, Pearson Education, 2001.

CS

12:MobileComputing(4Hours–4Credits)

Unit- I: INTRODUCTION:MobileComputing–MobileComputingVswireless Networking– MobileComputingApplications–CharacteristicsofMobilecomputing– StructureofMobileComputingApplication.MACProtocols–WirelessMACIssues– Fixed Assignment Schemes– Random Assignment Schemes – Reservation Based Schemes.

Unit-II : MOBILEINTERNETPROTOCOLANDTRANSPORTLAYER:Overviewof MobileIP–FeaturesofMobileIP–KeyMechanisminMobileIP–routeOptimization. OverviewofTCP/IP–ArchitectureofTCP/IP–AdaptationofTCPWindow–Improvement in TCP Performance.

Unit- III : MOBILE TELECOMMUNICATIONS SYSTEM: Global System for Mobile Communication (GSM)–General Packet Radio Service (GPRS)–Universal Mobile Telecommunication System (UMTS).

Unit- IV: MOBILE AD-HOC NETWORKS: Ad-Hoc Basic Concepts–Characteristics–Applications–Design Issues–Routing–Essential of Traditional Routing Protocols–Popular Routing Protocols–Vehicular Ad Hoc networks (VANET)–MANET vs VANET – Security.

Unit- V: MOBILE PLATFORMS AND APPLICATIONS: Mobile Device Operating Systems–Special Constraints & Requirements–Commercial Mobile Operating Systems–Software Development Kit: iOS, Android, BlackBerry, Windows Phone–MCommerce– Structure–Pros & Cons– Mobile Payment System– Security Issues.

Reference Books:

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Jochen H. Schiller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.
3. Dharma Prakash Agarwal, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.
5. William C. Y. Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition, Tata McGraw Hill Edition, 2006.
6. Mobile Computing, V. Jeyasri Arokiamary, Technical Publications, 2009.

CS13: Information Security (4 Hours–4 Credits)

Unit- I: Introduction: what is security? What is management? Principles of information security management. **Planning for security:** role of planning, precursor to planning, strategic planning. **Planning for contingencies:** Fundamentals and components of contingency planning.

Unit-II: Information security policy: why policy? Enterprise information security policy, issue specific security policy, system specific security policy.

Developing the security program: organizing for security, placing information security within an organization, components of the security program, information security roles and titles.

Unit III: Security management models: blueprint, framework and security models, access control model, security architecture models, security management models.

Security management practices: benchmarking, performance management.

Unit IV: Risk management: identifying and assessing risk-risk management, identification, assessment.

Controlling risk: risk control strategies, managing risk.

Unit- V: Production mechanism: access control, firewalls, intrusion detection and prevention systems, remote access protection, wireless networking protection, scanning and analysis tools, cryptography.

Reference Books:

1. Management of Information Security, 4th Edition, 2014, Michael E. Whitman and Herbert J. Mattord.
2. "Principles of Information Security", Michael E. Whitman and Herbert J. Mattord, Vikas Publishing House, New Delhi, 2003.
3. Information Security Management Principles, Andy Taylor, 2nd edition, 2013.
4. Fundamentals of Information Systems Security, by David Kim, Jones & Bartlett Learning, 3rd Edition, 2018.

CSP5: LAB: Python Programming (5 Hours – 3 Credit)

Section A

1. Write a program to find sum of digits using functions.
2. Write a program to find whether the given number is an Armstrong number or not.
3. Write a program that accepts a string from user and displays the same string after removing vowels from it.
4. Write a program that randomly generates a number. Raise a user-defined exception if the number is below 0.1.
5. Write a program to calculate number of days between two dates.
Sample dates: (2014, 7, 2), (2014, 7, 11). Expected output : 9 days.
6. Write a program to add two binary numbers.
7. Write a Python program for binary search.
8. Write a Python program to count repeated characters in a string.
Sample string: 'the quick brown fox jumps over the lazy dog'
Expected output :
 - o 4
 - e 3
 - u 2
 - h 2
 - r 2
 - t 2
9. Write a program to draw a pattern of straight lines.

Section B

1. Write a program to generate a Fibonacci sequence and store it in a list. Then find the sum of the even-valued terms.
2. Write a program that generates a set of prime numbers and another set of odd numbers. Demonstrate the result of Union, Intersection, Difference, and symmetric difference operations on these sets.
3. Write a program to remove all duplicates from a list.
4. Write a program to find the median of a list of numbers.
5. Write a program that prints a histogram of frequencies of characters occurring in a message.
6. Write a program that copies one Python script into another in such a way that all comment lines are skipped and not copied in the destination file.
7. Write a program to draw a pattern of different color squares with different angles.

Section C

1. Write a menu-driven program that keeps record of books and journals available in a library.

2. Write a program that has a class Person. Inherit a class Faculty from Person which also has a class Publication.
3. Write a program that has a class store which keeps a record of code and price of each product. Display a menu of all products to the user and prompt him to enter the quantity of each item required. Generate a bill and display the total amount.
4. Write a program that has a class student that stores roll number, name and marks (in three subjects) of the students. Display the information (roll number, name and total marks) stored about the student.
5. Write a program that overloads the + operator so that it can add a specified number of days to a given date.

CSP 6: LAB: Mobile Computing (5 Hours – 3 Credits)

1. Develop an application that uses Layout Managers.
2. Develop an application that uses event listeners.
3. Develop an application that uses Adapters, Toast.
4. Develop an application that makes use of database.
5. Develop an application that makes use of RSS Feed.
6. Implement an application that implements Multi threading.
7. Develop a native application that uses GPS location information.
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message.
10. Develop a game application.

ESII – ELECTIVE - II ES21: Soft Computing (4 Hours – 4 Credits)

Unit- I : Architectures: ANN: Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning – Single layer – Multilayer feedforward network – Learning algorithm – Back propagation network.

Unit- II: Neural Networks for Control: Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network – Process identification – Neuro controller for inverted pendulum.

Unit- III: FUZZY SYSTEMS: Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules – Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system – Adaptive fuzzy system.

Unit- IV: Application of Fuzzy Logic Systems: Fuzzy logic control: Home heating system – liquid level control – aircraft landing – inverted pendulum – fuzzy PID control, Fuzzy based motor control.

Unit- V: Genetic Algorithms: Introduction – Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representations schemes, selection methods, crossover and mutation operators for binary and real coding – constraint handling methods – applications to economic dispatch and unit commitment problems. CASE STUDY: study and discuss hybrid soft computing.

Reference Books:

1. Laurance Fauset, Englewood cliffs, N.J., Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, 1997.
3. S.N. Sivanandam and S.N. Deepa, Principles of Soft Computing, Wiley India Edition, 2nd Edition, 2013.
4. Simon Haykin, Neural Networks", Pearson Education, 2003.
5. John Yen & Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003
6. Hagan, Demuth, Beale, "Neural Network Design", Cengage Learning, 2012.
7. N.P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford, 2013.
8. William S. Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.

ES22: Network Programming (4 Hours – 4 Credits)

Unit- I : Introduction: UNIX Architecture – Logging In – Files and Directories – Input and Output – Programs and Processes – Error handling – User Identification – Signals – Time values – System Calls and Library functions – Standards and Implementation: UNIX Standardization – Implementations – Limits – Process Environment: main() – Process termination – Command line arguments – Environment list and variables, Process Control: Identifiers – fork(), vfork(), exit(), wait().

Unit- II: Exec, fork, tcps, Changing User IDs and Group IDs – System function – Process accounting – User identification – Process times, Process relationships: Terminal logins – Network logins – Process groups – Sessions – Controlling terminals – tcgetpgrp() – Job control – Shell execution of programs – Orphaned process groups. Daemon Processes: Characteristics – Coding rules.

Unit- III: SOCKET introduction: Socket address structure – Byte ordering and manipulation functions – Address conversion functions. Elementary TCP sockets: Introduction – socket, connect, bind, listen, accept, close functions – Concurrent server – Server host crashes, rebooting and shut down. I/O multiplexing: I/O models – select() – shutdown() – poll().

Unit- IV: Socket options: getsockopt() and setsockopt() – Generic socket options – IP socket options (IPv4 and IPv6) – ICMP socket options – TCP socket options. Elementary UDP sockets: recvfrom and sendto functions – Lost datagrams – Verifying received response – Server not running – connect() with UDP – Lack of flow control – Determining outgoing interface – TCP and UDP echo server using select() – DNS – gethostbyname() – gethostbyaddr() – getservbyname() and getservbyport().

Unit- V: IPv4 and IPv6 interoperability – Routing sockets – Key management sockets: Reading and Writing – SADB – SA – Maintaining SAs – Broadcasting: Address – Unicast Vs Broadcast – Multicasting: Multicast Vs Broadcast – Multicasting on LAN – Multicasting on WAN – Threads: Creation and termination – Raw sockets: Creation – Input – Output – ping program – trace route program.

Reference Books:

1. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX Environment", Second Edition, Pearson Education, New Delhi, 2007.
2. W. R. Stevens, B. Fenner, A. M. Rudoff, "UNIX Network Programming" Volume I, Third Edition, PHI Private Ltd, New Delhi, 2005.
3. Sumitabha Das, "Your UNIX the ultimate Guide", Tata McGraw Hill, 2002.

4. Ashok Arora, S. Bansal, "UNIX and C Programming" First edition, Firewall Media, 2005.

ES23: Optimization Techniques (4 Hours – 4 Credits)

Unit- I: Introduction to O.R – Linear Programming Problem formulation – Graphical Method – Simplex Method – Big M-method – Duality – Dual Simplex Method.

Unit- II : Transportation problems – Vogel's approximation method – MODI method – Assignment Problem – Travelling salesman problem.

Unit- III : Game theory – Two persons zero sum game – game with and without saddle point – solution of 2x2 game – dominance – Graphical Method. Networks scheduling – Critical path – CPM – PERT. PERT algorithm – Time cost optimization algorithm – resource allocation and scheduling.

Unit- IV: Inventory problems – Deterministic Model – EOQ Model with uniform demand – Production Inventory Model – Inventory model with planned shortages and inventory model with quantity discounts. Probabilistic inventory model – Inventory systems – Safety stock – reorder level – reorder point determination.

Unit- V: Queueing Theory – Poisson and Exponential distribution – Birth-Death process – Queues with combined arrivals and departures – Steady state measures – Specialised Poisson Queues including Multiple servers and /or finite waiting hall.

Reference Books:

1. Operations Research – Kanti Swarup, P.K. Gupta and Manmohan – Sultan Chand and Sons 2009.
2. Operation Research, S. D. Sharma, Kedar Nath Ram Nath & Co, 2004.
3. Linear Programming, Dr. S. Arumugam, A. Thangapandi Isaac, New Gamma Publication, 2010.
4. Operations Research, T. Veerarajan, University Press, 2017.
5. Optimization Techniques in Operation Research, C.B. Gupta, I.K. International Pvt Ltd, 2008
6. Optimization Techniques, Chander Mohan, Kusum Deep, New Age Science, 2009.

ES24: Big Data Analytics (4 Hours – 4 Credits)

Unit-I: **Introduction to Big Data:** Introduction to Big Data Platform – Challenges of Conventional Systems – Intelligent data analysis – Nature of Data – Analytic Processes and Tools – Analysis vs Reporting – Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re-Sampling – Statistical Inference – Prediction Error.

Unit- II: Mining Data Streams: Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window – Realtime Analytics Platform (RTAP) Applications – Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

Unit- III : Hadoop Environment:History of Hadoop-The Hadoop Distributed File System-Components of Hadoop-Analyzing the Data with Hadoop-Scaling Out-Hadoop Streaming-Design of HDFS-Hadoop file systems-Java interface to HDFS-Basics-Developing a MapReduce Application-How MapReduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort-Task execution-MapReduce Types and Formats-MapReduce Features-Setting up a Hadoop Cluster-Cluster specification - Cluster Setup and Installation- Hadoop Configuration-Security in Hadoop.

Unit- IV: Data Analysis Systems and Visualization:Link Analysis-PageRank-Efficient Computation of PageRank-Topic-Sensitive PageRank-Link Spam-Recommendation Systems-A Model for Recommendation Systems-Content-Based Recommendations-Collaborative Filtering-Dimensionality Reduction-Visualizations-Visual data analysis techniques-interaction techniques-Systems and applications.

Unit- V: Frameworks and Applications:IBM for Big Data-Framework -Hive -Sharding-NoSQL Databases-MangoDB-Cassandra-Hbase-Impala-Analyzing big data with twitter - Big data for Ecommerce - Big data for blogs.

Reference Books:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill Publishing, 2012.
3. DaRuan, Guoqing Chen, Etienne E. Kerre, Geert Wets, Intelligent Data Mining, Springer, 2007.
4. Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
5. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
6. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
7. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007
8. Michael Minelli, Michele Chambers, Ambiga Dhiraj, Big Data, Big Analytics: Emerging Business Int
9. Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012.
10. Pete Warden, "Big Data Glossary", O'Reilly, 2011.
11. Tom White "Hadoop: The Definitive Guide" Fourth Edition, O'Reilly Media, 2015.
12. Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011.

IV SEMESTER CS 14: Cloud Computing (4 Hours-4 Credits)

Unit- I: Distributed Systems Models and Enabling Technologies: Scalable Computing-Technologies for Network-Based Systems-System Models for Distributed and Cloud Computing-Software Environments for Distributed and Clouds-Performance, Security and Energy Efficiency.

Unit- II: Virtualization concepts: Implementation Levels of Virtualization – Virtualization Structures-Tools and Mechanisms – Virtualization of CPU, Memory and I/O Devices – Virtual Clusters and Resource Management – Virtualization for Data-Center Automation, Introduction to Various Virtualization OS- Vmware, KVM, Xen.

Unit- III: Service-Oriented Architecture for Distributed Computing: Services and SOA – Message-Oriented Middleware – Portals and Science Gateways – Discovery-Registries-Metadata -Workflow in SOA.

Unit- IV: Cloud Computing and Service Models – Data-center Design and Interconnection Networks – Architectural Design of Compute and Storage Clouds – Public cloud Platforms – Inter-cloud Resource Management – Cloud Security and Trust Management.

Unit- V: Cloud Programming and Software Environments – Features of Cloud and Grid Platforms – Parallel and Distributed Paradigms – Programming Support of Google App Engine – Amazon AWS and Microsoft Azure -Emerging Cloud Software Environments.

Reference Books:

1. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing", Elsevier India Private Limited, 2012.
2. Foster and Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", Morgan Kaufmann publishers Inc. 2004
3. Coulouris, Dollimore and Kindber, "Distributed System: Concept and Design", Fifth Edition, Addison Wesley, 2011.
4. Michael Miller, "Cloud Computing", Dorling Kindersley India, 2009.
5. Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, "Cloud computing: A practical Approach", McGraw Hill, 2010.

EES: Project Work and Viva-Voce (12 Credits)

(Industry/Institutional based)

Six Months internal/external project work with submission of project work and viva-voce examination.

Students will be able to :

1. Implement the solution for the chosen problem using the concepts and techniques in the curriculum.
2. Record the research to the development process of a particular problem.

ES III – ELECTIVE III

ES31: Software Project Management (4 Hours – 4 Credits)

UNIT-I : Introduction to Software Project Management : Introduction - Definition of Project – Comparison of projects – Activities – Plans, Methods and Methodologies – Categorization – Stakeholders - Setting Objectives - The business case - What is Management – Management control – Traditional versus Modern Project management Practices.

Project Evaluation & Programme Management : Introduction – Project Portfolio Management – Evaluation of individual project – Cost-benefit Evaluation techniques – Risk evaluation – Programme management - Allocation of resources – Strategic Program management – Creating a Programme – Aids to management – Benefits management.

UNIT – II : Overview of Project planning : Steps of Project Planning.

Selection of an appropriate project approach : Introduction – build or buy – Choosing Methodologies and technologies – Software Process and Process Models – Choice of process models – Structure versus speed of delivery.

Activity Planning : Objectives – When to plan – Project Schedules – Projects & activities – Sequencing & scheduling – Network Planning Models - Formulating a Network model - Adding Time dimensions – Forward & Backward pass – Identifying Critical path – Activity float.

UNIT –III : Risk Management : Risk – Categories of risk – Framework for Risk – Risk Identification – Assessment, planning, Management – Evaluating risks to the schedule – Applying the PERT technique – Monte Carlo Simulation – Critical chain concepts.

Resource Allocation : Nature of Resources – Identifying resource requirements – Scheduling Resources – Creating Critical paths – Counting the cost – Being Specific – Publishing the resource schedule - Cost schedule – The scheduling sequence.

UNIT – IV : Monitoring and Control : Creating Framework - Collecting the data– Review – Project Termination Review - Visualizing the progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Change Control.

Managing people in Software Environments : Introduction – Understanding behaviour – Organizational behaviour – Selection of people – Instruction in the best methods –Motivation – Job Characteristics model – Stress – Health and safety.

UNIT – V:Working in teams : Becoming a team – Decision making – Organizational structures – Coordination dependencies – Dispersed & Virtual teams – Communication plans – Leadership.

Software Quality : The place of software quality in project planning - Definition of Software Quality – Importance – ISO 9126 – Product and Process Metrics - Product versus Process Quality Management – Quality management systems – Process capability models - Techniques to enhance quality – Testing – Software reliability - Quality plans.

Text Books :

1. Bob Hughes and Mike Cotterell, Software Project Management, Fifth Edition, Tata McGraw Hill Edition 2015.
Unit I : Chapters 1, 2
Unit II : Chapters 3, 4.1 – 4.6, 6.1 – 6.13
Unit III : Chapters 7, 8
Unit IV : Chapters 9.1 – 9.12, 11
Unit V : Chapters 12, 13

Reference Books :

1. Pankaj Jalote, Software Project Management in Practice, Pearson Education Edition 2008.
2. Joel Henry, Software Project Management, Pearson Education.
3. Walker Royce, Software Project Management, Pearson Education, 2005.

ES32:InternetofThings(4 Hours–4Credits)

Unit-I: **IntroductiontoIoT:**InternetofThings-PhysicalDesign-LogicalDesign-IoT EnablingTechnologies-IoTLevelsand DeploymentTemplates-DomainSpecificIoTs-IoTandM2M-IoTSystemManagementwithNETCONF-YANG-IoTPlatforms Design Methodology.

Unit- II: **IoTArchitecture:**M2Mhigh-levelETSIarchitecture-IETFarchitectureforIoT- OGCarhitecture-IoTreferencemodelDomainmodel-informationmodel-functional model - communication model-IoT reference architecture.

Unit- III: IoTProtocols:ProtocolStandardizationforIoT–Efforts–M2MandWSN Protocols– SCADAandRFIDProtocols–UnifiedDataStandards–Protocols–IEEE 802.15.4– BACNetProtocol–Modbus–ZigbeeArchitecture–Networklayer–6LowPAN - CoAP – Security.

Unit- IV: BuildingIotwithRaspberryPI&Arduino:BuildingIOTwithRASPERRYPI- IoTSystems-LogicalDesignusing Python–IoTPhysicalDevicesEndpoints-IoT Device- Buildingblocks-RaspberryPi-Board-LinuxonRaspberryPi-RaspberryPiInterfaces- ProgrammingRaspberryPi with Python- OtherIoT Platforms- Arduino.

Unit- V: CaseStudiesandReal-WorldApplications:Realworlddesignconstraints- Applications-Assetmanagement,Industrialautomation,smartgrid,Commercialbuilding automation,Smartcities-participatorysensing-DataAnalyticsforIoT–Softwareand ManagementToolsforIoTCloudStorage Models&CommunicationAPIs-CloudforIoT-Amazon Web Services forIoT.

ReferenceBooks:

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Jan Ho'ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things- Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

ES33:MachineLearning(4 Hours–4Credits)

Unit-I : **Introduction:**MachineLearning-MachineLearningFoundations–Overview– applications-Typesofmachinelearning-basicconceptsinmachinelearningExamplesof MachineLearning-Applications–LinearModelsforRegression-LinearBasisFunction Models- TheBias-VarianceDecomposition-BayesianLinearRegression-BayesianModel Comparison.

Unit- II: Supervised Learning: Linear Models for Classification-Discriminant Functions- Probabilistic Generative Models- Probabilistic Discriminative Models- Bayesian Logistic Regression. Decision Trees—Classification Trees-Regression Trees-Pruning. Neural Networks- Feed-forward Network Functions- Error Backpropagation- Regularization- Mixture Density and Bayesian Neural Networks- Kernel Methods- Dual Representations- Radial Basis Function Networks. Ensemble methods- Bagging- Boosting.

Unit- III: Unsupervised Learning: Clustering-K-means-EM-Mixtures of Gaussians-The EM Algorithm in General- Model selection for latent variable models-high-dimensional spaces-- The Curse of Dimensionality—Dimensionality Reduction-Factor analysis-Principal Component Analysis- Probabilistic PCA-Independent components analysis.

Unit- IV: Probabilistic Graphical Models: Directed Graphical Models-Bayesian Networks- Exploiting Independence Properties—From Distributions to Graphs-Examples-Markov Random Fields-Inference in Graphical Models—Learning—Naive Bayes classifiers-Markov Models—Hidden Markov Models—Inference—Learning-Generalization—Undirected graphical models-Markov random fields-Conditional independence properties- Parameterization of MRFs-Examples-Learning-Conditional random fields (CRFs)-Structural SVMs.

Unit- V: Advanced Learning: Sampling—Basic sampling methods—Monte Carlo. Reinforcement Learning-K-Armed Bandit-Elements-Model-Based Learning- Value Iteration- Policy Iteration. Temporal Difference Learning-Exploration Strategies- Deterministic and Non-deterministic Rewards and Actions-Eligibility Traces- Generalization-Partially Observable States-The Setting-Example.Semi-Supervised Learning.Computational Learning Theory-Mistake bound analysis,sample complexity analysis, VC dimension.Occam learning, accuracy and confidence boosting.

Reference Books:

- 1.Christopher Bishop, “Pattern Recognition and Machine Learning”Springer, 2006.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
5. Hastie, Tibshirani, Friedman, “The Elements of Statistical Learning”(2nd ed)., Springer, 2008.
6. Stephen Marsland, “Machine Learning—An Algorithmic Perspective”, CRC Press, 2009.

ES34: Computational Intelligence(4 Hours—4 Credits)

Unit- I: Introduction to Computational Intelligence: Evolution of Computing— Introduction to Artificial Intelligence— Turing test- Propositional and Predicate Calculus - Expert system—Introduction—MYCIN—PROSPECTOR—Robotics—From Conventional AI to Computational Intelligence—Issues in Artificial Intelligence-Machine Learning Basics— Intelligence of ants-Artificial Life—BOTS—Comparison of various expert systems.

Unit- II: Knowledge Representation Methods: Introduction—rough sets—set approximation—analysis of decision tables—Application of LERS software—Type-1 fuzzy sets— definition—basic operations on fuzzy sets—The extension principle— Triangular norms and negations— Fuzzy Relations—Approximate reasoning—fuzzy Inference systems—Application of fuzzy sets—

Type-2 fuzzy sets–Footprint of uncertainty–basic operations on fuzzy sets–Type-2 fuzzy relations–Type reduction– type2 fuzzy Inference systems– Comparison of Fuzzy Inference systems.

Unit– III : Neural Networks and Learning Algorithms: Machine learning using Neural Network, Adaptive Networks–Feed Forward Networks Defuzzification–Supervised Learning Neural Networks–backpropagation Algorithm–Levenberg-Marquardt algorithm – Recurrent neural networks–BAM networks-Radial Basis Function Networks- Reinforcement Learning–Unsupervised Learning Neural Networks–Adaptive Resonance Architectures – Case Study: Neural Network explanation facility.

Unit- IV: Data Clustering Methods and Algorithms: Introduction–Hard and fuzzy partitions– Distance Measures–Hard C-Means algorithm–Fuzzy C-Means algorithm– Possibilistic C-Means algorithm-Fuzzy Maximum Likelihood Estimates (FMLE) algorithm–Neuro Fuzzy systems- Mamdani Fuzzy Model–modelling problems--Logical type-Takagi–Sugeno-Kang Fuzzy Model– comparison of neuro–fuzzy systems –Model evaluation criteria, complexity. Fuzzy Expert Systems– Fuzzy Decision Making– Casestudy: EEG spike detection.

Unit- V: Evolutionary Computation and Neuro-Fuzzy Systems: Evolutionary computation – GA–Particle Swarm Optimization–Ant colony Optimization–Artificial Immune Systems–Honey-Bee Optimization–Memetic Algorithms-Optimization problems–TSP, JSSP- evolutionary algorithms–Flexible neuro–fuzzy systems–Introduction–soft triangular norms– Parameterized triangular norms–Adjustable triangular norms–Flexible systems– Learning algorithms–Simulation examples–Hybrid Techniques-Neuro-Fuzzy Control – Casestudy: Evolutionary medical diagnosis.

Reference Books:

1. A.E. Eiben and J.E. Smith “Introduction to Evolutionary Computing” Springer, 2003.
2. Andries Engelbrecht, Computational Intelligence: An Introduction, 2007.
3. Amos Gilat, “MATLAB: “An introduction with applications”, John Wiley & Sons Inc, 2011.
4. David E. Goldberg, “Genetic Algorithms in Search, Optimization and machine Learning”, Addison Wesley, 2007.
5. Elaine Rich, Kevin Knight, Shiva Shankar B. Nair, “Artificial Intelligence”, Tata McGraw Hill Ltd, 2008.
6. E. Sanchez, T. Shibata, and L. A. Zadeh, Eds., "Genetic Algorithms and Fuzzy Logic Systems: Soft Computing Perspectives, Advances in Fuzzy Systems-Applications and Theory", Vol. 7, River Edge, World Scientific, 1997.
7. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995.
8. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
9. Kwang H. Lee, “First course on Fuzzy Theory and Applications”, Springer– Verlag Berlin Heidelberg, 2005.
10. Kaluza, B. INSTANT Weka How-to, Packt Publishing, 2013.
11. Leszek Rutkowski, “Computational Intelligence–Methods and Techniques”, Springer, 2008.
12. Mitsuo Gen and Runwei Cheng, “Genetic Algorithms and Engineering Optimization”, Wiley, Publishers 2000
13. Mitchell Melanie, “An Introduction to Genetic Algorithm”, Prentice Hall, 1998.
14. Ross Timothy J, Fuzzy Logic with Engineering Applications, Wiley India Pvt Ltd, New Delhi, 2010.

III SEMESTER –NON MAJOR ELECTIVE
NME Problem Solving and Programming in C
(5 Hours – 5 Credits)

Unit - I: Introduction to Computer Problem Solving:

Introduction – The Problem Solving aspect – Top down design – Implementation of algorithm – Program Verification – The efficiency of algorithms – The analysis of algorithms – Fundamental algorithms.

Unit - II: Programming and algorithms: Programs and Programming – building blocks for simple programs -pseudo code representation – flow charts - Programming Languages - compiler –Interpreter, Loader and Linker - Program execution – Classification of Programming Language - Structured Programming Concept.

Unit - III:Basics of “C”, Input / Output and Control Statements: Introduction- Identifier – Keywords - Variables – Constants – I/O Statements - Operators - Initialization – Expressions - Expression. Evaluation – Lvalues and Rvalues – Type Conversion in C – Formatted input and output functions - Specifying Test Condition for Selection and Iteration- Conditional Execution and Selection – Iteration and Repetitive Execution- go to Statement – Nested Loops- Continue and break statements.

Unit - IV: Arrays, Strings, Functions and Pointers: Array – One dimensional Character Arrays Multidimensional Arrays- Arrays of Strings – Two dimensional character array functions - parameter passing mechanism scope – storage classes – recursion - comparing iteration and recursion- pointers – pointer operators - uses of pointers- arrays and pointers – pointers and strings - pointer indirection- pointers to functions - Dynamic memory allocation.

Unit- V: User-Defined Data types and Files: Structures – initialization - nested structures – structures and arrays – structures and pointers - union– type def and enumeration types - bit fields - File Management in C – Files and Streams – File handling functions – Sequential access file- Random access file – Command line arguments.

Reference Books:

1. How to Solve it by Computer, R.G.Dromey, Pearson education , Fifth Edition,2007.
2. ReemaThareja, “Programming in C”, Oxford University Press,2011.
3. PradipDey, Manas Ghosh, —Computer Fundamentals and Programming in C, Second Edition, Oxford University Press,2013.
4. Byron S Gottfried, —Programming with C|| , Schaums Outlines, Second Edition, Tata McGraw Hill,2006.
5. BrianW. Kernighan and Dennis M. Ritchie, “The C programming Language”,2006, Prentice Hall.
6. Cormen, Leiserson, Rivest, Stein, “ Introduction to Algorithms”, McGraw Hill, Publishers,2002.
7. Deitel and Deitel, “C How to Program”, Pearson Education. 2013,7thEdition.
8. Kamthane, A.N., “Programming with ANSI and Turbo C”, Pearson Education, Delhi,2006.
9. Mastering C- by K R Venugopal ,Sudeep R Prasad McGraw Hill Education

(India) Private Limited; Second edition 2015.
10. Yashavant Kanetkar, "Understanding Pointers In C", 4th Revised & Updated Edition, 2011, BPB Publications. Unleashed Tech media SAMS.
