APPENDIX - CL
MADURAI KAMARAJ UNIVERSITY
(University with Potential for Excellence)
Master of Computer Applications (M.C.A)
(CBCS – Semester Pattern)
Revised Syllabus
REGULATIONS AND SCHEME OF EXAMINATIONS
(With effect from the Academic Year 2018-2019 onwards)

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 every day.

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

Duration of the Programme	:	**3 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 system 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

M.C.A Computer Application programme consists of number of Subjects. The following are the various categories of the courses suggested for M.C.A Computer Application programme.

- Core Subjects (CS) – 15
- Elective Subjects (ES) – 3
- Foundation course (FS) - 2
- Practical subjects

6 Subject Elective Papers

The University shall provide all information related to the Elective Subject in M.C.A Computer Application 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 Non – Major subject Elective Papers
   As per AICTE Guidelines-NILL

8 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.

9 Pattern of semester exam

See Appendix - PCA2

10 Scheme for Internal Assessment

See Appendix - PCA2

11 External Exam

See Appendix - 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 examinations 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.

12 Question Paper Pattern

See Appendix - 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.

A mark statement with

$$CCPA = \frac{\sum(Marks \times Credits)}{\sum(Credits)}$$

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

14   Passing Minimum

A candidate passes the M.C.A., Computer Application 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 / PPT 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 retotaling 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 scheme may be permitted to write exams in their own schemes up to the examinations of April 2020 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**

Appendix – PCA1

Subject/Structure of Course Study

Semester	Subjects							Total Hours	Total Credits
I	FS1(4) [4]	CS1(4) [4]	CS2(5) [5]	CS3(5) [5]	CS4(5) [3]	CS5(5) [3]	EES1(2) [1]	30	25
II	FS2(4) [4]	CS6(5) [4]	CS7(5) [5]	CS8(5) [5]	CS9(5) [3]	CS10(5) [3]	EES2(2) [1]	30	25
III	CS11(4) [4]	ES1(4) [4]	CS12(5) [5]	CS13(5) [5]	CS14(5) [3]	CS15(5) [3]	EES3(2) [1]	30	25
IV	CS16(4) [4]	ES2(5) [4]	CS17(5) [5]	CS18(5) [5]	CS19(5) [3]	CS20(5) [3]	EES4(2) [1]	30	25
V	CS21(4) [4]	ES3(5) [4]	CS22(5) [5]	CS23(5) [5]	CS24(5) [3]	CS25(5) [3]	EES5(2) [1]	30	25
VI	EES6 [15]								15
Total								**150**	**140**

Abbreviations:
- ( ) – Number of Hours
- [ ] – Number of Credits
- FS – Foundation Subject
- CS - Core Subject
- EES - Enhanced Employability Subject
- ES - Elective Subject

I SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	FS1	Mathematical Foundations of Computer Applications	4	4	25	75
2	CS1	Digital Fundamentals and Computer Architecture	4	4	25	75
3	CS2	Problem Solving and Programming in C	5	5	25	75
4	CS3	Relational Database Management Systems	5	5	25	75
5	CS4	LAB: Programming in C	5	3	40	60
6	CS5	LAB: Relational Database Management Systems	5	3	40	60
7	EES1	LAB:Communication Skill	2	1	40	60
		Total	30	25		

II SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	FS2	Optimization Techniques	4	4	25	75
2	CS6	Operating Systems	4	4	25	75
3	CS7	Object Oriented Programming and Design	5	5	25	75
4	CS8	Data Structures and Computer Algorithms	5	5	25	75
5	CS9	LAB: Object Oriented Programming using C++	5	3	40	60
6	CS10	LAB: Data Structures and Computer Algorithms	5	3	40	60
7	EES2	LAB: PHP Programming	2	1	40	60
		Total	30	25		

III SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS11	Data Communication and Computer Networks	4	4	25	75
2	ES1	Elective	4	4	25	75
3	CS12	Java Programming	5	5	25	75
4	CS13	Data Warehousing and Mining	5	5	25	75
5	CS14	LAB: Java Programming	5	3	40	60
6	CS15	LAB: Data Mining	5	3	40	60
7	EES3	LAB: Animation skill	2	1	40	60
		Total	30	25		

IV SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS16	Software Engineering	4	4	25	75
2	ES2	Elective	4	4	25	75
3	CS17	Dot Net	5	5	25	75
4	CS18	Network Programming	5	5	25	75
5	CS19	LAB: Dot Net	5	3	40	60
6	CS20	LAB: Network Programming	5	3	40	60
7	EES4	Mini Project and Report writing	2	1	40	60
		Total	30	25		

V SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	CS21	Information Security	4	4	25	75
2	ES2	Elective	4	4	25	75
3	CS22	Mobile Computing	5	5	25	75
4	CS23	Web Technology	5	5	25	75
5	CS24	LAB: Mobile Computing	5	3	40	60
6	CS25	LAB: Web Technology	5	3	40	60
7	EES5	LAB: Python Programming	2	1	40	60
		Total	30	25		

VI SEMESTER

S No	Code	Subject	Hours	Credits	Internal Marks	External Marks
1	EES6	Project Work and Viva Voce (Industry / Institutional based)		15	40	60
		Total		15		

Elective Subjects

S.No	Code	Subject	Hours	Credits	Int Marks	Ext Marks
1	ES11	Computer Graphics and Multimedia	4	4	25	75
2	ES12	Accounting and Financial Management	4	4	25	75
3	ES13	Compiler Design	4	4	25	75
4	ES14	Cloud Computing	4	4	25	75
5	ES21	Soft Computing	4	4	25	75
6	ES22	Computational Intelligence	4	4	25	75
7	ES23	Digital Image Processing	4	4	25	75
8	ES24	Big Data Analytics	4	4	25	75
9	ES31	Artificial Intelligence	4	4	25	75
10	ES32	Internet of Things	4	4	25	75
11	ES33	Machine Learning	4	4	25	75
12	ES34	Software Testing and Quality Assurance	4	4	25	75

Appendix – 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 10Marks	i. Part - A (10*1)	10 Marks
ii. Assignment 10 Marks	ii.Part – B (5*7)	35Marks
iii. Seminar /	iii.Part – C (3*10)	30 Marks
Group discussion 5 Marks	**Total**	**75 Marks**
iv.Peer-Team-Teaching 5 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:	5	iii. Debugging :	15
		iv. Results :	10
Total:	**40**	v. Viva:	10
		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: 60 Marks))

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 DesignReview: 7.5 Marks Implementation and Validation Review: 7.5 Marks Final Review : 10.0 Marks Overall Performance: 10.0 Marks **Total 40.0 Marks**	i. Project Report: 20 Marks ii. Project demo & Presentation : 30 Marks iii.Viva-Voce : 10 Marks **Total 60 Marks**

Appendix – PCA3
(Detailed Syllabus)

FS 1: 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, CompatibilityRelations, Partial Ordering;
Elementary Combinatorics: Basis of counting, Enumeration of Combinatins& Permutations, Enumeration of Combinations & 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, Multi graphs 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 Mathematical for computer Scientists & Mathematicians, Molt, Kandel, Baker, PHI
3. T.Veerarajan- Probability, Statistics and Random process (Third edition), TMH
4. Sundarapandian- Prabability, Statistics and Queueing theory, PHI
5. PurnaChandriaBiswal – Probability and Statistics, PHI
6. Elements of Discrete Mathematics, C.I.Liu, D P Mohanpatra, TMH
7. Discrete Mathematical Structures, Kolman, Busby, Ross, 6th ed. PHI, 2009

CS 1: Digital Fundamentals and Computer Architecture
(4 Hours – 4 Credits)

Unit I:

Number Systems - Binary Arithmetic - Boolean algebra - Map Simplifications - Gates - Combinational Circuits - Sequential Circuits.

Unit II:

Memory: Internal - External - Memory Organization - Associative - Cache – Virtual memory.

Unit III:

CPU: Arithmetic And Logic Unit - Instruction Sets - RISC - CISC - Instruction pipeline -Addressing modes and formats - Register organization - Control Unit Operation - Processor organization.

Unit IV:

External Devices: I/O modules - Programmed I/O - Interrupt Driven I/O - Direct Memory Access - I/O Channels - Asynchronous Data Transfer.

Unit V:

Processors: Parallel – Multi-core – Mobile – Embedded - Cloud computing.

Reference Books:
1. M. Morris Mano, Michael D. Ciletti, "Digital Design", 5th Edition, Pearson Education, 2013.
2. William Stallings, "Computer Organization and Architecture", 9th Edition, PHI,2012
3. Hennessy J. and Patterson D., "Computer Architecture: A Quantitative Approach", 5th Edition, Morgan Kaufmann, 2011.
4. Mile Murdocca, Vincent Heuring, " Computer Architecture and Organization", John Wiley &Sons, 2007.
5. Sivarama P Dandamudi "Fundamentals of Computer Organization and Design", Wiley DreamTech Publishers, 2003
6. G.V.Anjaneyulu, "Computer Organization", Himalaya Publishing House.

CS 2: Problem Solving and Programming in C
(5 Hours – 4 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 andalgorithms: 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 & 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 & 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. 2013,7th Edition.
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. YashavantKanetkar, "Understanding Pointers In C", 4th Revised & Updated Edition, 2011, BPB Publications.

CS 3: Relational Database Management Systems
(5 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. Raghu Ramakrishnan and Johannes Gehrke, "Data Base Management Systems", 3rd Edition, McGraw-Hill, 2014.

2. Raghu 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", 5thEdition, 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 2008

CS 4: LAB: Programming in C
(5 Hours – 3 Credits)
Section A

Develop programs for simple problems
1. Write a C Program (WCP) to find the sum of digits
2. WCP to check whether a given number is Armstrong or not

3. WCP to check whether a given number is Prime or not
4. WCP to generate the Fibonacci series
5. WCP to display the given number is Adam number or not
6. WCP to print reverse of the given number and string
7. WCP to find minimum and maximum of 'n' numbers using array
8. WCP to arrange the given number in ascending order
9. WCP to add, subtract and multiply two matrices
10. WCP to calculate NCR and NPR

Section B

Develop programs for complex problems applying the concepts of Arrays and pointers.

1. WCP to find the grade of a student using else if ladder
2. WCP to implement the various string handling function
3. WCP to create an integer file and displaying the even numbers only
4. WCP to calculate quadratic equation using switch-case
5. WCP to implement the various string handling function

Section C

Develop programs for complex problems applying the concepts of structures and files.
1. WCP to generate student mark list using array of structures
2. WCP to create and process the student mark list using file
3. WCP to create and process pay bill using file
4. WCP to create and process inventory control using file
5. WCP to create and process electricity bill using file

CS 5: LAB: Relational Database Management Systems
(5 Hours – 3 Credits)

Relational Database Schema - COMPANY
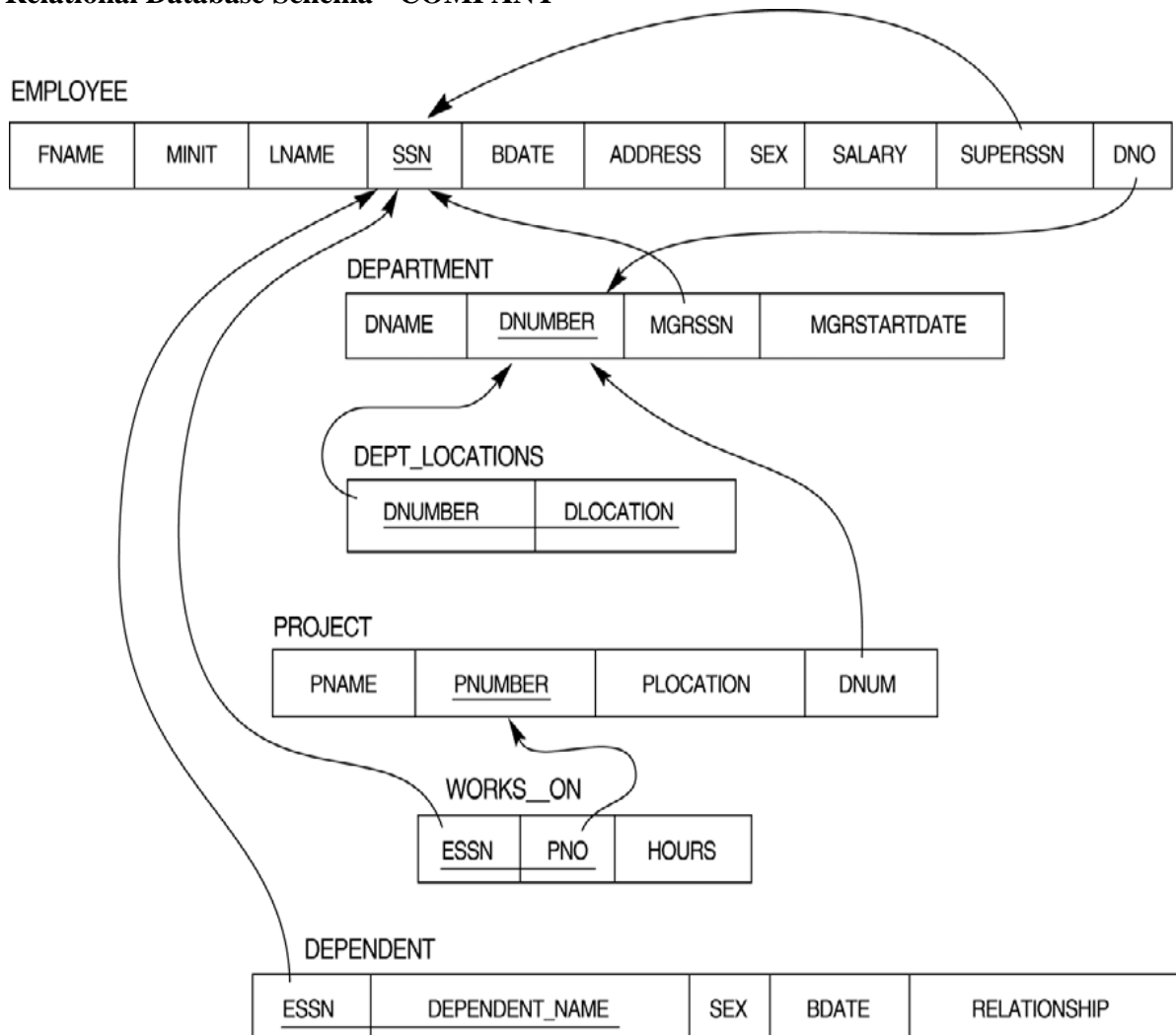
A. Create tables with relevant foreign key constraints

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'

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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
11. Retrieve the name and address of all employees who work for the 'Research' department
12. For every project located in 'Stafford', list the project number, the controlling department number, and the department manager's last name, address, and birthdate.
13. For each employee, retrieve the employee's name, and the name of his or her immediate supervisor.
14. Retrieve all combinations of Employee Name and Department Name
15. 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.
16. Increase the salary of all employees working on the 'ProductX' project by 15%. 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. Writ 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.
      2. Reading Comprehension: Filling in the blanks - Close exercises– Vocabularybuilding - Reading and answering questions.
      3. Speaking: Phonetics: Intonation–Ear training - Correct Pronunciation–Sound recognition exercises – Common Errors in English. Conversations: Face to Face Conversation – Telephone conversation– Role play activities

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

1. **Resume / Report Preparation / Letter Writing** (1)
   Structuring the resume / report - Letter writing / Email Communication - Samples.
2. **Presentation skills:** (1)
   Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples
3. **Soft Skills:**(2)
   Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples
4. **Group Discussion:** (1)
   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:** (1)
   Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews-Video samples.

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

1. **Resume / Report Preparation / Letter writing**:
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 – individualpresentation 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 - mock GD.
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

FS 2: 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 2 x 2 game – dominance – Graphical Method. Network 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. Probalilistic 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 – KantiSwarup, P.K. Gupta and Manmohan – Sultan Chand and Sons 2009.
2. Operation Research, S. D. Sharma, KedarNath 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.

CS 6: 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, Semophores, 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 StorageFile 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.

CS 7: Object Oriented Programming and Design
(5 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 – Pointers 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 – Name spaces –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. BjarneStroustrup, "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,PrenticeHall, 2000
5. Andrei Alexandrescu , "Modern C++ Design: Generic Programming and Design PatternsApplied" , 1st Edition, Addison-Wesley Professional, 2001

CS 8: Data Structures and Computer Algorithms
(5 Hours – 4 Credits)

Unit I:

Fundamental Concepts: Introduction to Programming, Introduction to Data Structures, Types of Data Structures, Introduction to Algorithms, Pseudo code, 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, SartajSahni, 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 9: LAB: Object Oriented Programming using C++
(5 Hours – 3 Credits)

Section A

1. Write a C++ Program to illustrate Enumeration and Function Overloading\
2. Write a C++ Program to illustrate Scope and Storage class
3. Write a C++ Program to illustrate the use of Constructors and Destructors and Constructor Overloading
4. Write a C++ program to illustrate the Call-by-Value and Call-by-Reference
5. Write a C++ Program to illustrate Static member and methods
6. Write a C++ Program to illustrate Bit fields
7. Write a C++ Program to overload as binary operator, friend and member function
8. Write a C++ Program to overload unary operator in Postfix and Prefix form as member and friend function
9. Write a C++ Program to illustrate Iterators and Containers
10. Write a C++ Program to illustrate function templates
11. Write a C++ Program to illustrate template class
12. Write a C++ Program to illustrate Virtual functions
13. Write a C++ Program to illustrate Exception Handling
14. Write a C++ Program to illustrate File Handling – Read, Write, Update

Section B

1. Write a C++ program with suitable hierarchy, classes for Point, Shape, Rectangle, Square, Circle, Ellipse, Triangle, Polygon, etc.
2. Write a C++ program to create stack and queue classes with necessary exception handling
3. Write a C++ Manage bank account using inheritance concept using C++
4. Write a C++ program to Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of assignment operator.

CS 10: 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 Back Tracking - 8-Queen's Problem

EES 2: LAB: PHP Programming
(2 Hours – 1 Credit)

Section A: (Basics)
1. Write a PHP script to get the client IP address
2. Write a PHP script, to check whether the page is called from 'https' or 'http'.
3. Write a PHP function to test whether a number is greater than 30, 20 or 10 using ternary operator
4. Write a PHP program to remove duplicates from a array
5. Write a PHP script to remove all white spaces in an array
6. Write a PHP program to get the size of a file.
7. Write a PHP script that removes the last word from a string.
   Sample string : 'The quick brown fox'
   Expected Output : The quick brown
8. Write a PHP script to remove nonnumeric characters except comma and dot.
   Sample string : '$123,34.00A'
   Expected Output : 12,334.00

9. Write a PHP script to check whether the given dates are valid or not?
10. Write a PHP script to calculate the current age of a person.
    Sample date of birth : 11.4.1987
    Output : Your age : 27 years, 1 month, 29 days
11. Write a PHP script to extract the user name from the following email ID.
    Sample String : 'user@example.com'
    Expected Output : 'user'
12. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.

Section B: (Moderate)

1. Write a PHP program to check a number is palindrome or not. (Input get Using Form)
2. Write a PHP script that inserts a new item in an array in any position. (Input get Using Form)
   Expected Output :
   Original array :
   4 5 6 7 8
   After inserting '#' the array is :
   4 5 6 $ 78
3. Write a function to check a number is prime or not.
   Note: A prime number (or a prime) is a natural number greater than 1 that has no positive divisors other than 1 and itself. (Input get Using Form)
4. Write a function to sort an array. (Without default array function)
5. Upload and Display images in particular directory
6. Write a program to count Page Hits or page visitor using file

Section C: (Advanced)

1. To design an Faculty details database using HTML Form and process using PHP(Add, Edit, delete, View records) with login option
2. Create webpage Simple Online student quiz program with 10 question include login option (Student Entry, Edit option not mandatory)
3. Create webpage Simple employee feedback form include login option (Employee Entry, Edit option not mandatory)

Note: Use MySqli or PDO for database connectivity

CS 11: Data Communication and Computer Networks
(4 Hours – 4 Credits)

Unit I:

Introduction to Data Communicatios:Components of data communication,Data representation,Transmission Impairments,Switching,Modulation,Multiplexing,Review of Network Harware:LAN,MAN,WAN, Wireless networks,Internetworks,Review of Network

Software:Layer,Protocols,Interfaces and services. Reference Models: OSI, TCP/IP and their comparison.

Unit II:

Physical Layer: Transmission Media: Twisted pair, Coaxial cable, Fiber optics, Wireless transmission (Radio, Microwave, Infrared). Introduction to ATM, ISDN, Cellular Radio and Communication Satellites. Data Link Layer – Services provided by DLL; FRAMING ERROR CONTROL, FLOW CONTROL, MEDIUM ACCESS, Medium Access Sub layer; Channel Allocation, MAC protocols – ALOHA, CSMA protocols, Collision free 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,Tockenbucket,Load shedding),Internetworking,IPProtocol,ARP,RARP,Network Trouble Shooting Using Ping, Tracerroute,IPconfig,Netstat,nslookup

Unit IV:

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

Unit V:

Cryptography: symmentric key cryptography- asymmentric 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. Behroz A. forouzan,"Data Communication and Networking", The McGraw Hill Education Private Limited,New Delhi.
2. Behroz A. forouzan,"TCP/IP Protocol suite", The McGraw Hill edition,New Delhi.
3. "Data communication and computer networks",ISRD group, TMH publications.
4. LarryL.Peterson Bruce S,Davie, "Computer Networks - a system approach",Morgan Kaufmann publishers.
5. Andrews S Tanenbaum,"Computer Networks",Prentice Hall.

ES 11: Computer Graphics and Multimedia
(4 Hours – 4 Credits)

Unit I:

Line Drawing Algorithms – Circle Generating Algorithms – Ellipse Generating Algorithms – Filled Area primitives- 2D Transformations – Clipping – Point Clipping – Line Clipping – Polygon Clipping – Text Clipping – Exterior Clipping

Unit II:

Window to View Port Mapping – Interactive Input Methods – Picture Construction Techniques - 3D Concepts – 3D Transformations

Unit III:

3D Viewing – Visible Surface Detection Methods – Back Face Detection Method – Depth Buffer Method – Scan Line Method –Virtual Reality Environment.

Unit IV:

Introduction to Multimedia – Applications– Hypermedia – Authoring —– File formats –Color Models – Digital Audio– Digital Music Making – MIDI – Digital Video – Video Compression Techniques – Video Performance Measurements –Multimedia Databases– Animation.Multimedia Network Services–Network Protocols–Requirements for Multimedia Communications

Unit V:

Multimedia Conferencing Architectures –QuickTime Movie File Format–MHEG– Multimedia File Sharing –Multimedia & Internet–Real-Time Interchange.Design of a Multimedia System –Content Based Information Retrieval – HDTV, ATV, EDTV, IDTV Standards –Development of User Interface Design – Multimedia Broadcasting –Social Media Sharing – Multimedia Development Issues

Reference Books:
1. Donald Hearn and M. Pauline Baker, "Computer Graphics C Version", Second Edition, Pearson Education
2. David Hillman, "Multimedia – Technologyand applications",Galgotia Publications, Delhi, 2008
3. Tom McReynolds – David Blythe," Advanced Graphics Programming Using OpenGL", Elsevier, 2005 .
4. JohnVillamil, Casanova ,LeonyFernanadez, Eliar, "Multimedia Graphics", PHI,1998.
5. Ze-Nian Li, Mark S Drew and Jiangchuan Liu, "Fundamentals of Multimedia", Second Edition, Springer, 2014
6. Ralf Steinmetz and Klara "Multimedia Computing, Communications and Applications", Pearson Education,2009
7. John F. KoegelBuford , "Multimedia Systems", Pearson Education, Delhi, 6th Edition, 2009

ES 12: Accounting and Financial Management
(4 Hours – 4 Credits)

Unit I:

Assets – Liabilities – Types - Trading account – Accounting records and Systems – Limitations - Income statement – Preparation and Interpretation

Unit II:

Depreciation – Methods - Inventory methods, Sources of working capital, Fund flows, Cash flows – Financial Statement analysis

Unit III:

Ratio analysis - Use of ratios in interpreting Trading Accounts and Financial Statements, Limitations – Management Accounting

Unit IV:

Variable costs – Fixed costs – Cost Volume Profit Analysis – Break even marginal and full costing contribution, Standard costing - Analysis of variance - Computer accounting and algorithms

Unit V:

Characteristics of Budgets - Forecasting – Long term, Short term – Methods of capital investment decision making, Sensitivity Analysis, Cost of capital

Reference Books:
1. S.N. Maheswari and S.K. Maheswari, "An Introduction to Accountancy", 8th Edition, Vikas Publishing, 2003.
2. Manmohan and Goyal, "Principles of Management and Accounting", 5th Edition, SahityaBhawan, 1994.

ES 13: 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-IntermediateCode 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 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 tables-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.

ES 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 IIII:
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 Kauffman 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.

CS 12: Java Programming
(5 Hours – 4 Credits)

Unit I:
Introduction to Java-Introduction- Overview of Java technology- Development of java- Java as a new Paradigm in programming- Features of Java- Comparing java and other Languages- Applications and Applets Java Development kit - Java Source File Structure-Prerequisites for Compiling and Running Java Programs.
Java as an OOP Language-Defining Classes- Creating instance and Class Variables- Defining Methods- Knowing this- Variable scope and method definitions-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 accessor 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 life cycle- 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 super classes- File Streams- FileInputStream and FileOutputStream- Filter Streams-DataInputStream and DataOutputStream- PushbackInputStream- Random Access File- Serialization

Applets-Introduction- Java Applications Versus Java Applets- Applet life cycle- The init() method- The start() method- The stop() method – The destroy() method - The paint() method- Working with Applets- Running the applet using AppletViewer- 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 Prepared statement- The method Callable statement- Handling Exceptions- Mapping database types 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 Radio Buttons- Choice controls- List Controls- Text field control- Scroll bars- Layout Managers- The FlowLayaout Manager- The GridLayout Manager- The

BorderLayout Manager- The CardLayout Manager- Java 2D API- Java 2D Shapes- Texture paint and gradient paint.

Swings-Introduction- The Swing packages- the Hierarchy of Swing classes-JPopupMenu – JdesktopPane and JInternalFrame- Advanced Layout Managers- The BoxLayout Manager- The GridBagLayout Manager- Additional Swing components- The Jlist class- The Jcombobox class- Constructing menus- The JTextAreaClass- The JTable Control- Customizing the frame and its look-and-feel- The JToolBar class-The JSlider control- The JProgressBar control- Borders.

UnitV:

Servlets-Introduction- Advantages of servlets- Writing servlets- How to run servlets-Running HTML to servlets- The Lifecycle of the servlet- Instantiating and Initializing a servlet the init() method- Handling client request and response the service() method-Destroying the servlet the destroy() method- Servlet API- Interfaces- Classes- The GenericServlet classes- The HttpServlet classes- Multitier Applications using JDBC from a servlet- Writing JDBC/Servlet- A sample JDBC/Servlet applications- Additional capabilities of HTTP servlets- Objects of the HttpServletRequest class- Objects of the HttpServletResponse class- Example of GET and POST Requests- Session Management.

Networking and Remote Method Invocation-Introduction to Networking-Understanding Ports- Networking Classes in the JDK- Basics of Sockets- Simple Client server program- Reading from and writing to a socket- Introduction to RMI- RMI Architecture- Proxy layer or stub/skeleton layer- Remote reference layer- Transport layer-Implementing Remote Class and Interface- Programming a Client- Programming a Server-Security.

New Language Features of Java 1.5-Introduction- Generics- The Enhanced for loop- Autoboxing and Unboxing- Type Safe Enumerations- Variable length Arguments-Formatted I/O- Static import- Metadata.

Reference Books:
1. Object Oriented Programming Through JAVA- P.Radha Krishna, University Press, 2007.
2. Java and Object-Oriented Programming Paradigm, Debasish Jana, PHI,Fifth Print , 2010.
3. Java How To Program, Paul Deitel, Harvey Deitel, PHI, Ninth Edition,2013.
4. The Complete Reference, Java2, Herbert Schildt, Tata McGraw Hill, Fifth Edition, 2002.
5. Introduction to Java Programming ,K.Somasundaram, Jaico Publications, 2013.
6. Core Java - Vol. I – Fundamentals, Cay S. Horstmann, Pearson Education; Tenth edition, 2016.

CS 13: Data Warehousing and Mining
(5 Hours – 4 Credits)

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 Item set Mining Methods - Which Pattern 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 - 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, MichelineKamber, Jian Pei
2. Insight into Data mining Theory and Practice K.P. Soman, ShyamDiwakar 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.

CS 14: LAB: Java Programming
(5 Hours – 3 Credits)

1. Writing Java programs by making use of class, interface, package, etc for the following
   - Different types of inheritance study
   - Uses of „this" keyword
   - Polymorphism
   - Creation of user specific packages
   - Creation of jar files and using them
   - User specific exception handling
2. Writing window based GUI applications using frames and applets such as Fahrenheit to Centigrade conversion, life cycle, digital clock, Calculator application, graphical bar chart by passing parameters etc.
3. Application of threads examples
4. Create a Personal Information System using Swing
5. Event Handling in Swing
6. Reading and writing text files
7. Writing an RMI application to access a remote method
8. Writing a Servlet program with database connectivity for a web based application such as students result status checking, PNR number enquiry etc.
9. Creation and usage of Java bean
10. Create an Application to search Phone Number using contact Name Using Hash Map.
11. Create an Application which finds the Duplicates in E-mail using Set Interface.
12. FTP Using Sockets.

CS 15: LAB: Data Mining
(5 Hours – 3 Credits)

Tool: 'R' Software

Simple Programs
1. Find Sum, Mean and Product of Vector in R
2. R Program to sample from a Population
3. R Program to Sort a Vector.
4. To combine the matrix using rbind and cbind methods.
5. Use seq() to create sequence.
6. Write a program to convert the table data into data frame.
7. Calculate student mark list and output it in data frame.

Decisions and loops
7. R Program to Check Prime Number
8. R Program to Check for Leap Year.

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9. R Program to Check if a Number is Odd or Even in R
10. R Program to Find the Sum of Natural Numbers

Functions
11. Convert Decimal into Binary using Recursion in R
12. R program to Find the Factorial of a Number Using Recursion
13. R Program to Make a Simple Calculator

Data Set and Graphs
14. Write a R Program to import CSV data into R.
15. Write a R Program to move the result data from R to CSV.
16. Draw the Line Graph for Student Data.
17. Draw the Pie-Chart for Employee Data.
18. Create a Table from the existing data set in R and draw the chart.
19. Apply K-Means Algorithm for IRIS data set and output it in graph
20. Get some input from mtcar data set and perform analysis.

EES 3: LAB: Animation skill
(2 Hours – 1 Credit)

Tool: Flash Professional CS6

Section A: (Basics)
1. Drawing with tools (Any Cartoon Character, Nature Scene)
2. Frame by frame animation (Ex: lip-sync animation, walks cycle, body movements, stick man animation)
3. Motion animation (Ex: Bouncing Ball, Moon rotating Earth)
4. Shape animation with shape hints (Ex: 3d box rotate, flag animation)
5. Mask Animation (Ex: Water rippling effect)
6. Character Walk Cycle using Bone Tool
7. Create movie clip animation with Play and Stop button (Ex: Multiple Butterfly fly, Multiple Wind mills rotating)
8. Design printable certificate using input text box(Merit certificate, Sports Certificate etc.).
9. Create animation for rotate 3d ring.

Section B: (Moderate)
1. Write a action script for Simple stopwatch
2. Write a action script for Dynamic mask effect
3. Write a action script for Scale images with buttons
4. Write a action script for Rain effect
5. Write a action script for Random Bubbles made
6. Write a action script for Draw Custom shapes
7. Write a action script for Simple game (Ex: Roll The Dice, Hit the object, Maze)

Section C: (Advanced)
1. Develop a animated banner of recent activity in your college or any festival using text transformation and effects (rotation, skewing, flipping, and scaling, Scrolling text, Dangling text, Glowing text, Fading text)
2. Create an interactive Slide Show movie about the details of your college. Include **"PREVIOUS", "NEXT"** and "**HOME**" buttons to achieve interactivity.
3. Create an animation to help teach a poem or a song with sound
4. Create cartoon animation include sound with any social message

Note: Ensure all the above experiments must Export/ Publish in webpage

CS 16: Software Engineering
(4 Hours – 4 Credits)

Unit I:
     INTRODUCTION: Software Engineering Paradigms – Waterfall Life Cycle Model – Spiral Model – PrototypeModel – Agile Process Model – Unified Process Model - Planning – Software ProjectScheduling – SRS - Case Study: Project Plan and SRS

Unit II:
     SOFTWARE DESIGN: Designing Concepts - Abstraction – Modularity – Software Architecture – Cohesion – Coupling – Dataflow Oriented Design - Jackson System Development - Real time and Distributed System Design – Designing for Reuse — Case Study : Design for any Application Oriented Project.

Unit III:
     SOFTWARE TESTING AND MAINTENANCE: Software Testing Fundamentals – Software Testing Strategies – Black Box Testing – White Box Testing – System Testing – Object Orientation Testing – State Based Testing – TestingTools – Test Case Management – Types of Maintenance – Case Study: Testing Techniques

Unit IV:
     SOFTWARE METRICS: Scope – Classification of metrics – Measuring Process and Product attributes – Direct and Indirect measures – Cost Estimation - Reliability – Software Quality Assurance – Standards – Case Study for COCOMO model.

Unit V:
     SCM & WEB ENGINEERING: Need for SCM – Version Control – SCM process – Software Configuration Items – Taxonomy – Re Engineering – Reverse Engineering - Web Engineering - CASE Repository – Features

Reference Books:
1. Ali Behforroz, Frederick J.Hudson, "Software Engineering Fundamentals", Oxford Indian Reprint,2012.

2. Jibitesh Mishra, Ashok Mohanty, "Software Engineering", Pearson Education, First Edition, 2011.
3. Kassem A. Saleh, "Software Engineering", First Edition, J.Ross Publishing, 2009.
4. PankajJalote, "An Integrated approach to Software Engineering", Third Edition, Narosa Publications, 2011.
5. Roger S. Pressman, David Lowe, "Web Engineering: A Practitioner" s Approach", Special Indian edition, McGrawHill, 2008.
6. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill Edition, 2008
7. Roger S. Pressman, "Software Engineering: A Practitioner Approach", Seventh Edition, Tata McGraw – Hill International Edition, 2009.
8. Sommerville, "Software Engineering", Tenth Edition, Pearson, 2015

ES 21: Soft Computing
(4 Hours – 4 Credits)

UnitI:

Architectures: ANN: Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward 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 representation 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. LauranceFausett, 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.

ES 22: Computational Intelligence
(4 Hours – 4 Credits)

Unit I:

Introduction to Computational Intelligence: Evolution of Computing – Introduction to Artificial Intelligence –– Turing test - Prepositional 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 – Typereduction – type 2 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 – Case study: 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 – Case study : Evolutionary medical diagnosis

Reference Books:

1. A.E. Eiben and J.E. Smith "Introduction to Evolutionary Computing" Springer, 2003
2. AndriesEngelbrecht, 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, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003
9. KwangH.Lee, "First course on Fuzzy Theory and Applications", Springer– Verlag Berlin Heidelberg, 2005
10. Kaluza, B. INSTANT Weka How-to, Packt Publishing, 2013.
11. LeszekRutkowski, " Computational Intelligence – Methods and Techniques", Springer, 2008.
12. Mitsuo Gen and RunweiCheng, "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.
15. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic Algorithms", Springer, 2007.

ES 23: Digital Image Processing
(4 Hours – 4 Credits)

Unit I:

Digital Image Processing: Origins of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels, Mathematical Tools used in Digital Image Processing.

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, Pseudo color 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 24: Big Data Analytics
(4 Hours – 4 Credits)

Unit I:

Introduction to Big Data: Introduction to BigData 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 - Real time 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 interfaces to HDFS- Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features - Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation – Hadoop Configuration-Security in Hadoop

Unit IV:

Data Analysis Sytems 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 –Mango DB-Casandra-Hbase – Impala – Analyzing big data with twitter – Big data for Ecommerce – Big data for blogs.

Reference Books:

1. AnandRajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", CambridgeUniversity Press, 2014
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding BigData: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012
3. Da Ruan,Guoquing Chen, Etienne E.Kerre, Geert Wets, Intelligent DataMining, Springer,2007
4. Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streamswith Advanced Analytics", John Wiley & sons, 2012
5. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007
6. Jiawei Han, MichelineKamber "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 , AmbigaDhiraj, Big Data, BigAnalytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses,WileyPublications,2013
9. Paul Zikopoulos ,DirkdeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw HillPublications, 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 Hadoopand Streaming Data, Tata McGraw Hill Publications, 2011.

CS 17: Dot Net
(5 Hours – 4 Credits)

Unit I:

   Building-blocks of C#: C# the Trailblazer – Productivity of C# - Features, and Advantages – C# Vs. Java –Overview of C# - Gaining momentum with C# programs in VS.NET – Keywords – DataTypes, Literals, and Variables – Value Types, Integers, Floating-Point Types, TheDecimal Type, Characters, The Bool Type - Literals – Character Escape Sequences -Working with Variables – Scope, Type Conversion and Casting-Operators – ProgramControl Structures – Classes and Objects – Arrays and Strings

Unit II:

  Advanced Programming concepts in C#: Inheritance – Constructors and Inheritance, Name Hiding, Virtual Methods Overriding,Boxing and Unboxing – Indexers and Properties, Interfaces Vs. Abstract Classes –Structures – Enumerations – Exception Handling – Try and Catch, Multiple CatchClauses, Nesting Try Blocks, Using Finally, Using Checked and Unchecked – Delegates– Multicasting, Covariance and Contravariance – Anonymous Functions Vs. Methods –Lamda Expressions – Events – Reflection, and Attribute – Unsafe Code, Pointers -Introduction to Generics, and LINQ – Multithreaded Programming using TPL andPLINQ

Unit III:

  Features-rich Web Application Development using ASP.NET: Introduction to ASP.NET - Advantages of ASP.NET - ASP.NET Architecture – ASP Vs.ASP.NET - ASP.NET Page's Structure - Sample Program in ASP.NET - Page Events -HTML Server Controls - Basic Web Server Controls - Data List Web Server Controls -Validation Controls - Web User Controls in ASP.NET

Unit IV:

  Intrinsic Objects, and Security Mechanism in ASP.NET: Objects and Advanced Concepts in ASP.NET: Request Object - Response Object - Code-Behind Feature of ASP.NET - Caching in ASP.NET - Output Caching – FragmentCaching - Data Caching - Session / State Management – Events and Abandon Method –Authentication in ASP.NET - Error Handling and Debugging - Tracing an Application –Accessing Data with ADO.NET – Implementing Crystal Reports in ASP.NET

Unit V:

  Introduction to Windows Phone Apps Development: Mobile Application Development – Featured Phone Vs. Smart Phone – Smart Phone Oss– Introducing Windows Phone 7 and the Windows Phone Platform - Building WindowsPhone 7 Applications - Using Cloud Services as Data Stores - Catching and DebuggingErrors - Packaging, Publishing, and Managing Applications

ReferenceBooks:
1. Herbert Schildt, "C# 4.0", Edition 2010, Tata McGraw-Hill.
2. Kogent Learning Solutions, "ASP.NET 4.0 Black Book", Reprint 2012, Dreamtech Press.
3. Matt J.Crouch, "ASP.NET and VB.NET Web Programming", Edition 2012, Pearson Education.
4. Henry Lee, Eugene Chuvyrov, "Beginning Windows Phone App Development", , Apress, 2012 Edition.
5. John Sharp, "Microsoft Visual C# 2010", Reprint 2011, Dreamtech Press.
6. Ben Watson, "C# 4.0 How-To", Edition 2010, Pearson Education.
7. Stephen Walther, Kevin Hoffman, Nate Dudek, "ASP.NET 4 Unleashed", Second Impression 2013, Pearson Education.

CS 18: Network Programming
(5 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 fybctuibs – 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 – Orphanced process groups. Daemon Processes: Characteristics – Coding rules.

Unit III:

SOKET introduction: Socket address structure – Byte ordering and manipulation functions – Address conversions 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: getsocket() and setsocket() – 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, Stephone A. Rago, "Advanced Programming in the UNIX Environment", Second Edition, Pearson Education, New Delhi, 2007.
2. W.R. Stevents, B. Fenner, A.M. Rudoof, "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.

CS 19: LAB: Dot Net
(5 Hours – 3 Credits)

1. Develop a control application to demonstrate the control structures in C#
2. Demonstrate Indexers and Properties
3. Demonstrate Interfaces, Structures, and Enumerations
4. Demonstrate Delegates, and Events
5. Demonstrate the working mechanism of PLINQ
6. Develop a web application to demonstrate various web server controls
7. Demonstrate the validation controls in ASP.NET
8. Demonstrate caching in ASP.NET
9. Demonstrate the intrinsic objects in ASP.NET
10. Develop a web application for students' information management with crystalreports
11. Demonstrate LINQ to an SQL application
12. Develop a basic Windows Phone Application

CS 20: LAB: Network Programming
(5 Hours – 3 Credits)

1. Implementation of File System Calls
2. Implementation of ICP Techniques – Pipe, Message Queue, Shared Memory
3. Socket Programming
   - a) TCP Sockets
   - b) UDP Sockets
   - c) Applications using Sockets
4. Simulation of Sliding Window Protocol
5. Simulation of Routing Protocols
6. RPC
7. Development of applications such as DNS / HTTP / E-mail / Multi-user chat

EES 4: Mini Project and Report writing
(2 Hours – 1 Credit)

Students will be able to
1. Identify the problem from the core subjects related to the project work
2. Implement the case studies using the concepts and techniques in the curriculum
3. Use Latex to compile Mini Project work report

CS 21: 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, precursors to planning, strategic planning. **Planning for contingencies:** Fundamentals and components of contingency planning.

UnitII:

    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.

UnitIII:

    Security management models: blue print, 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

ES 31: 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*, CryptoArithmetic 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: Uncertainly, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bays 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 Lugar, .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

ES 32: Internet of Things
(4 Hours – 4 Credits)

Unit I:

  Introduction to IoT: Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels &DeploymentTemplates - Domain Specific IoTs - IoT and M2M - IoT System Management withNETCONF-YANG- IoT Platforms Design Methodology.

Unit II:

  IoT Architecture: M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference modelDomain model - information model - functional model - communication model - IoT reference architecture

Unit III:

  IoT Protocols: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

Unit IV:

  Building Iot with Raspberry PI& Arduino: Building IOT with RASPERRY PI-IoT Systems - Logical Design using Python – IoT Physical DevicesEndpoints - IoT Device - Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

Unit V:

  Case Studies and Real-World Applications: Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, "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, VlasiosTsiatsis , 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", CRCPress, 2012.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

ES 33: Machine Learning
(4 Hours – 4 Credits)

Unit I:

Introduction : Machine Learning - Machine Learning Foundations –Overview – applications - Types of machinelearning - basic concepts in machine learning Examples of Machine Learning -Applications – LinearModels for Regression - Linear Basis Function Models - The Bias-Variance Decomposition -Bayesian Linear Regression - Bayesian Model Comparison

Unit II:

Supervised Learning: Linear Models for Classification - Discriminant Functions - Probabilistic Generative Models -Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees – ClassificationTrees- 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 selectionfor latent variable models - high-dimensional spaces -- The Curse of Dimensionality –DimensionalityReduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independentcomponents analysis

Unit IV:

Probabilistic Graphical Models: Directed Graphical Models - Bayesian Networks - Exploiting Independence Properties – FromDistributions 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 independenceproperties - 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

ES 34: 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 White box 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 Levels 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. Besterfiled , "Total Quality Management", Pearson Education Asia, ThirdEdition, Indian Reprint (2011).
4. Edward Kit, " Software Testing in the Real World – Improving the Process", PearsonEducation, 1995
5. Glenford J. Myers, Tom Badgett, Corey Sandler, "The Art of Software Testing", 3rd Edition, John Wiley & Sons Publication, 2012
6. IlleneBurnstein, " Practical Software Testing", Springer International Edition, Chennai, 2003.
7. NareshChauhan , "Software Testing Principles and Practices " Oxford University Press , New Delhi ,2010
8. Ron Patton, "Software Testing", Second Edition, Pearson Education, 2009
9. RenuRajani,Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill,2004
10. SrinivasanDesikan 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, WileyPublishing.

CS 22: Mobile Computing
(5 Hours – 4 Credits)

Unit I:

      INTRODUCTION: Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications –Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

Unit II:

　　　　MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER: Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

Unit III:

　　　　MOBILE TELECOMMUNICATION 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 Constrains & 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. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.
3. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson AsiaPvt Ltd, 2005.
4. Uwe Hansmann, LotharMerk, 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.JeyasriArokiamary, Technical Publications, 2009.

CS 23: Web Technology
(5 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 toHTML5 -Semantic/Structural Elements -HTML5 style Guide and Coding Convention– Html Svg and Canvas – Html API" s - 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 InlineStyles – 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 - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form validations.

Unit IV:

  Advanced Features of Javascript: Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping **-** Sub classes and Super classes – Introduction to JSON – JSON Structure – Introduction to jQuery –Introduction to AJAX-Bootstrap - Bootstrap components.

Unit V:

  Django: Introduction to Django-Django model layer – View layer – Template Layer – Forms – Automated admin interface – Django Security – Internationalization and localization – Django Web application tools – Core functionalities – Geographic Framework.

Reference Books:
1. David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011
2. AymanHourieh, "Learning Website Development with Django", Packt Publishing, 2008.
3. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011
4. James Lee, BrentWare , "Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP" AddisonWesley, Pearson 2009
5. Thomas A. Powell, "HTML & CSS: The Complete Reference", Fifth Edition, 2010
6. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", Third Edition, Tata McGraw Hill, 2013
7. Thomas A Powell, "Ajax: The Complete Reference", McGraw Hill, 2008

CS 24: 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.

CS 25: LAB: Web Technology
(5 Hours – 3 Credits)
Section A

1. Create your own Resume using HTML 5 Tags and CSS 3 Properties
2. Debug and validate your HTML document (Resume) using W3C validator and fix the issues.(https://validator.w3.org/#validate_by_upload).
3. (a) Add functionalities that use any 2 of HTML 5 API" s. (b) Create a student Registration form for Job Application and validate the form fields using JavaScript.
4. (a) Create a CGPA Calculator in Web Brower using HTML, CSS and JavaScript. Use functions in JavaScript. (b) Create a Quiz Program with adaptive questions using JavaScript.
5. Create a Pan Card Validation form using Object Oriented JavaScript, consider the 10th character to be an alphabet.(a)Get the user" s First Name, Last Name and other required fields as input (b) Assume the last digit of the Pan Number to be an alphabet (c)Validate the PAN Number.
6. Create an online Event Registration form and validate using JQuery
7. Create an online video Player which will allow you to play videos from the system and also create custom playlist using JQuery.
8. Construct a JSON Structure for a bookstore and validate it using JSON Validator such as http://jsonlint.com/ and parse the Json file to list the books under the category "Fiction". Use Javascript or JQuery for parsing.
9. Build an application that uses Spring" sRestTemplate to retrieve a random Spring Boot quotation at http://gturnquist-quoters.cfapps.io/api/random
10. Create weather service using spring/struts which will return the temp in JSON format and XML format.

Section B

11. Create a Single Page application allowing to search for a movie and displaying the trailer, poster for various movies.
    (a) Create an admin login to upload the trailer, poster, keyword and details of the movie.
    (b) Use Bootstrap and JQuery for designing the User Interface.
    (c) Form Submission should be handled through Ajax.
12. Develop a Social Media Web Application using HTML5, CSS3, JQuery, AJAX& PHP, MySqli.

EES 5:LAB: Python Programming
(2 Hours – 1 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 Amstrong number or not.
3. Write a program that accepts a string from user and redisplays 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 apython program to count repeated characters in a string.
   Sample string: 'thequickbrownfoxjumpsoverthelazydog'
   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 in Fibonacci Sequence and store it in 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 print 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 destination file.
7. Write a program to draw a pattern of different color square 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 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 given date.

EES 6: Project Work and Viva Voce
(14 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