ST. JOSEPH'S COLLEGE (AUTONOMOUS)
DEVAGIRI, CALICUT

SYLLABUS OF
MASTER OF SCIENCE (M.Sc)
IN
COMPUTER SCIENCE

AS PER

CHOICE BASED CREDIT AND SEMESTER SYSTEM PG 2019

PROGRAMME CURRICULUM

(FOR THE STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020 - 21 ONWARDS)

ST. JOSEPH’S COLLEGE (AUTONOMOUS), DEVAGIRI

MASTER OF SCIENCE (M.Sc.) IN COMPUTER SCIENCE

EFFECTIVE FROM THE ACADEMIC YEAR 2020 - 21

1. PROGRAMME OBJECTIVES

The course of the MSc (Computer Science) programme is designed with the following objectives:

1. To equip students to take up challenging research oriented responsibilities and courses for theirhigher studies/profession.
2. To train and equip the students to meet the requirements of the Software industry in the country and outside.
3. To motivate and support the students to prepare and qualify challenging competitive examinations such as JRF/NET/JAM/GATE etc.

2. ELIGIBILITY FOR ADMISSION

Candidates should have passed BSc Computer Science/BSc Information Technology/BCA Degree examination of University of Calicut with 50% marks or an equivalent examination of any other University recognized by the University of Calicut.

3. DURATION OF THE PROGRAMME

1. The minimum duration for completion of a four semester M.Sc Computer Science Programme is two years. The maximum period for completion is 4 years.
2. The duration of each semester shall be 90 working days, inclusive of examinations, spread over five months.
3. Odd semesters shall be held from June to October and even semesters fromNovember to March subject to the academic calendar of the College.

4. PROGRAMME STRUCTURE

1. The programme includes three types of courses, viz., Core courses (Code C), Elective Courses (Code E) and Audit Courses (Code A).
2. Every student of the MSc Computer Science programme shall have to work on a project/dissertation of not less than 8 credits under the supervision of a faculty member as per the curriculum. Project/dissertation shall be treated as Core Courses. Project Work is mandatory for all regular programmes and Comprehensive Viva-voce is optional and these shall be done in the end semester. The combined Credit for the Project Work and Comprehensive Viva-voce shall not be more than 8 (eight) credits subject to a minimum of 4 (four) credit for Project Work. All students have to submit a Project Report/Dissertation in the prescribed structure and format as a part of the Project Work undertaken.

3. Total credit for the programme shall be 80 (eighty), this describes the weightage of the course concerned. The pattern of distribution is as detailed below

   i) Total Credit for Core Courses shall not be less than 60 (sixty) and not more than 68 (sixty eight).

   ii) Total Credit for Elective Course shall not be less than 12 (twelve) and not more than 20 (Twenty).

   iii) Total Credits for Comprehensive Viva-voce and Project Work combined together shall be 8 (eight) subject to a minimum of 4 (four) credits for Project Work.

   iv) Total credit in each semester shall vary between 18 to 22.

   v) No course shall have less than 2 credits and more than 5 credits.

4. Elective courses shall be spread over in the Third & Fourth Semesters combined.
5. Audit Courses: There will be two Audit Courses (Ability Enhancement Course & Professional Competency Course) with 4 credits each. These have to be done one each in the first two semesters. The credits will not be counted for evaluating the overall SGPA & CGPA. The colleges shall conduct examination for these courses. Students have to obtain only minimum pass requirements in the Audit Courses.
6. A student shall accumulate a minimum of 80 credits for the successful completion of the programmes.

2. ATTENDANCE

1. The students admitted in the M.Sc Computer Science programme shall be required to attend at least 75 percent of the total number of classes (theory/practical) held during each semester. The students having less than prescribed percentage of attendance shall not be allowed to appear for the End Semester Examination.
2. Condonation of shortage of attendance for a maximum of 9 days (10% of the working days in a semester) in the case of single condonation and 18 days (20% of the working days in a semester) in the case of double condonation in a semester subject to a maximum of two times (for single condonation only) during the whole period of Post Graduate programme may be granted by the College as per the existing procedures. In the case of double condonation, only one condonation shall be allowed during the entire programme.
3. Benefit of condonation of attendance will be granted to the students on health grounds, for participating in College Union activities, meeting of the University bodies /Govt. bodies / College bodies and participation in other extracurricular activities on production of genuine supporting documents, with the recommendation of the Head of the Department concerned.
4. A student who is not eligible for such condonation shall be observed the provisions as per College PG regulation.
5. Women students can avail maternity leave as per the existing university rules.

6. EXAMINATION

1. There shall be End Semester Examination at the end of each semester.
2. Practical examinations shall be conducted by the College at the end of each semester. There will be one internal and one external examiner for the conduct of End Semester Practical examination.
3. Project Work / Dissertation shall be evaluated at the end of the programme only. There shall be both Internal and External evaluation for the Project Work.
4. There shall be one end-semester examination of 3 hours duration for each theory course and practical course.

7. EVALUATION AND GRADING

1. Evaluation: The evaluation scheme for each course shall contain two parts; (a) Internal / Continuous Assessment (CA) and (b) External / End Semester Evaluation (ESE).
2. Of the total, 20% weightage shall be given to Internal evaluation / Continuous assessment and the remaining 80% to External/ESE and the ratio and weightage between Internal and External is 1:4.
3. Primary evaluation for Internal and External shall be based on 6 letter grades (A+, A, B, C, D and E) with numerical values (Grade Points) of 5, 4, 3, 2, 1 & 0 respectively.
4. Grade Point Average: Internal and External components are separately graded and the combined grade point with weightage 1 for Internal and 4 for external shall be applied to calculate the Grade Point Average (GPA) of each course. Letter grade shall be assigned to each course based on the categorization based on Ten point Scale.
5. Evaluation of Audit Courses: The examination and evaluation shall be conducted by the college itself either in the normal structure or MCQ model from the Question Bank and other guidelines provided by the College /BoS. The Question paper shall be for minimum 20 weightage and a minimum of 2 hour duration for the examination.

8. INTERNAL EVALUATION – CONTINUOUS ASSESSMENT

1. This assessment shall be based on a predetermined transparent system involving periodic written tests, assignments, seminars and viva-voce in respect of theory courses and based on tests, lab skill and records/viva in respect of practical courses.
2. The criteria and percentage of weightage assigned to various components for internal evaluation are as follows :
   (a) Theory: The weightage assigned to various components for internal evaluation for theory papers is as shown below.

Sl.No	Component	Percentage	Weightage
1	Examination /Test	40%	2
2	Seminars / Presentation	20%	1
3	Assignment	20%	1
4	Attendance	20%	1

To ensure transparency of the evaluation process, the internal assessment grade awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal grade.

The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the Controller of Examination of the college.

(b) Practical: Themarkdistributiontoawardinternalcontinuousassessment marks for practical course should be as follows:

Sl.No	Component	Percentage	Weightage
1	Lab Skill	40%	4
2	Records/viva	30%	3
3	Practical Test	30%	3

Note:

- All students should have a rough record (observation note book) in which they write all the works to be carried out in the lab prior to his/her entering the lab. (S)he may also note down the i/p and o/p that (s)he gives for program verification in the observation note book (rough record).
- All lab works should be neatly recorded in a Laboratory Record Book (Fair Record) in written form. However program results can be pasted in the left hand side of the fair record.
- Chairperson, Board of Examination (PG) has to prepare the modalities of the practical papers (list of experiments to be done, number of minimum experiments required in the practical record, etc) at the beginning of each semester itself. Model lists of experiments are provided with the syllabus for each practical session.
- No candidate will be permitted to attend the end-semester test unless he/she produces certified record of the laboratory.

3. Grades shall be given for the internal evaluation based on the grades A+, A, B, C, D & E with grade points 5,4,3,2, 1 & 0 respectively. The overall grades shall be as per the Ten Point scale.
4. There shall be no separate minimum Grade Point for internal evaluation.
5. To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board before 5 days of commencement of external examination.
6. There shall not be any chance for improvement of internal marks.
7. The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the Controller of Examination of the college, after being endorsed by the Head of the Department.
8. For each course there shall be class test/s during a semester. Grades should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal.
9. Each student shall be required to do assignment/s for each course. Assignments after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation etc. and inform the same to the students. Punctuality in submission is to be considered.
10. Every student shall deliver Seminar / Presentation as an internal component for every course and must be evaluated by the respective course teacher in terms of structure, content, presentation and interaction. The soft and hard copies of the seminar report are to be submitted to the courseteacher.
11. All the records of Continuous Assessment (CA) must be kept in the department and must be made available for verification by the COE of the college, if asked for.

Calculation of overall internal grade for one theory course will be done as shown below:

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	Weighted GP	Overall Grade of the course
Examination /Test	4	A	4	16	Weighted GP/Total Weight 43/10 = 4.30
Seminars /Presentation	3	A+	5	15	
Assignments	3	A	4	12	
Total	10			43	O

Calculation of overall internal grade for one Lab Course will be done as shown below:

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	Weighted GP	Overall Grade of the course
Lab Skill	2	A	4	8	Weighted GP/Total Weight 22/5 = 4.40
Records/viva	1	A+	5	5	
Practical Test	1	A	4	4	
Viva-voce	1	A+	5	5	

Components	Weightage (W)	Grade Awarded	Grade Point(GP)	Weighted GP	Overall Grade of the course
Total	5			22	O

9. EXTERNAL / END SEMESTER EVALUATION (ESE)

1. The semester-end examinations in theory courses shall be conducted by the College with question papers set by external experts. The evaluation of the answer scripts shall be done by examiners based on a well-defined scheme of valuation.
2. After the external evaluation, only Grades are to be entered in the space provided in the answer script for individual questions and calculations need to be done only up to the Cumulative Grade Point (CGP) and all other calculations including grades are to be done by the COE of the College.
3. Students shall have the right to apply for revaluation or scrutiny as per rules within the time permitted for it.
4. Photocopies of the answer scripts of the external examination shall be made available to the students for scrutiny on request by them as per rules.
5. The external evaluation shall be done immediately after the examination preferably in a Centralized Valuation Camp.
6. The language of writing the examination shall be English.
7. Pattern of questions for external/ESE (theory courses):
    a. Questions shall be set to assess the knowledge acquired, standard, and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. Due weightage shall be given to each module based on content/teaching hours allotted to each module.

    b. It has to be ensured that questions covering all skills are set. The setter shall also submit a detailed scheme of evaluation along with the question paper.

    c. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

    d. The question shall be prepared in such a way that the answers can be awarded A+, A, B, C, D, E Grades.

    e. Weightage: Different types of questions shall be given different weightages to quantify their range given in the following model:

Sl. No.	Type of Questions	Individual weightage	Total Weightage	Number of questions to be answered
1	Short Answer type questions	2	2*4 = 8	4 out of 7
2	Short essay/ problem solving type	3	3*4 = 12	4 out of 7
3	Long Essay typequestions	5	5*2 = 10	2 out of 4
Total			30	18

f. Questions should be asked as far as possible from all modules following a uniform distribution.

A sample ESE evaluation sheet of a theory course is illustrated below:

Type of Question	Qn. No	Grade Awarded	Grade Point	Weightage	Weighted Grade Point	Calculation
Short Answer type	1	A+	5	2	10	Overall Grade of the theory paper = Sum of Weighted Grade Points / Sum ofthe weightage 115/30= 3.83 = Grade A+
	2	-	-	-	-	
	3	A	4	2	8	
	4	C	2	2	4	
	5	-	-	-	-	
	6	A	4	2	8	
	7	-	-	-		
Medium Essay type	8	B	3	3	9	
	9	A+	5	3	15	
	10	-	-	-	-	
	11	-	-	-	-	
	12	-	-	-	-	
	13	A	4	3	12	
	14	B	3	3	9	
Long Essay type	20	A+	5	5	25	
	21	-	-	-	-	
	22	-	-	-	-	
	23	B	3	5	15	
	24	-	-	-	-	
TOTAL				30	115	

4. End Semester Evaluation in Practical Courses shall be conducted and evaluated by both Internal and External Examiners.

Mark distribution for practical courses shall be as follows:

Component	Weightage
Algorithm/Flow diagram/UI diagram/Class	6
Implementation	6
Result/ Output	6
Record	6
Viva	6
Total	**30**

A sample ESE evaluation sheet of a practical course is illustrated below:

Type of Question	Grade Awarded	Grade Point	Weightage	Weighted Grade Point	Calculation
Algorithm/Flow diagram/UI diagram/Class Diagram	A	4	6	24	114/30 = 3.80
Implementation	A	4	6	24	
Result/ Output	B	3	6	18	
Record	A	4	6	24	
Viva	A	4	6	24	
Total			**30**	**114**	**O**

10. EVALUATIONOFPROJECTWORK/DISSERTATION

1. There shall be External and Internal evaluation for Project Work done and the grading system shall be followed.
2. One component among the Project Work evaluation criteria shall be Viva-voce (Project Work related) and the respective weightage shall be 40%.
3. Consolidated Grade for Project Work is calculated by combining both the External and Internal in the Ratio of 4:1 (80% & 20%).
4. For a pass in Project Work, a student has to secure a minimum of P Grade in External and Internal examination combined. If the students could not secure minimum P Grade in the Project work, they will be treated as failed in that attempt and the students may be allowed to rework and resubmit the same in accordance with the College exam stipulations. There shall be no improvement chance for Project Work.
5. The External and Internal evaluation of the Project Work shall be done based on the following criteria and weightages as detailed below :

Sl. No	Criteria	% of Weightage	Weightage	
			External	Internal
1	Relevance of the topic and Statement of problem, Methodology & Analysis Quality of Report & Presentation	60%	24	6
2	Viva-voce	40%	16	4
Total Weightage		**100%**	**40**	**10**

The first component for 60% weightage can be sub-divided into following project implementation components:

SlNo	Components	Weightage	
		External	Internal
1	Relevance of the Topic, Statement of Objectives, Methodology	2	2
2	Quality of Literature Survey/Product Review	2	
3	Quality of Analysis Phase	2	
4	Quality of Design Phase	2	
5	Quality of Implementation/Simulation	4	2
6	Quality of Testing/Result Analysis	2	
7	Quality of Contributions	2	
8	Identification of Future Work	1	2
9	Quality of Project Report	4	
10	Publications/Presentations out of the Project Work*	1	
11	Quality of Presentation	1	
12	Demonstration of the Project Work	1	
13	General Viva Voce	16	4
	Total	**40**	**10**

11. DIRECT GRADING SYSTEM

1. Direct Grading System based on a 10 – Point scale is used to evaluate the performance (External and Internal Examination of students)
2. For all courses (Theory & Practical)/Semester/Overall Programme, Letter grades and GPA/SGPA/CGPA are given on the following way :

a. First Stage Evaluation for both Internal and External done by the Teachers concerned in the following Scale :

Grade	Grade Points
A+	5
A	4
B	3
C	2
D	1
E	0

b. The Grade Range for both Internal & External shall be :

Letter Grade	Grade Range	Range of Percentage (%)	Merit Indicator
O	4.25 - 5.00	85.00 - 100.00	Outstanding
A+	3.75 - 4.24	75.00 - 84.99	Excellent
A	3.25 - 3.74	65.00 - 74.99	Very Good

B+	2.75 - 3.24	55.00 - 64.99	Good
B	2.50 - 2.74	50.00 - 54.99	Above Average
C	2.25 - 2.49	45.00 - 49.99	Average
P	2.00 -2.24	40.00 - 44.99	Pass
F	< 2.00	Below 40	Fail
I	0	-	Incomplete
Ab	0	-	Absent

3. No separate minimum is required for Internal evaluation for a pass, but a minimum P Grade is required for a pass in the external evaluation. However, a minimum P grade is required for pass in a course.

4. A student who fails to secure a minimum grade for a pass in a course will be permitted to write the examination along with the next batch.

5. Improvement of Course- The candidates who wish to improve the grade / grade point of the external examination of a course/s they have passed already can do the same by appearing in the external examination of the concerned semester along with the immediate junior batch

6. Betterment Programme One time- A candidate will be permitted to improve the CGPA of the Programme within a continuous period of four semesters immediately following the completion of the programme allowing only once for a particular semester. The CGPA for the betterment appearance will be computed based on the SGPA secured in the original or betterment appearance of each semester whichever is higher.

12. SEMESTER GRADE POINT AVERAGE (SGPA)-CALCULATION

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses taken by a student.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below.

Semester Grade Point Average - SGPA (Sj) = Σ(Ci x Gi) / Cr

(SGPA= Total Credit Points awarded in a semester / Total credits of the semester)

Where ‘Sj‘ is the j^{th} semester , 'Gi' is the grade point scored by the student in the i^{th} course 'Ci ‘ is the credit of the i^{th} course, 'Cr' is the total credits of the semester.

13. CUMULATIVE GRADE POINT AVERAGE (CGPA)-CALCULATION

Cumulative Grade Point Average (CGPA) = **Σ** (Ci x Si) / Cr

(CGPA= Total Credit points awarded in all semesters/Total credits of the programme)

Where C_1 is the credit of the I^{st} semester S1 is the SGPA of the 1^{st} semester and Cr is the total number of credits in the programme. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme. The SGPA and CGPA shall be rounded off to 2 decimal points.

For the successful completion of a semester, a student should pass all courses and score a minimum SGPA of 2.0. However, the students are permitted to move to the next semester irrespective of their SGPA.

14. AWARD OF DEGREE

Thesuccessfulcompletion of allthecourseswith P Gradeshallbe theminimumrequirement for the award of the degree.

15. M.Sc COMPUTER SCIENCE - PROGRAMME STRUCTURE

LEGEND	
Item	**Description**
C	Credits
E	External Component (%)
I	Internal Component (%)
L	Lecture Hours
P	Practical Hours
T	Total

SEMESTER I

No	Course Code Course Name		C	Weightage			Hrs/Week		
				I	E	T	L	P	T
1.1	FCSS1C01	Discrete Mathematical Structures	4	1	4	5	4	0	4
1.2	FCSS1C02	Advanced Data Structures	4	1	4	5	3	2	5
1.3	FCSS1C03	Theory of Computation 0	4	1	4	5	4	0	4
1.4	FCSS1C04	The Art of Programming Methodology	4	1	4	5	2	2	4
1.5	FCSS1C05	Computer Organization Architecture	4	1	4	5	4	0	4
1.6	FCSS1L01	Practical I	2	1	4	5	0	4	4
1.7	FCSS1A01	Introduction to Research (Ability Enhancement Audit Course)	4	5	0	5	0	0	0
Total Credits(Excluding Audit Course):22							**17**	**8**	**25**

SEMESTER II

No	Course Code Course Name		C	Weightage			Hrs/Week		
				I	E	T	L	P	T
2.1	FCSS2C06	Design and Analysis of Algorithms	4	1	4	5	4	0	4
2.2	FCSS2C07	Operating System Concepts	4	1	4	5	3	2	5
2.3	FCSS2C08	Computer Networks	4	1	4	5	4	0	4
2.4	FCSS2C09	Computational Intelligence	4	1	4	5	2	2	4
2.5	FCSS2C10	Principles of Software Engineering	4	1	4	5	4	0	4
2.6	FCSS2L02	Practical II	2	1	4	5	0	4	4
2.7	FCSS2A02	Term Paper (Professional Competency Audit Course)	4	5	0	5	0	0	0
Total Credits(Excluding Audit Course):22							**17**	**8**	**25**

SEMESTER III

No	Course Code Course Name		C	Weightage			Hrs/Week		
				I	E	T	L	P	T
3.1	FCSS3C11	Advanced Database Management System	4	1	4	5	3	1	4
3.2	FCSS3C12	Object Oriented Programming Concepts	4	1	4	5	2	3	5
3.3	FCSS3C13	Principles of Compilers	4	1	4	5	4	0	4
3.4	FCSS3E01	Elective 1: Virtualisation and Cloud Computing	4	1	4	5	4	0	4
3.5	FCSS3E02	Elective 2: Data Warehousing and Data Mining	4	1	4	5	4	0	4
3.6	FCSS3L03	Practical III	2	1	4	5	0	4	4
Total Credits:22							**17**	**8**	**25**

List of Elective Courses for FCSS3E01	
Course Code	Course Name
FCSS3E01a	Virtualisation and Cloud Computing
FCSS3E01b	Introduction to Soft Computing
FCSS3E01c	Web Technology
FCSS3E01d	Bioinformatics
FCSS3E01e	Computer Optimization Techniques
FCSS3E01f	Numerical and Statistical Methods

List of Elective Courses for FCSS3E02	
Course Code	Course Name
FCSS3E02a	Pattern Recognition
FCSS3E02b	Wireless and Mobile Networks
FCSS3E02c	Cryptography and Network Security
FCSS3E02d	Advanced Web Technology
FCSS3E02e	Computer Graphics
FCSS3E02f	Data Warehousing and Data Mining

SEMESTER IV

No	Course Code	Course Name	C	Weightage			Hrs/Week		
				I	E	T	L	P	T
4.1	FCSS4E03	Elective 3: Fundamentals of Big Data	3	1	4	5	5	0	5
4.2	FCSS4E04	Elective 4: Advanced Machine Learning	3	1	4	5	5	0	5
4.3	FCSS4P01	Project Requirements Analysis & Design Related Discussion	8	1	4	5	3	1	4
		Project Coding, Testing & Implementation Related Discussion					2	2	4
		Project Evaluation & Assessment					2	0	2
		Project Lab Work					0	5	5
Total Credits(Excluding Audit Course):14							**17**	**8**	**25**

List of Elective Courses for FCSS4E03	
Course Code	Course Name
FCSS4E03a	Data Compression
FCSS4E03b	Pervasive Computing
FCSS4E03c	System Security
FCSS4E03d	Molecular Simulation and Modelling
FCSS4E03e	Fundamentals of Big Data
FCSS4E03f	Web Engineering

List of Elective Courses for FCSS4E04	
Course Code	Course Name
FCSS4E04a	Digital Image Processing
FCSS4E04b	Advanced Topics In Database Design
FCSS4E04c	Advanced Machine Learning
FCSS4E04d	Storage Area Networks
FCSS4E04e	Semantic Web
FCSS4E04f	Advanced Java Programming

Programme Specific Outcome

PSOs	PROGRAMME SPECIFIC OUTCOMES
PSO1	Evaluate complex real-world problems by applying principles of theoretical computing, engineering and Mathematical models.
PSO2	Modern Tool usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PSO3	Understand all dimensions of the concepts of software application development and projects.
PSO4	Aware the students to publish their work in reputed journals
PSO5	Conceive Project Management capabilities to solve real world problems in accordance to the needs of the industry, in a specific time frame
PSO6	Design and develop computer programs/computer-based systems in the field of Computer Sciences viz. Computational Intelligence, Machine learning, Web technology, Information Retrieval Systems, Data Analytics, Communication and networking.
PSO7	To prepare the students to address the challenging requirements coming from the enterprise applications

FCSS1C01 – DISCRETE MATHEMATICAL STRUCTURES

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To introduce discrete mathematics concepts necessary to understand basic foundation of Computer Science.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Verify the validity of an argument using propositional and predicate logic
CO2	Understand allocations of set theory by applying operations on set
CO3	Apply operations of relations and functions in discrete structures
CO4	Understand applications of Lattices and Boolean algebra in computer science domain
CO5	Identify Group, Ring and Field in Group Theory
CO6	Understand applications of Graph Theory and Tree
CO7	Apply the concepts of graph theory and trees to formulate problem solving

Course Outline

Unit I: Sets and Mathematical Logic: Set Theory - Types of sets, Set operations, Principles of Inclusion and Exclusion. Mathematical Logic - Propositional Calculus - Statement, Connectives, Conditional and Biconditional, Equivalence of Formula, Well Formed Formula, Tautologies, Duality Law, Functionally Complete Sets of Connectives, Normal Forms, Theory of Inference for the Statement Calculus, Predicate Calculus - Statement Functions, Variables and Quantifiers, Free and Bound Variables, Theory of Inference for the Predicate Calculus.

Unit II: Functions and Relations: Functions – Types of Functions, Composition of Functions and Inverse Functions. Relations - Relations and Their Properties, Functions as relations, Closure of Relations, Composition of relations, Equivalence Relations and Partitions. Partial Ordering, Hasse Diagram. The Pigeon Hole Principle.

Unit III: Lattices and Boolean Algebra - Lattices and Algebraic Systems, Principles of Duality, Basic Properties of Algebraic Systems Defined by Lattices, Distributive Lattices and Complemented Lattices. Boolean Lattices and Boolean Algebras. Boolean Functions and Boolean Expressions.

Unit IV: Group Theory – Definition and Elementary Properties - Permutation Groups, Cyclic Groups - Subgroups - Cosets and Lagrange's Theorem, Semigroup and Monoid. Homeomorphism and Isomorphism. Rings, Integral Domains and Fields.

Unit V: Graph Theory – Introduction, Directed Graph, Undirected Graph, Connected and Disconnected Graphs, Bipartite Graph, Complete Bipartite Graph, Isomorphic Graphs, Subgraph. Paths and Circuits. Shortest Paths in Weighted Graphs - Dijkstra's Algorithm. Eulerian Paths and Circuits, Hamiltonian Paths and Circuits. Trees - Spanning Trees and Cut-Sets, Minimum Spanning Trees - Kruskal's Algorithm, Prim's Algorithm.

References:

1. C Liu and D. Mohapatra, *Elements of Discrete Mathematics - A Computer Oriented Approach*, TMH, ISBN: 1259006395.
2. Alan Doerr and Kenneth Levassur, *Applied Discrete Structure for Computer Science*, Galgotia Publications Pvt. Ltd, ISBN: 9780574217554.
3. J. K. Sharma, *Discrete Mathematics*, Macmillan Publishers India Limited, ISBN: 1403924759.
4. J. P. Tremblayand R. Manohar, *Discrete Mathematical Structureswith Application to Computer Science*, McGraw-Hill Companies, ASIN: B001FPXR5Y.

FCSS1C02 – ADVANCED DATA STRUCTURES

Hrs/Week: 5 (3L+2P) **Credit: 4**

Objective: To introduce basic and advanced data structures dealing with algorithm development and problem solving.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Summarize different categories of data structures.
CO2	Design algorithms to perform operations with linear and non – linear data structures.
CO3	Describe how arrays, linked lists, stacks, queues, trees and graphs are represented in memory and used by algorithms
CO4	Describe common applications for arrays, linked lists, stack, queue, tree and graphs
CO5	Demonstrate different methods for traversing trees.
CO6	Design and implement an appropriate hashing function for an application
CO7	Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing
CO8	Describes various types of trees and heap structures

Course Outline

Unit I: Data structure - definition - types & operations, characteristics of data structures - Abstract Data Type (ADT) – algorithms - concepts - definition - objectives of algorithms - quality of an algorithm - space complexity and time complexity of an algorithm.

Unit II: Counting Techniques: Basic counting techniques - permutations and combinations, asymptotic behaviour of functions. Linear data structures - Arrays - records - representation - data structure operations - traversing, inserting and deleting - sorting and searching - sorting algorithms - linear search & binary search - complexity. Linked lists - operations and implementations, - Stack - operations and its implementations (both array and linked list) - Applications - parsing arithmetic expressions, conversion and evaluating expressions. Recursion - characteristics of recursion, types of recursion applications of recursion in algorithms - comparison of recursive and non-recursive algorithms. Queue - operations and its implementations (both array and linked list) - circular queue - dequeue - priorityqueues, recursivelists,heterogeneouslists, deterministicskiplists, doublylinkedlists and circular lists sparse matrix-representation.

Unit III: Non-linear Data Structures - trees - terminology - tree traversals algorithms - Binary trees - threaded binary trees - binary search trees - traversals and operations on BST heap Tree - balanced trees - M-way trees - B and B+ trees, Red Black Tree, Digital Search Tree, Tries, Treaps, Huffman algorithm for extended binary tree - operations and their implementation. Graphs - representation of graphs – operations - traversals and their implementation.

Unit IV: Hashing - overview of hashing - hash tables - hash functions and their computations open addressing - linear probing - quadratic probing - double hashing algorithms and their implementations - rehashing - extendable hashing - separate chaining - hashing efficiency - heaps - overview of heaps - implementation and operations.

Unit V: Heap structures - Min-Max heaps - Deaps - leftist heaps - binomial heaps - Fibonacci heaps - binary heaps - skew heaps - pairing heaps - applications - amortized analysis an unrelated puzzle - Binomial queues - skew heaps - Fibonacci heaps - Splay trees.

References:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *Data Structures and Algorithms*, Addison-Wesley, ISBN: 978-0201000238.
2. Horowitz E and Sahni S, *Fundamentals of Data Structures*, Computer Science Press, ISBN: 9780716780427.
3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, *Fundamentals of Data Structures in C*, Silicon Press, ISBN: 0929306406.
4. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach With C*, Thomson Brooks/Cole Publications, Course Technology, ISBN: 9780534390808.
5. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, *Data Structure using C*, Prentice- Hall, ISBN: 9780131997462.
6. Robert Kruse, Tondo C L and Bruce Leung, *Data Structures & Program Design in C*, Pearson India, 2nd Edition, ISBN: 9788177584233.
7. U. A. Deshpande and O. G. Kakde, *Data Structures & Algorithms*, ISTE Learning Materials Centre, New Delhi, ISBN: 9788188057054.
8. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, *Introduction to Algorithms*, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 978-0262033848.
9. Seymour Lipschutz, *Data Structures With C*, 1st Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 0070701989.
10. Jean-Paul Tremblay, Paul G. Sorenson, P. G. Sorenson, *Introduction to Data Structures with Applications*, 2nd Edition, Mcgraw-Hill College, ISBN: 0070651574.

FCSS1C03 – THEORY OF COMPUTATION

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To provide the students with an understanding of basic concepts in the theory of computation.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Describe broad overview of the theoretical foundations of computer science
CO2	Understand regular languages and finite automata
CO3	Apply the concept of context free languages in problem solving
CO4	Solve various problems of applying normal form techniques, push down automata and Turing Machines
CO5	Propose solutions for the problems based on computability and decidability

Course Outline

Unit I: Preliminaries - Introduction to formal proof and inductive proofs - The central concepts of Automata Theory - Alphabets, Strings, .Languages - Introduction to automata and grammar - Deterministic Finite Automata, Non-deterministic Finite Automata - Equivalence of Deterministic and Nondeterministic Finite Automata - Finite Automata with Epsilon Transitions - Equivalence of NFA with and without epsilon moves.

Unit II: Regular Expressions, Finite Automata and Regular Expressions, Properties of Regular Languages - Pumping lemma and proof for existence of non-regular languages, Closure properties, homomorphism, substitution - Decision Properties - Equivalence and Myhill Nerode and DFA state minimization - Regular Grammar.

Unit III: Context Free Languages - Equivalence of CFG and PDA - Normal forms (CNF and GNF) - Closure properties of CFL's - DCFL's and their properties - Decision procedures

- CYK algorithm - Pumping lemma and proof for existence of non-context - free languages

- Context sensitive languages: Equivalence of LBA and Context Sensitive Grammar (CSG).

Unit IV: Turing machines - TM computations - Equivalence of standard TM with multi tape and non deterministic TM's - Turing acceptable, Turing decidable and Turing enumerable language classes - Equivalence of type 0 grammars with TM's - Church thesis - Chomsky hierarchy - Closure properties of recursive and recursively enumerable languages.

Unit V: Computability and Decidability - halting problem - reductions - post correspondence problem. Computational complexity - Time and space bounded simulations

- Classes P and NP - NP completeness - Cook's theorem.

References:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, *Introduction to Automata Theory*, Languages of Computation, 3rd Edition, Prentice Hall, ISBN: 0321455363.
2. LinzP,*An Introductionto Formal LanguagesandAutomata*,NarosaPublishingHouse Pvt. Ltd., New Delhi, ISBN: 9788173197819.
3. Michael Sipser, *Introduction to Theory of Computation*, Cengage Learning India Private Limited, Indian Edition, ISBN: 8131505138.
4. H.R. Lewis and C.H. Papadimitriou, *Elements of Theory of Computation*, 2nd Edition, Prentice Hall, ISBN: 0132624788.
5. J. E. Savage, *Models of Computation, Exploring the Power of Computing,* Addison Wesley, 1998, Available at http://cs.brown.edu/~jes/book/.
6. MartinJ.C,*Introductionto Languagesand TheoryofComputation*,TataMcGrawHill, 3rd Edition, ISBN: 9780070660489.

FCSS1C04 – THE ART OF PROGRAMMING METHODOLOGY

Hrs/Week: 4 (2L+2P) **Credit: 4**

Objectives:

- To learn the art of designing algorithms and flowcharts.
- To introduce the concept of algorithmic approach for solving real-life problems.
- To develop competencies for the design and coding of computer programs.
- To learn designing programs with advanced features of C.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Improve ability to develop effective algorithms
CO2	Understand the fundamental principles of problem-solving using computers
CO3	Demonstrate the applications of the programming constructs including decision making, looping, arrays and strings
CO4	Conceptualize modular programming basics using functions, structures and Unions
CO5	Understand features like pointers and macros and to become familiar with programming with files
CO6	Design, develop, implement, test and document well-structured and reliable computer programs using the C programming language

Course Outline

Unit I: Problem Solving - Flow Chart – Algorithm Design - Introduction to C Programming - overview and importance of C - C Program Structure and Simple programs - Creation and Compilation of C Programs under Linux and Windows Platforms. Elements of C Language and Program constructs - structure of C program - character set, tokens, keywords, identifier - Data types, constants, symbolic constants, variables, declaration, data input and output, assignment statements. Operators in C - arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, special operators, precedence of operators - arithmetic expressions - evaluation of expressions, type conversion inexpressions - precedence and associativity - mathematical functions - I/O operations.

Unit II: Decision making - if statement, if else statement, nesting of if else and else if ladder, switch statement, break statement, continue statement, goto statement, return statement. looping - while, do-while, and for loops, nesting of loops, skipping & breaking loops. Arrays - single dimension arrays - accessing array elements - initializing an array, two dimensional & multi-dimensional arrays - memory representation - strings - processing of strings - string manipulation functions.

Unit III: The Concept of modularization - defining function - types of functions - User defined functions - function prototype and definition - arguments - passing parameters - call by reference - call by value - returning - nesting of functions and recursion - passing arrays & strings to function - returning multiple values - recursion - scope and life time of variables storage class specifiers - automatic, extern, static storage, register storage. Structures & Union definition, giving values to members, structure initialization, comparison of structure variables, arrays of structures, arrays within structures, structures within arrays, structures and functions, Unions, bit-fields.

Unit IV: Pointer - pointer operator - pointer expression - declaration of pointer - initializing pointer - de-referencing - pointer to pointer, constant pointer, array of pointers, pointer to function. Files - file handling - defining & opening a file - closing a file - Input/output operations on files - error handling, random access to files, command line arguments - dynamic memory allocation - linked lists (concepts only) - preprocessor directives: macro substitution directives - simple macros - macros with arguments - nesting of macros, compiler control directives.

Unit V: oop in C++, Class, object, Instantiation, Inheritance, Encapsulation, Abstract class, Polymorphism, Overloading Virtual functions, Constructors &destructors, friend functions.

References:

1. Martin M. Lipschutz and Seymour Lipschutz, *Schaum's Outline of Theory and Problems of Data Processing*, ISBN: 9780070379831 (Unit I Part A).
2. Anil Bikas Chaudhuri, *The Art Of Programming Through Flowcharts &Algorithms*, Laxmi Publications, New Delhi (Unit I Part A).
3. Jean Paul Trembley and Pual G Sorenson, *An Introduction to Data Structures with Applications*, Tata McGraw Hill (Unit I Part B).
4. RGDromey, *How to Solve by Computer*, Pearson Education, 5thEdition, ISBN: 0134340019 (Unit I Part B).
5. J.BDixit, *Computer Fundamentalsand Programmingin C*, Firewall Media, ISBN: 8170088828. (Unit I Part C).
6. Dennie Van Tassel, Program Style, *Design, Efficiency, Debugging, and Testing*, PHI, ISBN: 0137299478 (Unit I Part C).
7. E Balagruswamy, *Programming in ANSI C*, TMH, 5th Edition, ISBN: 0070681821.
8. Kamthane, *Programming in C*, 2nd Edition, PearsonIndia, ISBN: 8131760316.
9. Brian W. Kernighan and Dennis M. Ritchie, *C Programming Language*, PHI, ISBN: 0131103628.
10. Kanetkar, *Let Us C*, BPB Publications, 8th Edition, ISBN: 1934015253.

FCSS1C05 – COMPUTER ORGANIZATION & ARCHITECTURE

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To familiarize with the digital fundamentals, computer organization, computer architecture and assembly language programming.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Identify, understand and apply different number systems and codes
CO2	Understand the digital representation of data in a computer system
CO3	Understand the general concepts in digital logic design and their use in sequential and combinational circuit design
CO4	Describe fundamental organization of a computer system
CO5	Explain addressing modes, instruction formats and program control statements
CO6	Understand computer arithmetic formulae and solve problems
CO7	Distinguish the organization of various parts of a system memory hierarchy
CO8	Identify and compare different methods for computer I/O

Course Outline

Unit I: Number systems and Conversions, Boolean Algebra - Truth Tables - Logic gates and Map simplification - flip-flops - design of combinational and sequential circuits - examples of digital circuits - adders, multiplexers, decoders, counters, shift registers - register transfer language and micro operations - data representation - data types, sign and magnitude, complements, fixed-point representation, floating-point representation, other binary codes, error detection codes.

Unit II: Basic computer organization - machine instructions - classification, function, addresses, size, addressing modes - instruction cycle - instruction sequencing. Fundamental concepts - registers, register transfers, performing arithmetic or logic operations, memory read and write, execution of a complete instruction, branch instruction, single bus, two bus, three bus organization, a complete processor - Control unit - hardwired control, micro programmed control, micro instructions-types.

Unit III: Arithmetic & Logic Unit - addition of positive numbers - fast adders - signed addition and subtraction - addition/subtraction logic unit - multiplication of positive numbers - array multiplier, sequential multiplier - signed number multiplication - multiplication using Booth's algorithm - fast multiplication - bit pair recording of multiplication, division-restoring and non-restoring algorithms, floating pointnumbers and operations.

Unit IV: Main Memory - memory hierarchy - main memory - RAM, ROM - memory cells - cell organization - working - performance considerations - cache memory - virtual memory - memory management requirements - secondary storage - memory interleaving. Input / Output Organization - Accessing I/O ,d&Vices - programmed I/O, interrupt I/O - interrupts - interrupt processing - hardware interrupts - programmable interrupt controller - vectored interrupts - interrupt nesting - daisy chaining - direct memory access (DMA) - DMA operations & DMA Controller, Introduction to I/O interfaces, I/O channels, IO Processors.

Unit V: Architecture - General 8-bit microprocessor and its architecture - 8085 - Functional block diagram - architecture functions of different sections - architecture of 8086 CPU. Instruction Sets - Instruction format - addressing modes - instruction set of 8085 CPU - Instruction cycle - timing diagrams - different machine cycles - fetch and execute operations - estimation of execution time - estimation of execution time. Intel 8051 Micro controller - Architecture - basic instructions - basic assembly language programs peripherals: interrupts, timers, parallel port, serial port.

References:

1. VCarl Hamacher, ZvonkoVranesicand Safwat Zaky, *Computer Organization,* Mc- Graw Hill International Edition, 5th Edition, ISBN: 9780071122184.
2. Morris Mano, *Digital Logic and Computer Design*, Prentice Hall of India, ISBN: 0876924178.
3. M Morris Mano, *Computer System Architecture,* Prentice Hall, 3rd Edition. ISBN: 0131755633.
4. William Stallings, *Computer Organization and Architecture*, 9th Edition, Prentice Hall, ISBN: 013293633X.
5. Andrew S Tanenbaum, *Structured Computer Organization,* Prentice Hall, 6th Edition, ISBN: 0132916525.
6. Floyd Thomas L, *Digital Fundamentals,* Pearson Education, 10th Edition, Prentice Hall, ISBN: 0132359235.
7. Albert Paul Malvino, Donald P Leach, *Digital Principles and Applications,* McGraw Hill, 4th Edition, ISBN: 0070398836.
8. Thomas C Bartee, *Digital Computer Fundamentals*, McGraw Hill, 6th Edition, ASIN: B004H0SL5K.
9. Ramesh. S. Gaonkar, *Microprocessor Architecture*, Programming, and Applications with the 8085, 6th Edition, Wiley Eastern Ltd, New Delhi, ISBN: 9788187972884.
10. Mohamed Rafiquzzaman, *Introduction to Microprocessors and Microcomputer Based System Design,* 2nd Edition, CRC Press, ISBN: 9780849344756.
11. Muhammad Ali Mazidi, Janice Mazidi, Rolin Mckinlay, Janice M. Mazidi, Janice Gillispie Mazidi and Rolin D., *The 8051 Microcontroller and Embedded Systems*, Pearson Education Asia, 5th Indian Reprint, ISBN: 013119402X.

FCSS1L01 – PRACTICAL I

Hrs/Week: 4 (4P) **Credit: 2**

Objectives: To practically implement the theory portions covered in The Art of ProgrammingMethodology (FCSS1C04) and Advanced Data Structures (FCSS1C02).

Course Outcome:

COs	COURSE OUTCOMES
CO1	Develop programming skills using the fundamentals and basics of C language
CO2	Develop programs using the basic elements like control statements, arrays and strings
CO3	Design and implement the effective usage of arrays, structures, functions and pointers
CO4	Implement files handling and command line arguments
CO5	Demonstrate the concepts of stack, queue and linked list and apply various operations on them
CO6	Demonstrate the concept of tree traversal and its operations
CO7	Design program based on the concepts of sorting and searching techniques

Course Outline

Unit I: C Programming

1. Simple C Programs like area of a circle, checking whether a given number is odd or even.
2. Implementation of programs using Loops (pyramid printing, factorial computation, number reversing, checking for Armstrong numbers, finding first N or Nth Prime numbers etc).
3. Use of 1D and 2D Arrays (searching, sorting and vector operations, matrix addition, matrix multiplication).
4. String Manipulations.
5. Structures and Unions (like addition of two complex numbers, student record creation and manipulation etc).
6. Writing functions.
7. Implementation of recursion(recursivefunctiontocompute afactorial, reversestring etc).
8. Command line arguments.
9. Pointers - simple programsto learn concept of pointers, array operation using pointers etc.
10. File operations – file and structures.

Unit 2: Data Structures and Algorithms

1. Implementation of stacks using arrays.
2. Implementation of queues, circular queue using arrays.
3. Implementation of sequential search and binary search techniques.
4. Implementation of linked lists and operations (add, insert, delete, search) on linked lists.
5. Implementation of stacks using linked list.
6. Implementation of queues using linked list.
7. Implementation of doubly linked list.
8. Implementation of circular linked list.
9. Implementation of binary tree and traversals.
10. Implementation of Binary search trees and perform the operations on BST.
11. Implementation of various sorting algorithms.
12. Conversion of an infix expression to the postfix form using stacks.
13. Evaluation of a postfix expression.
14. Implementation of graphs and graph traversals.
15. Implementation of heap tree and operations.

FCSS1A01 – INTRODUCTION TORESEARCH
(ABILITY ENHANCEMENT AUDIT COURSE)

Objectives: Large numbers of students are actively considering and taking up research and associated higher studies. An introductory course on research aims to introduce students to the important aspects of research. The intent of such a course is to make students aware of the details associated with formal research. By going through this introductory course on research, students are likely to be able to take up research activities in a more systematic and formal manner right from the beginning. The specific objectives of the course include:

- Understand research terminology
- Be aware of the ethical principles of research
- Identify the components of a literature review process
- Critically analyse published research
- To introduce research methods in the field of computer Science

Course Outcomes

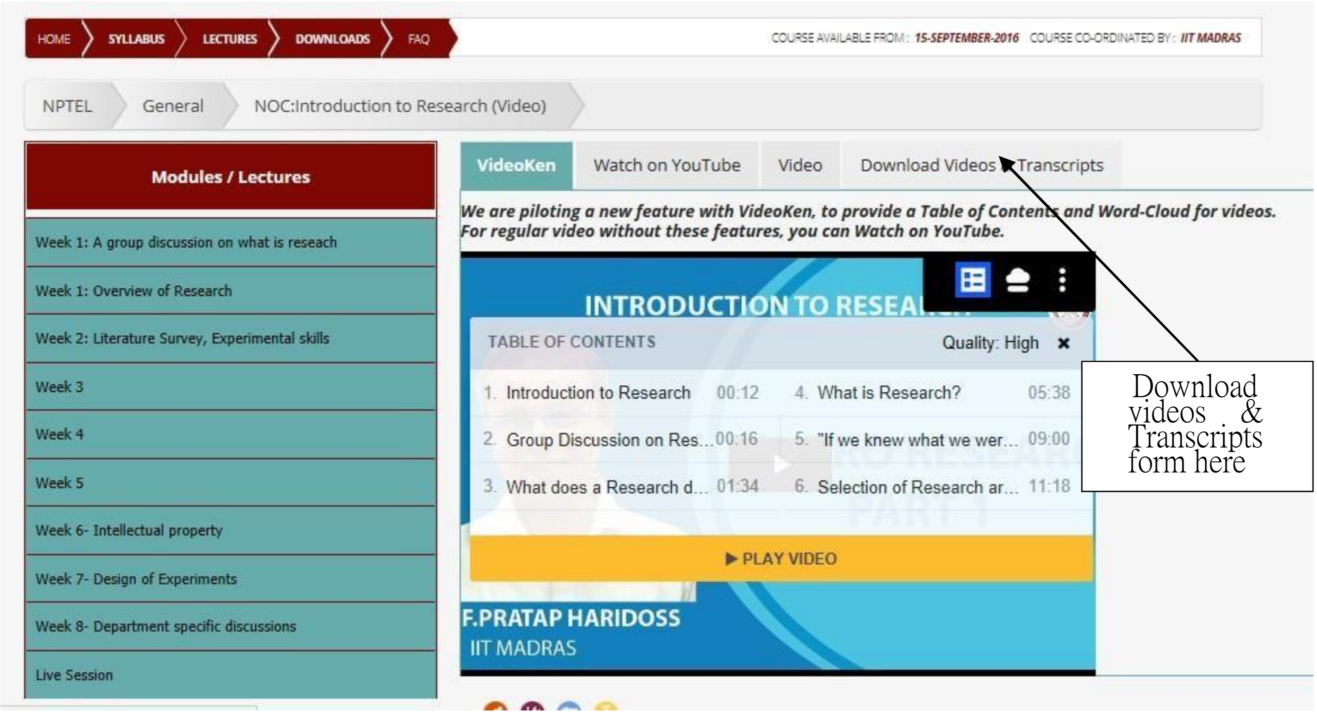
COs	COURSE OUTCOMES
CO1	Understand research terminology.
CO2	Apply the ethical principles of research.
CO3	Identify the components of a literature review process.
CO4	Critically analyze published research works.
CO5	Innovate and apply research methods in the discipline of computing

Course Evaluation & Course Credit

The Ability Enhancement Audit Course has 4 credits which will not be counted for evaluating the overall SGPA & CGPA. The College/Department shall conduct examination of 2 Hrs duration with a minimum of 20 weightage before the conclusion of first semester classes. Students have to obtain only minimum pass requirements in this Audit Course.

Course Delivery Mode

This course is an Ability Enhancement Audit Course. The course content is not delivered in the classrooms. Instead, the students have enrol themselves for the online course offered at NPTEL. The online course is available at https://nptel.ac.in/courses/121106007/. Students can either view the video module online or can download the video lessons and transcripts to view or read them offline.



COURSE AVAILABLE FROM : **15-SEPTEMBER-2016** COURSE CO-ORDINATED BY : **IIT MADRAS**

NOC:Introduction to Research (Video)

Modules / Lectures

- Week 1: A group discussion on what is reseach
- Week 1: Overview of Research
- Week 2: Literature Survey, Experimental skills
- Week 3
- Week 4
- Week 5
- Week 6- Intellectual property
- Week 7- Design of Experiments
- Week 8- Department specific discussions
- Live Session

We are piloting a new feature with VideoKen, to provide a Table of Contents and Word-Cloud for videos. For regular video without these features, you can Watch on YouTube.

INTRODUCTION TO RESEA...

TABLE OF CONTENTS Quality: High ✖

1. Introduction to Research	00:12	4. What is Research?	05:38
2. Group Discussion on Res...	00:16	5. "If we knew what we wer...	09:00
3. What does a Research d...	01:34	6. Selection of Research ar...	11:18

F.PRATAP HARIDOSS
IIT MADRAS

Download videos & Transcripts form here

Course Outline

The students are encouraged to cover the following modules of the course *Introduction to Research* from NPTEL:

- Week1: Overview of Research
- Week2: Overview of Literature Survey: Literature Survey using Web of Science, Literature Survey using Scopus, Writing Up, Tutorial on using BibTeX with LaTeX to add references toa document, Tutorial on using Microsoft Word with Bibliographic Sources, Tutorial on using Microsoft Word with endnote entries
- Week3: Data Analysis
- Week4: How to make Technical presentation – Technical Writing
- Week 6: Intellectual property
- Week8: Research in Computer Science & Engineering

References:

1. Video Lessonsand Transcriptsavailable(including in theregionallanguage) at https://nptel.ac.in/courses/nptel_download.php?subjectid=121106007

SEMESTER II

FCSS2C06 – DESIGN AND ANALYSIS OF ALGORITHMS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To introduce the concept of algorithmic approach for solving real-life problems.
- To teach basic principles and techniques of computational complexity.
- To familiarize with parallel algorithms and related techniques.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Design algorithms in context of space and time complexity and apply asymptotic notation
CO2	Analyze the problem and develop the algorithms related to these problems
CO3	Classify the problems and apply the appropriate design strategy to develop algorithms
CO4	Analyze the problem and develop the algorithms related to these problems
CO5	Demonstrate the use of parallel algorithms

Course Outline

Unit I: Algorithm Design: Introduction, Steps in developing algorithm, Methods of specifying an algorithm, Decisionsprior to designing: based on thecapabilities of thedevice, based on the nature of solutions, based on the most suitable data structures. Model of Computation: RAM model and PRAM model. Important Problem Types (Introductory concepts): Sorting, Searching, String processing, Graph problems, Combinatorial problems, Geometric problems and Numerical problems.

UnitII: Basic Techniquefor Design of Efficient Algorithm: Brute Forceapproach(String matching), Divide-and-Conquer approach (Merge sort), Branch-and-Bound technique (Knapsack problem). Greedy approach (Kruskal's algorithm and Prim's Algorithm), Dynamic Programming (Longest Common Subsequence), Backtracking (Sum of subsets problem).

Unit III: Algorithm Analysis: Importance of algorithm analysis, Time and Space Complexity. Growth of Functions: Asymptotic notations, Cost estimation based on key operations- Big Oh, Big Omega, Little Oh, Little Omega and Theta notations, Big Oh Ratio Theorem, Big Theta Ratio Theorem, Big Omega Ratio Theorem. Analyzing Algorithm Control Structures, Solving Recurrences: Iteration Method, Substitution Method, The Recursion Tree Method, Master's Theorem, Problem solving using Master's Theorem Case 1, Case 2 and Case 3. Analysis of Strasser's algorithm for matrix multiplication, Analysis of Merge sort.

Unit IV: Complexity - Complexity Classes: P, NP, NP Hard and NP Complete problems. NP Completeness reductions for Travelling Salesman Problem and Hamiltonian Cycle. P versus NP problem.

Unit V: Analysing Parallel Algorithms: Time Complexity, Cost, Number of Processors, Space Complexity, Speed up, Efficiency, Scalability, Amdahl's Law. Parallel merging and sorting, Euler tour technique, Parallel prefix computation, Deterministi c symmetry breaking.

References:

1. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, *Introduction to Algorithms*, 3rd Edition, Prentice Hall of India Private Limited, New Delhi, ISBN: 9780262033848 (Unit I, II, III and IV).
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, *The Design and Analysis of Computer Algorithms*, 1st Edition. Addison Wesley, ISBN: 0534915728 (Unit I, II, III and IV).
3. Pallaw, V K, *Designand Analysisof Algorithms*, Asian Books Private Ltd, 2012, ISBN: 8184121687 (Unit I, II, III and IV).
4. SanjayRazdan, *Fundamentalsof Parallel Computing*, Narosa Publishing House, 2014, ISBN: 9788184873481 (Unit V).
5. PandeyHM, *Designand Analysisof Algorithms*, UniversitySciencePress, 2013, ISBN: 9788131803349 (Unit I, II, III and IV).
6. Upadhyay N, *Design and Analysis of Algorithms*, SK Kataria & Sons, 2008 (Unit I, II, III and IV).
7. U.Manber, *Introductionto Algorithms: ACreative Approach*, AddisonWesley, ISBN: 9780201003277 (Unit I, II, III and IV).
8. Gilles Brassardand Paul Bratley, *Fundamentalsof Algorithmics*, Prentice-Hallof India, ISBN: 0133350681 (Unit I, II, III and IV).
9. Goodman S E and Hedetniemi, *Introduction to the Designand Analysisof Algorithms*, Mcgraw Hill, ISBN: 0070237530 (Unit I, II, III and IV).
10. Horowitz E and Sahni S, *Fundamentalsof Computer Algorithms*, Galgotia Publications Pvt. Ltd, ISBN: 8175152575 (Unit I, II, III and IV).
11. Oded Goldreich, P, *NP and NP - Completeness*, Cambridge University Press, 2011. ISBN: 0521122546 (Unit V).
12. DonaldKnuth, *TheArtofComputerProgramming, FundamentalAlgorithms*, Volume 1, Addison Wesley, 1997, ISBN: 8177587544 (Unit I).
13. Sanjeev Arora and Boaz Borak, *Computational Complexity - A Modern Approach*, Cambridge University Press; 2009, ISBN: 0521424267 (Unit III).
14. Daniel Hills W and Bruce M Boghosian, *Parallel Scientific Computation*, Science, 13 August 1993, Vol. 261 (5123), pp.856-863 (Unit V).

FCSS2C07 – OPERATING SYSTEM CONCEPTS COURSE

Hrs/Week: 5 (3L+2P) **Credit: 4**

Objectives:

- Introduce the underlying principles of an operating system.
- Exposure of multi programming, virtual memory and resource management concepts.
- Case study of public and commercially available operating systems

Course Outcome:

COs	COURSE OUTCOMES
CO1	Understand the basic components of a computer operating system
CO2	Compare and interpret the applications of Process and threads
CO3	Describe the policies for scheduling, deadlocks, synchronization, system calls, and file systems
CO4	Illustrate the functioning of process management, memory management and file management Modules present in an OS
CO5	Differentiate various types of scheduling algorithms
CO6	Understand the concepts of Three-Tier Client/Server Architecture, Middleware and the characteristics of mobile operating systems

Course Outline:

Unit I: Operating System Overview - Objectives and functions - Evolution of Operating System - Major Achievements - Process Description and Control - Process, Creation & Termination of Processes, Five State Model, Suspended Process, Process Description, Process Control - Modes of Execution, Process Creation, Process and Mode Switching. Threads - Processes Vs Threads, Multithreading, Thread States, Types of Threads, Multi Core and Multithreading. Case Study - Unix SVR4 Process Management, Linux Processand Thread Management.

Unit II: Concurrency - Principles, Race Condition, Operating System Concerns, Process Interaction, Completion for Resources, Cooperation by Sharing. Mutual Exclusion - Requirements, Hardware Support, Semaphores, Producer Consumer Problem, Monitors, Message Passing, Readers/Writers Problem. Deadlock - Principles, Prevention, Avoidance, Detection, Recovery, Dining Philosophers Problem. Case Study: Unix Concurrency Mechanisms.

Unit III: Memory Management, Address binding, Logical Vs Physical address space, Dynamic Loading, Dynamic Linking and Shared Libraries, Overlays, Swapping, Contiguous Memory allocation, Paging, Segmentation, Virtual memory, Demand paging, Page replacement, Thrashing. Case Study: Windows Memory Management.

Unit IV: Uniprocessor Scheduling - types, scheduling algorithms - criteria, nonpreemptive, preemptive. Comparative study of scheduling algorithms - FCFS, SJF, Priority, RR, Multilevel, Feedback Queue. Multiprocessor Scheduling - Classification, Granularity, Design Issues, Process Scheduling, Thread Scheduling. Real Time Scheduling - Background, Characteristics of Real Time OS, Scheduling, Deadline Scheduling, Rate Monotonic Scheduling, Priority Inversion. Case study: Linux Scheduling .

Unit V: Client/Server Computing - Definition, Applications, Classes, Three-Tier Client/Server Architecture, Middleware. Service-Oriented Architecture- Distributed Message Passing - Remote Procedure Calls - Clusters. Mobile Operating Systems - Characteristics - Comparative Study of the Features of iOS and Android.

References

1. William Stallings, *Operating System- Internals and Design Principles*, 7th Edition, Pearson, ISBN: 9780273751502.
2. Abraham Silberschatz, Peter B. Galvin and, Greg Gagne, *Operating System Concepts*, 9th Edition, John Wiley & SonsTISBN: 9781118063330.
3. Ann Mclver McHoes and Ida M. Flynn, *Understanding Operating Systems*, 6th Edition, Cengage Learning, 2010, ISBN: 9781439079201.
4. Mukesh Singhal and Niranjan G. Shivaratri, *Advanced Concepts in Operating Systems - Distributed, Database, and Multiprocessor Operating Systems*, Tata McGraw-Hill Education Private Limited, ISBN: 9780070575721.
5. Current Literature (for Mobile Operating Systems).

FCSS2C08 – COMPUTER NETWORKS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To provide the student with a top down approach of networking starting from the application layer.
- To introduce computer networking in the back drop of Internet protocol stack.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Understand the basics concepts of computer network organization and implementation
CO2	Describe theoretical understanding of layered network models - OSI and TCP/IP Models
CO3	Illustrate the functionalities of different network layers
CO4	Analyze the network application such as data transmission between client and server, file transfer, real-time and multimedia transmission
CO5	Explain the security aspects in networks and principles of cryptography

Course Outline:

Unit I: Introduction to Computer networks - introduction - topology - categories of networks Internetwork - Internet - network modes- layered model - OSI and TCP/IP Models Transmission media - Wired and unwired media. Computer networks and Internet - the network edge - the network core - network access - delay and loss - protocol layers and services - history of computer networking and Internet.

Unit II: Application layer protocols – principles – the web and HTTP – FTP, SMTP, POP, IMAP – Email in Internet – DNS. Socket programming – building a Web server - content distribution.

Unit III: Transport layer services – introduction – relationship between Transport and Network layer – UDP – reliable data transfer – TCP - congestion control - Network layer services – routing – IP - routing in Internet - router - IPV6 - multicast routing – mobility. Routing protocol – Distance vector, Link State

Unit IV: Link layer services - error detection and correction - multiple access protocols – LAN address – ARP– Ethernet– hubs– bridges– switches- wirelesslinks– PPP- ATM.

Unit V: Security in Networks –Authentication – Integrity – Principles of Cryptography –DES, AES, RSA, Diffie-Hellman, SHA-I, MDS, Digital Signature - Key Distribution and Certification – Firewalls – Attacks and Counter Measures.

References:

1. J.F.Kuroseand K.W.Ross,*Computer Networking: ATop-Down ApproachFeaturing Internet*, 6th Edition, Perason Education, ISBN: 0132856204.
2. Behrouz Forouzan, *Data Communications and Networking*, 4th Edition, McGraw- Hill Reprint, ISBN: 0073250325.
3. Peterson L.L. and Davie B .S., *Computer Networks, A Systems Approach*, 5th Edition, Morgan Kaufmann, ISBN: 9780123850591.
4. Keshav,*An Engineering Approachto Computer Networking*, Pearson Education Asia, ISBN: 97898123598652000.
5. Andrew S. Tanenbaum, *Computer Networks*, 5th Edition, PHI, ISBN: 9788131787571.
6. Herbert Scheldt, *Java Complete Reference*, 7th Edition, McGraw-Hill Osborne Media, ISBN: 9780072263855.

FCSS2C09 – COMPUTATIONAL INTELLIGENCE

Hrs/Week: 4 (2L+2P) **Credit: 4**

Objectives: To introduce concepts of Artificial Intelligence and Machine Learning.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems
CO2	Conceptualize various knowledge representation techniques
CO3	Analyze the problem-solving methods and algorithms related to searching, reasoning, game playing and machine learning
CO4	Understand the functioning of expert systems and its importance
CO5	Demonstrate the implementation various AI algorithms to solve real life problems

Course Outline

Unit I: Introduction - Artificial Intelligence - problems, scope and applications, problem space and search - production system- characteristics - the predicate calculus, inference rules, structures and strategies for state space search, strategies for space search, using state space to represent reasoning with the predicate calculus.

Unit II: Heuristics Search: control and implementation of state space search, generate and test, hill climbing, Best-first search, problem reduction, constraint satisfaction, means- ends analysis, heuristic in games, complexity issues, Fussy sets: Fuzziness, Membership function , Fuzzification & De-fuzzification, Operations on Fuzzy sets, Fuzzy Rules and Reasoning.

Unit III: Knowledge representation issues, representation and mappings, representing simple facts in logic, representing instances and ISA relationships, computable functions and predicates, resolution, natural deduction, knowledge representation using rules, logic programming, forward versus backward reasoning, symbolic reasoning under uncertainty- non-monotonic reasoning, depth first search, breadth first search.

Unit IV: Game playing - the mini-max search procedure, adding alpha-beta cut-offs, additional refinement, iterative deepening, planning system and its components, understanding, understanding as constrained satisfaction. Slot and filler structures: semantic nets, frames, conceptual dependency, scripts. Definition and characteristics of expert system, representing and using domain knowledge, expert system shells. Knowledge engineering, knowledge acquisition, expert system life cycle & expert system tools, MYCIN & DENDRAL examples of expert system.

Unit V: Machine learning - rote learning, learning by taking advice, learning in problem solving, learning from examples, explanation based learning, analogy, formal learning theory, connectionist models - hopfield networks, learning in neural networks, back propagation, the genetic algorithm, classifier systems and genetic programming, artificial life and society based learning.

References:

1. Elaine Rich, Kevin Knight and Shivshankar B. Nair, *Artificial Intelligence*, 3rd Edition, Tata - McGraw Hill, New Delhi, ISBN: 0070087709.
2. V S Janakiraman, K Sarukesi and P Gopalakrishnan, *Foundations of Artificial Intelligence and Expert System*, Macmillan India Limited, ISBN: 0333926250.
3. Stuart Russell and Peter Norvg, *Artificial Intelligence: A Modern Approach*, 3rd Edition, Prentice Hall, ISBN: 0136042597.'
4. G.F. LugerandW.AStubblefield,*Artificial Intelligence- StructuresandStrategiesfor Complex Problem Solving*, Addison-Wesley, 6th Edition, ISBN:9780321545893.
5. P. H. Winston, *Artificial Intelligence*, Addison-Wesley, 3rd Edition, ISBN: 0201533774.
6. Nils J. Nilsson, Artificial Intelligence, A New Synthesis, 1st Edition, Morgan Kaufmann Publishers, Inc, ISBN: 1558604677.

FCSS2C10 – PRINCIPLES OF SOFTWARE ENGINEERING

Hrs/Week: 4 (2L+2P) **Credit: 4**

Objectives:

- To develop familiarity with software engineering principles and practices.
- To have an understanding about the process of product/literature survey, techniques of problem definition, and methods of reportwriting.

Course Outcome:

COs	COURSE OUTCOMES
CO1	Understand the software process and development models
CO2	Understand the software design process and structured analysis of systems
CO3	Distinguish different types of modelling like DFD and UML
CO4	Illustrate the knowledge about the design of user interface
CO5	Apply the skill of project management and report preparation

Course Outline

Unit I: Introduction – problem domain - software engineering challenges – approaches – software process and development models – agile models – SDLC - software process.

Unit II: Software requirements analysis & specification - feasibility study - types of feasibility – software requirements - problem analysis – requirement specification – functional specification – metrics. Software design – outcome – cohesion and coupling – layered arrangement of modules – approaches to software design - structured analysis – DFD - extending DFD technique for applying to real-time systems – structured design – detailed design - object oriented modelling – use case model – class diagram – interaction diagram - activity diagram - data diagram – state chart diagram - ER diagram.

Unit III: User Interface (UI) design – characteristics – basic concepts – types – fundamentals of component-based GUI Development – UI design methodology – process planning – cost estimation – project scheduling – configuration management – risk management - software coding – review – documentation – software testing - software testing basics - steps involved in test plan - software testing strategies.

Unit IV: Managing project – time management – setting aims and objectives – techniques for generating ideas – literature survey – types of information sources – writing literature survey.

Unit V: Project story preparation – key deliverables – communicating with experts – forms of communication – presenting ideas – common problems faced by a research scholar – report writing.

References:

1. Pankaj Jalote, *An Integrated Approach to Software Engineering*, 3rd Edition, Narosa Publishing House, ISBN: 9788173197024.
2. Rajib Mall, *FundamentalsofSoftware Engineering*, 3rd Edition, PHILearning Pvt Ltd, ISBN: 9788120338197.
3. Rohit Khurana, *Software Engineering: Principles and Practices*, 2nd Edition, Vikas Publishing House Pvt Ltd, ISBN: 8125939466.
4. Andy Hunt, *Your Research Hunt, How to Manage it*, Routledge, ISBN: 0415344085.
5. MichaelJayPolonsky,DavidS.Waller,*DesigningandManagingaResearchProject:A Business Student's Guide*, Sage, ISBN: 1412977754.
6. Richard Bullock, Maureen Daly Goggin and Francine Weinberg, *The Norton Field Guide to Writing (with Readings and Handbook)*, 3rd Edition, W. W. Norton & Company, ISBN: 0393919595.
7. Kavadia Garg, Agrawal and Agrawal, *An introduction to Research Methodology*, Rbsa Publishers ISBN: 8176111651.

FCSS2L02 – PRACTICAL II

Hrs/Week: 4 (4P) **Credit: 2**

Objectives: To practically implement the theory portions covered in the courses *Operating System Concepts* (FCSS2C07) and *Computer Networks* (FCSS2C08) and to extend the programming knowledge acquired through course *The Art of Programming Methodology* (FCSS1C04).

Course Outcome:

COs	COURSE OUTCOMES
CO1	Discuss and formulate the problems based on the basic principles of networks
CO2	Implementation of different memory management techniques in OS
CO3	Implement various system operations of the operating system and also the various process scheduling algorithms
CO4	Understand the TCP/IP configuration for Windows and Linux
CO5	Design and implement various network applications such as data transmission between client and server, file transfer, real-time multimedia transmission
CO6	Understand different Linux/UNIX shell scripts and execute various shell programs

Course Outline

Unit I: Computer Networks

1. Design a LAN with a given set of requirements. The design should include topology, hardware and software requirements like cable, connectors, hubs/switches/bridges, interface cards along with a budget for the LAN. (Faculty in charge should give the requirements to the students)*.
2. Establish a LAN that consists of at least one server and two clients*.
3. Study of network utilities in Linux/Windows (hostname, ping, ifconfig, ipconfig, netstat, nslookup, telnet, traceroute, finger, telnet, tracert, arp, ftp etc)*.
4. Implementation of TCP Client.
5. Implementation of TCP Server.
6. Write a program to check the Date and Time in TCP Date Time Client.
7. Write a program to check the Date and Time in TCP Date Time Server. 8. Implementation of UDP client and server.
8. Write a program to transfer Files using UDP.
9. Implementation of transferring files using FTP.
10. Write a program to simulate the sliding window protocol.
11. Study of Network Simulators (NS2/Glomosim)*.

**These questions are NOT meant for examination purpose. However Viva questions can be asked based on these experiments.*

Unit II: Operating SystemConcepts

1. Write programs using the following system calls: fork(), execl() and wait().
2. Write File System Calls to write, append and display.
3. To accept the burst time for a set of processes for FCFS scheduling and create chart consisting of the burst time, turnaround time and wait time of each process.
4. To accept the burst time for a set of processes for SJF scheduling and create chart consisting of the burst time, turnaround time and wait time of each process.
5. To accept the burst time and priority for a set of processes for Priority scheduling and create chart consisting of the burst time, priority, turnaround time and wait time of each process.
6. To create n Fibonacci numbers and prepare a list of prime numbers amongst them (use pipe for IPC).
7. To demonstrate IPC using shared memory.
8. To allocate memory requirements for processes using best fit allocation- Accept n processes with their memory requirements and *n* holes with their sizes. Perform memory allocation using Best Fit algorithm. Display a chart consisting of the process and the allocated hole.

9. To accept n processes with their memory requirements and n holes with their sizes. Perform memory allocation using First Fit algorithm. Display a chart consisting of the process and the allocated hole.
10. To demonstrate the process of contiguous allocation of memory blocks to store files of varying sizes.
11. To implement Producer Consumer problem usingsemaphores.

FCSS2A02 – TERM PAPER (PROFESSIONALCOMPETENCYAUDIT COURSE)

Objectives:

- To introduce the student to the techniques of literature survey.
- To acquaint him/her with the process of presenting his/her work through seminars and technical reports.

The student is expected to do an extensive literature survey and analysis in an area related to computer science, chosen by him/her, under the supervision of a faculty member from the department. The student has to choose an area for his/her work after due consultation and approval from the guide. The study should preferably result in a critical review of the present works/design ideas/designs/algorithms/theoretical contributions in the form of theorems and proofs/new methods of proof/new techniques or heuristics with analytical studies/implementations and analysis of results.

The student should give a seminar on his/her work, during the semester, and submit a technical report. Technical report should be prepared in TEX in IEEE conference style format.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Apply critical thinking skills analytical ability in problem solving.
CO2	Apply foundational research skills to address research problem.
CO3	Innovate, experiment and analyze research findings.
CO4	Demonstrate capacity to lead and manage change through a collaborative environment.
CO5	Innovate, experiment and analyze research findings and practice the process of scientific publishing

Course Delivery Mode

Students be given choice to opt for the supervisor according to his/her area of interest. The Department council will finally decide and distribute the students among the faculty members by accommodating the choice and interest of the students, as far as possible. The faculty in charge must give proper directions and guidance to the students in carrying out the literature review effectively and systematically.

Course Evaluation & Course Credit

The Professional Competency Audit Course has 4 credits which will not be counted for evaluating the overall SGPA & CGPA. The Department shall conduct the final evaluation of the course based on the following criteria

Component	Weightage
Publication of the Review Paper in a UGC Listed, Peer Reviewed or other peer reviewed refereed Journals	20% (Maximum weightage be given to UGC listed Journal and weightage be reduced in other cases)
Presentation in an International/National/ Regional Conference	20% (Maximum weightage be given to International Conferences with Proceeding having ISBN and weightage be reduced in other cases)
Quality of the Technical Report	40%
Quality and Effectiveness of the Report Presentation	20%

Students have to obtain only minimum pass requirements in this Audit Course.

References:

Articles from ACM/IEEE/INFLIBNET Journals/Conference Proceedings and/or equivalent documents, standard textbooks and web based material, approved by the supervisor.

SEMESTER III

FCSS3C11 – ADVANCED DATABASE MANAGEMENT SYSTEM

Hrs/Week: 4 (3L+1P) **Credit: 4**

Objectives:

- To understand the relational model, and know how to translate requirements captured in an Entity-Relationship diagram into a relational schema.
- To reason about dependencies in a relational schema.
- To understand normal form schemas, and the decomposition process by which normal forms are obtained.
- To familiarize with advanced SQL' statements.
- To understand advanced features of database technologies.

Course Outcomes:

COs	COURSE OUTCOMES
CO1	Explain the basics of database management system, concepts of relational data model, entity-relationship model, relational database design, relational algebra and calculus
CO2	Apply the normalization techniques to improve the database design
CO3	Describe various database manipulation commands in SQL
CO4	Understand Transaction Processing & Locking using the concept of Concurrency control
CO5	Conceptualize advanced features of Object-Oriented Database Management Systems and Distributed databases

Course Outline

Unit I: Introduction - purpose of database systems, views of data - data abstraction, instances and schemas, data independence, data models - hierarchical data model, network data model, relational data model, ER d&tg9,mg9lei. Database languages - DDL, DML, transaction management, storage management, database administrator, database users, overall system structure. Relational data model - relational model concepts, keys, integrity constraints - domain constraints, key constraints, entity integrity constraints, referential integrity constraints. ER data model - basic concepts, constraints, keys, design issues, entity relationship diagram, weak entity sets, extended ER features, design of an ER database schema, reduction of an ER schema to tables. Relational algebra and calculus -relational algebra - selection and projection, set operations, renaming, joins, division. Relational calculus - tuple relational calculus, domain relational calculus. Expressive power of algebra and calculus.

Unit II: Relational database design - anomalies in a database - functional dependency - lossless join and dependency- preserving decomposition - normalization - normal forms - first, second and third normal form - Boyce Codd normal form - multivalued, dependency
- fourth normal form - join dependency - project join normal form - domain key normal form.

Unit III: Relational database query languages - basics of QBE and SQL. Data definition in SQL data types, creation, insertion, viewing, updation, deletion of tables, mo difying the structure of the tables, renaming, dropping of tables. Data constraints - I/O constraints, primary key, foreign key, unique key constraints, ALTER TABLE command database manipulation in SQL - computations done on table data - SELECT command, logical operators, range searching, pattern matching, grouping data from tables in SQL, GROUP BY, HAVING clauses. Joins - joining multiple tables, joining a table to it. DELETE - UPDATE. Views - creation, renaming the column of a view, destroys view. Program with SQL - data types Using SET and SELECT commands, procedural flow, IF, IF /ELSE, WHILE, GOTO, global variables. Security - locks, types of locks, levels of locks. Cursors - working with cursors, error handling, developing stored procedures, CREATE, A LTER and DROP, passing and returning data to stored procedures, using stored procedures within queries, buildinguserdefinedfunctions, creatingandcallingascalarfunction, implementing triggers, creating triggers, multiple trigger interaction (Use MySQL as the RDBMS).

Unit IV: Transaction management, concurrency control and query processing - concept, definition and states of transactions, ACID properties - concurrency control, serializability - conflict serializability, view serializability, recoverability-recoverable schedules, non- cascading schedules, strict schedules.

Concurrency control schemes - locking- two phase locking, deadlock, granularity, timestamp ordering protocol. Basics of query processing.

UnitV: Object Oriented Database Management Systems(OODBMS)- concepts, needfor OODBMS, composite objects, issues in OODBMSs, advantages and disadvantages of OODBMS. Distributed databases - motivation - distributed database concepts, types of distribution, architecture of distributed databases, the design of distributed databases, distributed transactions, commit protocols for distributeddatabases.

Reference

1. Elmasriand Navathe, *Fundamentalsof Database Systems*, 5th Edition, Pearson, ISBN: 9788131758984.
2. Abraham Silbersehatz, Henry F. Korth and S.Sudarshan, *Database System Concepts*, 6th Edition, Tata McGraw-Hill, ISBN: 0071325220.
3. CJ Date, *An Introduction to Database Systems*, 8th Edition, Addison Wesley, ISBN: 0321197844.
4. Ramakrishnan and Gehrke, *Database Management Systems*, 3rd Edition, McGraw - Hill Education, ISBN: 9339213114.
5. Alexis Leon and Mathews Leon, *Database Management Systems*, 1st Edition, Vikas Publishers, ISBN: 8182092221.
6. Vikram Vaswani, *MySQL The complete Reference*, 1st Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 0070586845.
7. Joel Murach, *Murach's Mysql*, Mike Murach & Associates Inc, ISBN: 9350237695.
8. PaulDuBois, *MySQLCookbook*, 2nd Edition, O'Reilly Media, ISBN: 8184042809.

FCSS3C12 – OBJECT ORIENTED PROGRAMMING CONCEPTS

Hrs/Week: 4 (3L+1P) **Credit: 4**

Objectives: To learn object oriented concepts and programming concepts and methodologies and to learn its implementation usingJava.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Recall the object-oriented programing concepts and basics of Java
CO2	Design and implement object-oriented programs including packages and interfaces
CO3	Explain and handle exceptions and threads
CO4	Develop interactive programs using applets, AWT and swings
CO5	Explain the concepts of JDBC, sockets and gives an introduction to Unified Modelling Language (UML)

Course Outline

Unit I: Introduction to OOPS - basic principles of object orientation (objects , attributes and methods, encapsulation and information hiding, state retention, object identity, messages, class hierarchy, inheritance, polymorphism, genericity) - introduction to Java - history, versioning, the Java Virtual Machine, byte code, features of Java, language components - primitive data types, comments, keywords, literals, variables scope & declarations, control structures - FOR, IF, WHILE, DO WHILE, SWITCH, BREAK, CONTINUE statements - operators - casts and conversions - arrays.

Unit II: Object - oriented programming – classes - class fundamentals - declaring objects - new operator – methods – parameter passing – constructors - parameterized constructors - this keyword – finalize method. Overloading methods and constructors, access controls, static and final, nested and inner classes. Inheritance - extends, member access and inheritance, super keyword, polymorphism, method overriding, dynamic method dispatch, abstract classes, packages and interfaces.

Unit III: Exceptions, threads & IO in Java - The file and standard streams, stream classes and interfaces, using byte streams and character streams, threads - threads vs. processes, creating threads, runnable interface, thread class, inter thread communication, synchronization. Exceptions - basic of Java exception handling, hierarchy, developing user defined exception classes.

Unit IV: Applets, AWT & Swing - applet class, types of applet, skeleton, applet tag, passing parameters, event handling, delegation event model, event classes, listeners, AWT classes and window fundamentals, frames, working with fonts, graphics and colors, AWT controls, layouts and menus, dialogue boxes. Swings - Japplets, icon, labels, buttons, textbox, combo box, tables and panes.

Unit V: Database and sockets - JDBC - introduction, architecture, drivers, connections, statements, resultset and meta data (Use MySQL as the RDBMS). Sockets: introduction to networking, InetAddress, url, socket, server sockets, datagrams.

Introduction to Unified Modelling Language (UML), UML diagrams, class diagrams, object interaction diagrams, state and activity diagrams, component diagrams, deployment diagrams. Introduction to analysis - object oriented system analysis, design and implementations.

References

1. Herbert Scheldt, *Java Complete Reference*, 8th Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 1259002462.
2. E Balaguruswamy, *Programming in Java: A Primer*, 4th Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 007014169X.
3. Kathy Sierra, *Head First Java*, 2nd Edition, Shroff Publishers and Distributors Pvt Ltd, ISBN: 8173666024.
4. David Flanagan, Jim Farley, William Crawford and Kris Magnusson, *JavaEnterprise in a Nutshell: A Desktop Quick Reference*, 3rd Edition, O'Reilly Media, ISBN: 0596101422.
5. Grady Booch, James Rumbaugh and Ivar Jacobson, *The Unified Modeling Language User Guide*, 2nd Edition, Pearson, ISBN: 8131715825.

FCSS3C13 – PRINCIPLES OFCOMPILERS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To introduce the fundamental concepts and various phases of compiler design.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the major phases of compilation, identify tokens of a typical high -level programming language, define regular expressions for tokens, design and implement a lexical analyzer
CO2	Develop the parsers and experiment the knowledge of different parsers design without automated tools
CO3	Construct the intermediate code representations and generation
CO4	Explain the role of different types of runtime environments and memory organization for implementation of typical programming languages
CO5	the optimization techniques to have a better code for code generation

Course Outline

Unit I: Introduction to compiling - definition of compiler, translator, interpreter, analysis of the source program, the phases of a compiler, compiler construction tools- applications of compiler technology– programminglanguagebasics-lexicalanalysis–roleoflexicalanalyser
- input buffering - specification of tokens – recognition of tokens using finite automata - regular expressions and finite automata - from NFA to DFA - Regular Expression to an NFA

- Design of a lexical analyser generator.

Unit II: Syntax analysis – role of parser – error handling and recovery – definitions of parsing, top-down parsing and bottom-up parsing - context free grammars – derivations - parse tree – ambiguity – associativity and precedence of operators - writing a grammar – top- down parsing – recursive descent parsing - FIRST and FOLLOW – LL (1) Grammars – recursive predictive parsing - bottom up parsing – reductions – handle pruning – shift reduce parsing - operator precedence parsing, simple LR parsing.

Unit III: Intermediate code generation – DAG – three address code – addresses and instructions – quadruples–triples–Static Simple Assignmentform–typesanddeclarations

- typeexpressions-typeequivalences–declarations–typechecking–rules–typeconversion
- function and operator overloading – type inference and polymorphic functions – control flow – boolean expressions – short circuit code – flow-control statements – control-flow translation for boolean expressions – BREAK CONTINUE and GOTO statements.

Unit IV: Run time environments – storage optimization – static Vs dynamic allocation – stack allocation of space - activation trees and records – calling sequences – access to non local data on the stack – data access without nested procedures – issues with nested procedures – heap management – the memory manager – the memory hierarchy – locality in programs – reducing fragmentation - manual deallocation requests.

Unit V: Code generation – issues in the design of a code generator – the target language – a simple target machine model – the program and instruction costs – address in the target code – static allocation – stack allocation – run-time address for names – basic blocks and flow graphs – representation of flow graphs. Code optimization - the principal sources of optimization – data flow analysis – abstraction – data flow analysis schema – data flow schemas on basic blocks – reaching definitions – live variable analysis – available expressions. Region based analysis – regions – region hierarchies for reducible flow graphs – overview of a region based analysis.

References:

1. V Aho A, Ravi Sethi, D Ullman J, *Compilers Principles*, Techniques and Tools, 2nd Edition, Pearson Education Singapore Pte Ltd, ISBN: 8131721019.
2. K. V. N. Sunitha, *Compiler Construction*, Pearson, ISBN:9789332500297.

3. W Appel and Andrew, *Modern Compiler Implementation in C*, 1st Edition,Cambridge University Press, ISBN: 817596071X.
4. Allen I Holub, *Compiler Design in C*, 1st Edition, PHI Learning Pvt Ltd, ISBN: 812030778X.
5. Tremblay and Sorenson, *The Theory and Practice of Compiler Writing*, 1st Edition, BSP Books Pvt Ltd, ISBN: 8178000776.
6. Torben Ægidius Mogensen, *Basics of Compiler Design*, Department of Computer Science, University of Copenhagen (Online Edition).

FCSS3L03 – PRACTICAL III

Hrs/Week: 4 (4P) **Credit: 2**

Objectives: To practically implement the theoretical aspects covered in Advanced Database Management System (FCSS3C11) and Object Oriented Programming Concepts (FCSS3C12) and to extend the programming knowledge acquired through The Art of Programming Methodology (FCSS1C04) to encompass object oriented techniques.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Design and development of relational database systems
CO2	Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger and views
CO3	Apply various software to design and build ER Diagrams, UML, Flowchart for related database systems
CO4	Design and implement database applications on their own
CO5	Apply JDBC to provide a program level interface for communicating with database using Java programming
CO6	Use an integrated development environment to write, compile, run, and test simple object oriented Java programs
CO7	Understand Java programming concepts and utilize Java Graphical User Interface in program writing
CO8	Design and develop Java programs that solve real-world problems

Course Outline

Unit I: Advanced Database Management System,

1. Creating database tables and using data types (create table, modify table, drop table).
2. Data Manipulation (adding data with INSERT, modify data with UPDATE, deleting records with DELETE).
3. Implementing the Constraints (NULL and NOT NULL, primary key and foreign key constraint, unique, check and defaultconstraint).
4. Retrieving Data Using SELECT (simple SELECT, WHERE, IN, BETWEEN, ORDERED BY, DISTINCT and GROUP BY).
5. Aggregate Functions (AVG, COUNT, MAX, MIN, SUM).
6. String functions.
7. Date and Time Functions.
8. Use of union, intersection, set difference.
9. Implement Nested Queries & JOIN operation.
10. Performing different operations on a view.
11. Stored Procedure Programming - Simple Procedures - decision making - Loops - Error handlers - Cursors - Functions - Triggers - Calling Stored Procedure from Triggers.

Unit II: Object Oriented Programming Concepts

1. Simple Java programs like computing formulas expressions.
2. Programs involving loops and decisions like generating Fibonacci, prime, strange series.
3. Programs involving arrays.
4. Programs involving class and objects.
5. Illustrate method overloading.
6. Illustrate single level inheritance.
7. Illustrate multiple inheritances using interface.
8. String sorting, pattern matching etc.
9. Illustrate threads and thread priorities.
10. Illustrate the use of Packages.
11. Exception handling (user-defined).
12. Abstract class.

13. Method overriding.
14. Illustrate usage of Applets like moving ball, face etc.
15. Create an AWT application for a simple calculator.
16. Frame application to illustrate the windowevents.
17. Frame application to illustrate mouse and keyboard event handling.
18. Swing applications.
19. Create a JDBC application to add the details of a student into a table (Use MySQL as the RDBMS).
20. Socket Programming.

FCSS3E01a – VIRTUALISATION AND CLOUD COMPUTING

Hrs/Week: 4 (4L) **Credit: 4**

Objectives

- Understand the technical capabilities and business benefits of virtualization and cloud computing and how to measure these benefits.
- Describe the landscape of different types of virtualization and understand the different types of clouds.
- Illustrate how key application features can be delivered on virtual infrastructures.
- Explain typical steps that lead to the successful adoption of virtualization technologies.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basics of cloud computing.
CO2	Describe different types of virtualization
CO3	Identify the cloud infrastructure and the key application features delivered on virtual infrastructures
CO4	Describe parallel and distributed programming models and programming paradigms.
CO5	Understand mapping applications and Hadoop configuration.
CO6	Analyze security challenges in the cloud

Course Outline

Unit I: Introduction - evolution of cloud computing - system models for distributed and cloud computing - NIST cloud computing reference architecture - Infrastructure as a Service (IaaS) - resource virtualization - Platform as a Service (PaaS) - cloud platform & management - Software as a Service (SaaS) - available service providers, Public and Private Cloud.

Unit II: Virtualization - basics of virtualization - types of virtualization - implementation levels of virtualization - virtualization structures - tools and mechanisms - virtualization of CPU, memory, I/O devices - desktop virtualization - server virtualization - Linux KVM, Xen, Qemu, LXC, OpenVZ.

Unit III: Cloud infrastructure - FOSS cloud software environments - Eucalyptus, Open Nebula, OpenStack - OpenStack architecture - compute, object storage, image service, identity, dashboard, networking, block storage, metering, basic cloud orchestration and service definition.
Unit IV: Programming model - parallel and distributed programming paradigms – Mapreduce, twister and iterative Mapreduce – mapping applications - programming support

- Apache Hadoop – HDFS, Hadoop I/O, Hadoop configuration, MapReduce on Hadoop.

Unit V: Security in the cloud - security overview – cloud security challenges – software-as- aservice security – security governance – risk management – security monitoring – security architecture design – data security– application security– virtual machine security– Qubes

- desktop security through Virtualization.

References:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, Distributed and Cloud Computing (From Parallel Processing to the Internet of Things), Elsevier Science, ISBN: 9780128002049.
2. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management, and Security, 1st Edition, CRC Press, ISBN: 1439806802.
3. Toby Velte, Robert Elsenpeter and Anthony Velte, Cloud Computing, A Practical Approach, TMH, ISBN: 9780071626958.
4. George Reese, Cloud Application Architectures, 1st Edition, Shroff /O'Reilly, ISBN: 8184047142.

5. Ravi Nair and Jim Smith, Virtual Machines: Versatile Platforms for Systems and Processes, 1st Edition, Elsevier Science / Morgan Kaufmann, ISBN: 9780080525402/ 1558609105.
6. Katarina Stanoevska - Slabeva, Thomas Wozniak, Santi Ristol, Grid and Cloud Computing - A Business Perspective on Technology and Applications, Springer, ISBN: 3642051928.
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FCSS3E01b – INTRODUCTION TO SOFT COMPUTING

Hrs/Week: 4 (4L) **Credit: 4**

Objectives

- To give students the fundamental knowledge of soft computing theories.
- To expose the fundamentals of non-traditional technologies and approaches to solving hard real-world problems.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand soft computing techniques and their role in problem solving
CO2	Conceptualize and parameterize various algorithms in problem solving
CO3	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.
CO4	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
CO5	Conceptualize advanced topics of evolutionary algorithms and swarm intelligence

Course Outline

Unit I: Introduction - introduction to statistical ,syntactic and descriptive approaches - features and feature extraction - learning - Bayes Decision theory - introduction - continuous case - 2-category classification - minimum error rate classification - classifiers - discriminant functions - decision surfaces – error probabilities and integrals - normal density - discriminant functions for normal density.

Unit II: Introduction to genetic algorithm, genetic operators and parameters, genetic algorithms in problem solving, theoretical foundations of genetic algorithms, implementation issues – systems.

Unit III: Neural model and network architectures, perceptron learning, supervised hebbian learning, back-propagation, associative learning, competitive networks, hopfield network, computing with neural nets and applications of neural network.

Unit IV: Introduction to fuzzy sets, operations on fuzzy sets, fuzzy relations, fuzzy measures, applications of fuzzy set theory to different branches of science and engineering.

Unit V: Advanced topics - support vector machines, evolutionary computation (EC) - evolutionary algorithms, harmony search, swarm intelligence.

References:

1. Chuen-Tsai Sun, Eiji Mizutani and Jyh-Shing Roger Jang, *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*, Prentice Hall India, ISBN: 8120322436.
2. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, ISBN: 0262631857.
3. D. E. Goldberg, *Genetic Algorithmsin Search, Optimization, and Machine Learning*, Addison-Wesley, ISBN: 0785342157673.
4. S. V. Kartalopoulos, *Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications*, Wiley-IEEE Press, 1st Edition, ISBN: 07803112802004.
5. S.RajasekaranandG.A.VijayalakshmiPai,*NeuralNetworks,FuzzyLogicandGenetic Algorithms: Synthesis & Applications*, PHI, ISBN:9788120321861.

FCSS3E01c – WEB TECHNOLOGY

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To introduce the tools for creating and maintaining websites – content development (HTML), client side scripting (JavaScript), web server (Apache), server side scripting (PHP) and content management system (Joomla!).

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basics of HTML, XML and CSS
CO2	Learn client-side programming and basics of Javascript
CO3	Explore web servers and server-side technologies
CO4	Able to do server-side programming with PHP
CO5	Illustrate and apply content management systems and its features

Course Outline

Unit I: Introduction to web programming - introduction to SGML features - HTML, XHTML, DHTML, XML - HTML Vs XML - creating XML documents - parsing an XML document writing well-formed documents - organizing elements with namespaces - defining elements in a DTD - declaring elements and attributes in a DTD. Overview of HTML basic formatting tags - heading, paragraph, underline break, bold, italic, underline, superscript, subscript, font and image. Attributes - align, color, bgcolor, font face, border, size. Navigation links using anchor tag - internal, external, mail and image links. Lists - ordered, unordered and definition, table tag, HTML form controls - form, text, password, textarea, button, checkbox, radio button, select box, hidden controls, frameset and frames. CSS.

Unit II: Client side programming – introduction – popular client side scripting languages

- Java Script - introduction, identifiers, operators, functions, event handling, classes, objects, array, math, string, window object, navigator DHTML font, text, image change, table expansion. JavaScript's object model- strengths and weaknesses of JavaScript - building and extending objects in JavaScript - events in JavaScript - event handlers - creating interactive forms – cookies - storing users choices in cookies - encoding cookies - browser objects - object hierarchy, creating browser objects, working with window, document, history & location - browser detection, Java to JavaScript communication.

Unit III: Web server – role - Apache web server – introduction – architecture – features - Apache's role in the Internet – LAMP – WAMP - installation and configuration - build and install Apache web server - verify initial configuration start, stop, and status the Apache server process. Configure Apache core modules security - basic security with Apache - host-based authentication - user-based authentication - secure sockets layer (SSL) - delivering dynamic web content - Apache's role in the dynamic web - server side includes (SSIs) - configure Apache web server to support CGI – CGI Alternative Technologies. virtual hosts, redirection, indexing – virtual hosting with Apache, virtual host configuration redirection, directory indexing. Proxy servers and firewalls - apache proxy configuring, proxy services firewalls and apache, firewall architecture models monitoring apache web server - error logs, logging http access, web server status and server information, user tracking - proxy caching.

Unit IV: Server side programming – server side scripts – PHP – designing dynamic web pages using PHP - defining PHP variables – variable types – operators – control flow constructs in PHP – passing form data between pages - establishing connection with MySQL database – managing database.

Unit V: Overview of content management system - coding for reusability (header.php) – user management - article publishing - additional CMS features – Web site development using Joomla!.

References:

1. Thomas A. Powell, *The Complete Reference HTML*, 3rd Edition, McGraw- Hill/Osborne Media, ISBN: 0072129514.
2. Thomas A. Powell, *Web Design: The Complete Reference*, 2nd Sub-Edition, McGraw-Hill/Osborne Media, ISBN: 0072119772

3. Robert W. Sebesta, *Programming with World Wide Web*, 7th Edition, Addison- Wesley, ISBN: 9780132665810.
4. Xue Bai, Michael Ekedahl, Joyce Farrell, Don Gosselin, Diane Zak, Bill Morrissey, Michael V. Ekedahl, Peter Macintyre and Shashi Kaparthi, *The Web Warrior Guide to Web programming*, Thomson Learning, ISBN: 9780619064587.
5. Chris Bates, *Web Programming: Building Internet Applications*, 3rd Edition, Wiley Academic Catalog, ISBN: 9780470017753.
6. Paul J. Deitel, Harvey M. Deitel, Harvey Deitel, Paul Deitel and Abbey Deitel, *Internet and World Wide Web: How to Program*, 5th Edition, Prentice Hall, ISBN: 9780132151009.
7. R. Allen Wyke and Richard Wagner, *JavaScript Unleashed*, 3rd Edition, SAMS, ISBN: 9780672317637.
8. Richard Bowen Ken Coar, Ken A Coar and Matthew Marlowe, *Apache Server Unleashed*, SAMS, ISBN: 0672318083.
9. Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz and Michael K Glass, Beginning PHP5, *Apache, and MySQL Web Development*, Wrox, ISBN: 0764579665.
10. Jennifer Marriott and Elin Waring, *The Official Joomla! Book*, Addison-Wesley Professional, ISBN: 978-0321821546.
11. Ron Severdia and Kenneth Crowder, *Using Joomla: Building Powerful and Efficient Web Sites*, 1st Edition, O'Reilly Media, ISBN: 9780596804947.

FCSS3E01d – BIOINFORMATICS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: Expose students to the popular genomic and proteomic databases and to impart knowledge in processing and analysing genomic data and to introduce advanced topics in Bioinformatics.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basic concepts of Bioinformatics and its significance in Biological data analysis
CO2	Demonstrate various techniques, algorithms and tools employed in computational biology.
CO3	Identify steps in sequence alignment.
CO4	Analyze various databases and tools on nucleic acids and protein.
CO5	Understand the types of data found at NCBI and EBI resources

Course Outline

Unit I: Bioinformatics - introduction to - nature and scope of computational biology and Bioinformatics. Cells - prokaryotes and eukaryotes - DNA double helix - central dogma - RNA, Amino acids, Proteins - string representations. A glossary of Bioinformatics terms - file format for bio-molecular sequences, sequence alignment, phylogeny, gene finding, microarray analysis, homology and evolutionary relationships.

Unit II: Basic algorithms in Computational Biology - exhaustive search methods and their applications in Computational Biology - string matching algorithms. Motif finding - tandem repeats - concept of dynamic programming - graph algorithms - clustering algorithms.

Unit III: Sequence alignment - pair-wise sequence alignment, need of scoring schemes - penalizing gaps, scoring matrices for amino acid sequence alignment, PAM probability matrix and log odds matrix, BLOSUM, Dot-plot visualization, Needleman- Wunsch algorithm- effect of scoring schemes - evalues - BLAST and FASTA, Smith - Waterman algorithm for local alignment.

Unit IV: Multiple sequence alignment - sequence alignment using dynamic programming, Ndimensional dynamic programming. Tools for MSA - muscle and T-Coffee. Phylogenetic algorithms - evaluation of phylogenetic trees, significance.

Unit V: Introduction to the major resources - NCBI, EBI and ExPASy - nucleic acid sequence databases - GenBank, EMBL, DDBJ – Protein sequence databases - SWISS- PROT, TrEMBL, PIR_PSD - genome databases at NCBI, EBI, TIGR, SANGER – procedures to access these databases and to make use of the tools available.

References:

1. Mount D, *Bioinformatics; Sequence & Genome Analysis*, 2nd Edition, Cold spring Harbor Press, ISBN: 978-087969712.
2. Dan Gusfield, *Algorithms on Strings Trees and Sequences*, 1st Edition, Cambridge University Press, ISBN: 0521585198.
3. Pevzner P A, *Computational Molecular Biology: An Algorithmic Approach*, MIT Press, Cambridge, MA, ISBN: ISBN: 9780262161978.
4. Jeremy J. Ramsden, *Bioinformatics: An Introduction*, Springer, ISBN: 9789401570961.
5. Sushmita M and Tinku A, *Data Mining: Multimedia, Soft Computing and Bioinformatics*, Wiley-Interscience, ISBN: 9780471460541.
6. Richard M. Karp, *Mathematical Challenges from Genomics and Molecular Biology*, Notices of the American Mathematical Society, vol. 49, no. 5, pp. 544553.
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8. Tao Jiang, Ying Xu and Michael Q. Zhang, *Current Topics in Computational Molecular Biology Edible OH Processing*, 1st Edition, Ane Books Pvt Ltd, ISBN: 9788180520525.
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FCSS3E01e – COMPUTER OPTIMIZATION TECHNIQUES

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To give an exposure for the student to the area of modelling techniques, numerical methods and algorithms.
- To realize the importance of various aspects of optimizationtechniques in industries like IT.
- To implement the knowledge of optimization techniques in real life problems.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand linear programming methods and formulate real world problems into mathematical problems
CO2	Apply linear programming methods like transportation and network problems.
CO3	Understand different linear programming methods and applications.
CO4	Understand integer linear programming and algorithms to solve it.
CO5	Understand the basics of dynamic programming and nonlinear programming

Course Outline

Unit I: Linear programming and sensitivity analysis - two variable LP model, graphical and algebraic LP solutions, some LP applications, the simplex method and sensitivity analysis, primal-dual relationships and economic interpretation, dual simplex and generalized simplex algorithms and post-optimal analysis.

Unit II: Transportation and Network models - The transportation models and algorithm, the assignment and trans-shipment models, minimum spanning tree algorithm, shortest- route problem, maximum flow and min-cost models, critical path method andalgorithms for matching.

Unit III: Advanced linear programming and applications - simplex method fundamentals, revised simplex method and computational considerations, bounded variables algorithm, duality, parametric linear programming, goal programming formulations and algorithms.

Unit IV: Integer linear programming - illustrative applications, integer programming algorithms, unimodularity and cutting-plane methods, travelling salesperson problem.

Unit V: Dynamic programming (DP) and its application - recursive nature of computations in DP, forward and backward recursion, selected DP applications, problem of dimensionality, branch and bound method and dynamic programming, some deterministic inventory models. Nonlinear programming - convex programming problems, unconstrained problems and algorithms, constrained problems and algorithms.

References:

1. H. A. Taha, *Operations Research: An Introduction*, 9th Edition, Pearson Prentice Hall, ISBN: 013255593X.
2. C. H. Papadimitriou, K. Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Dover Publications, ISBN: 9780486402581.

FCSS3E01f – NUMERICAL AND STATISTICAL METHODS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives: To provide the student with basic concepts in statistics, probability that can be applied for mathematical modelling of computer applications.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Recognize the error in the number generated by the solution.
CO2	Compute solution of algebraic and transcendental equation by numerical methods like the Bisection method and Newton Rapshon method
CO3	Understand the concepts of solving integrals mathematically.
CO4	Understand different probabilities and its properties.
CO5	Solve linear programming problems

Course Outline

Unit I: Approximation and errors in computing - introduction, significant digits - inherent errors - numerical error - modelling errors - blunders - absolute and relative errors - conditioning and stability. Roots of non-linear equations - introduction - iterative methods

- bisection - false position - Newton - Raphson's, Secant and Bairstow's methods.

Unit II: Introduction solution of linear equations - Gauss elimination - Gauss-Jordan method Jacobi Iteration method - Gauss-Seidal methods. Interpolation - linear interpolation Newton's forward backward & divided difference interpolation methods - Lagrange's method.

Unit III: Integration - trapezoidal rule, Simpson's 1/3, & 3/8 rules. Differential equations: Heunn's polygon, Range-Kutta fourth order, Milne-Simpson, Adams-Bashforth and Adams- Moulton methods.

Unit IV: Classical definition of probability – statistical definition of probability – axiomatic approach to probability – addition and multiplication theorem on probability - compound and conditional probability – independence of events – Bayes theorem random variables – discrete and continues – pmf, pdf and distribution functions.

Unit V: Introduction linear programming - mathematical formulation - graphical method of solution - simplexmethod- duality- dualsimplex- transportation- assignment problems.

References

1. E. Balagurusamy, *Numerical Methods*, 1st Edition, Tata McGraw Hill Education Private Limited, ISBN: 0074633112.
2. S.G. Gupta and V.K. Kapoor, *Fundamentals of Mathematical Statistics*, 11th Edition, Sultan Chand & Sons , ISBN: 9788180545283.
3. V.Rajaraman, *Computer Oriented Numerical Methods*, 3rd Edition, Prentice Hall Of India, ISBN: 81203078601993.
4. Satyendra Mittal and C. P. Sethi, *Linear Programming*, Pragati Prakashan.

FCSS3E02a – PATTERN RECOGNITION

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To understand the concept of a pattern and the basic approach to the development of patternrecognition algorithms.
- To understand and apply methods for pre-processing, feature extraction, and feature selectionto multivariate data.
- To understand supervised and unsupervised classification methods to detect andcharacterize patterns in real-world data.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques
CO2	Recognize the principles of Bayesian parameter estimation
CO3	Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis
CO4	Apply pattern recognition techniques for pre-processing, feature extraction and feature selection
CO5	Understand supervised and unsupervised classification methods to detect and characterize patterns in real-world data

Course Outline

Unit I: Introduction - introduction to statistical - syntactic and descriptive approaches - features and feature extraction - learning - Bayes Decision theory - introduction - continuous case 2 - category classification - minimum error rate classification - classifiers - discriminant functions - decision surfaces – error probabilities and integrals - normal density - discriminant functions for normal density..

Unit II: Parameter estimation and supervised learning - maximum likelihood estimation - the Bayes classifier - learning the mean of a normal density - general Bayesian learning nonparametric technique - density estimation - parzen windows - k-nearest neighbour estimation - estimation of posterior probabilities - nearest-neighbour rule - k-nearest neighbour rule.

Unit III: Linear discriminant functions - linear discriminant functions and decision surfaces - generalized linear discriminant functions - 2-category linearly separable case – non- separable behaviour - linear programming algorithms, support vector machines - multilayer neural networks - feed forward operation and classification, back propagation algorithm, error surface, back propagation as feature mapping.

Unit IV: Syntactic methods - stochastic search - Boltzmann learning - Nonmetric methods

- decision trees - CART - other tree methods, grammatical methods, grammatical inference.

Unit V: Unsupervised learning and clustering - mixture densities and identifiability, maximum likelihood estimates, applications to normal mixtures, unsupervised Bayesian learning, data description and clustering.

References:

1. Richard O. Duda, Peter E. Hart and David G. Stork, Pattern Classification, CBS Publishers & Distributors, 2nd Edition, ISBN: 9788126511167.
2. Gonzalez R.C. and Thomson M.G., Syntactic Pattern Recognition: An Introduction, 1st Edition, Addison-Wesley, ISBN: 0201029316.
3. Fu K. S., Syntactic Pattern Recognition and Applications, Prentice Hall, ISBN: 0138801207.
4. Rajjan Shinghal, Pattern Recognition: Techniques and Applications, 1st Edition, Oxford University Press India, ISBN: 0195676858.

FCSS3E02b – WIRELESS & MOBILE NETWORKS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives

- To understand the fundamental concepts of wireless and mobile networks.
- To familiarize with wireless application Protocols to develop mobile content applications.
- To understand about the security aspects of wireless networks.
- To learn programming in the wireless mobileenvironment.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the fundamental concepts of wireless and mobile networks.
CO2	Illustrate the wireless application protocols for mobile content development.
CO3	Analyze various wireless mobile programming methodologies.
CO4	Understand security aspects of wireless networks.
CO5	Understand TCP/IP extensions for wireless mobile networking

Course Outline

Unit I: Introduction - applications - brief history of wireless communication – open research problems – wireless transmission – frequencies for radio transmission – signals – antennas – signal propagation – multiplexing – modulation – spread spectrum – cellular systems – medium access control – motivation – SDMA – FDMA – TDMA – CDMA – comparison.

Unit II: Different generations of Wireless Cellular Networks - 1G, 2G, 2.5G, 3G, 4G. Telecommunication systems – GSM – DECT – TETRA – UMTS – IMT-2000. Wireless LAN – Infrared Vs Radio transmission – Infrastructure Vs Adhoc networks – IEEE 802.11

- HIPERLAN – Bluetooth.

Unit III: Mobile network layer - Mobile IP - Dynamic Host Configuration Protocol - Routing - DSDV - DSR - Alternative Metrics. Transport and application layers - traditional TCP classical TCP improvements - WAP, WAP 2.0.

Unit IV: Wireless network security - IEEE 80211i security - Wireless Transport Layer Security sessions and connections - protocol architecture - WAP end-to-end security.

Unit V: Java for wireless devices - setting up the development environment - basic data types, libraries (CLDC, MIDP) - UI controls - displayable and display image - events and event handling - list and choice - text box - alerts - persistent storage - record stores -records
- record enumeration - network MIDlets - the connection framework - connection interface
- connection using HTTP - datagram connection.

References:

1. Jochen Schiller, *Mobile Communications*, Pearson Education, 2nd Edition, ISBN: 8131724263.
2. Raj Kamal, *Mobile Computing*, 2nd Edition Oxford Univ Press, ISBN: 0198068913.
3. William Stallings, *Network Security Essentials Applications and Standards*, 4th Edition, Pearson India, ISBN: 8131761754.
4. Yu Feng and Jun Zhu, *Wireless Java Programming with J2ME*, 1st Edition, Sams, ISBN: 0672321351.
5. Dreamtech Software Team, *Wireless Programming with J2ME*: Cracking the Code, Wiley, ISBN: 0764548859. C,
6. William Stallings, *Wireless Communications and Networks*, 2nd Edition, Pearson India, ISBN: 8131720934.
7. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtorff and Thomas Schaeck, *Pervasive Computing Technology and Architecture of Mobile Internet Applications*, 14th Edition, Pearson Education, ISBN: 8177582801.
8. Nishit Narang and Sumit Kasera, *2G Mobile Networks: GSM and HSCSD*, Tata McGraw Hill Education, ISBN: 0070621063.
9. Hasan Ahmed, Roopa Yavagal and Asoke K Talukder, *Mobile Computing: Technology, Applications and Service Creation*, 2nd Edition, Tata Mcgraw Hill Education Private Limited, ISBN: 0070144575.

FCSS3E02c – CRYPTOGRAPHY AND NETWORK SECURITY

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To be familiar with classical and modern encryption and decryption techniques and apply in the security system.
- To understand various aspects of network security standards.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the fundamentals of cryptography.
CO2	Describe data integrity, authentication, digital signatures.
CO3	Analyze different network security applications
CO4	Familiarize standard algorithms that provide confidentiality, integrity and authenticity
CO5	Understand network security technologies

Course Outline

Unit I: Computer security concepts – challenges – security attacks – security services – security mechanisms – a model for network security. Cryptography – symmetric encryption principles – cryptography – cryptanalysis – Feistal Cipher structure. symmetric block encryption algorithms - DES – Triple DES – AES – random and pseudorandom numbers – stream cipher and RC4 – cipher block modes of operation.

Unit II: Message authentication – approaches – MAC – one way Hash function – secure Hash functions – Message Authentication Codes. Public key cryptography principles –

algorithms – digital Signatures.

Unit III: Network security applications - symmetric key distributions using symmetric encryption - Kerberos version 4 - key distributions using asymmetric encryption - X.509 certificates - public key infrastructure - federated identity management.

Unit IV: Transport level security - web security considerations - secure socket layer and transport layer security - SSL architecture - SSL record protocol - change cipher spec protocol - handshake protocol. Transport layer security - HTTPS - SSH. IP Security - overview - policy - encapsulating security payload - combining security associations - internet key exchange.

Unit V: Intruders - intruders, intrusion detection, password management. Malicious software - types, viruses, countermeasures, worms, DDoS. Firewalls - need - characteristics, types, firewall basing, location and configuration - DMZ networks, VPN - distributed firewalls.

References:

1. William Stallings, Network Security Essentials Applications and Standards, 4th Edition, Pearson India, ISBN: 8131761754.
2. William Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Pearson India, ISBN: 9332518777.
3. Atul Kahate, Cryptography and Network Security, 3rd Edition, Tata McGraw- Hill Publishing, ISBN: 9789332900929.
4. Eric Maiwald, Fundamental of Network Security, 1st Edition, Tata McGraw - Hill Education, 0071070931.
5. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security: Private Communication in Public WorJd, 2nd Edition, PHI Learning Pvt Ltd, ISBN: 8120322134.

FCSS3E02d – ADVANCED WEB TECHNOLOGY

Hrs/Week: 4 (4L) **Credit: 4**

Objective: To introduce the advanced concepts of web development tools - Web 2.0, Web Services, Python, SQLite and MVC architecture.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the concepts of Web 2.0.
CO2	Conceptualize web services and its architecture.
CO3	Develop applications using Python programming language.
CO4	Analyze server-side programming with Python.
CO5	Develop applications with Python-SQLite integration

Course Outline

Unit I: Web 2.0 - definition, characteristics, key features, client side technologies (Ajax and JavaScript frameworks - YUI library, Dojo toolkit, MooTools, jQuery, Ext JS and prototype JavaScript framework), server side technologies (Ruby, Perl, Python, Enterprise Java J2EE and Microsoft.NET Framework), concepts (Rich Internet Application — Web-Oriented Architecture — Social Web), SLATES.

Unit II: Fundamentals of Web Services - Definition, Components, benefits, behavioural characteristics. Web services architecture - web service roles, web service protocol stack, service transport. Web services components - XML-RPC, SOAP, WSDL, UDDI. web services security (notions) - confidentiality (XML-RPC and SOAP run on top of HTTP) - support for Secure Sockets Layer (SSL) for HTTP - encrypted communication via SSL, authentication (HTTP's built-in support for Basic and Digest authentication - SOAP security extensions - Digital Signature - SOAP - DSIG - SAML).

Unit III: Introduction to Python - installation - Python interpreter - usage and customization - editor setup - variables, expressions and statements - functions. Strings - lists
- list comprehensions - stacks - queues - tuples - sequences - sets - dictionaries - sets - modules, I/O and exception handling - modules - search path - compiled modules - standard modules
- packages - input and output functions - files - read and write - exception - handling and raising - user defined exceptions.

Unit IV: Server side programming using Python - server side scripting - CGI - role of Web server – Apache web server – Python server side script – developing Python Server Side Pages (PSP) – capturing form data– validation– processing data– exchange of databetween form and server.

Unit V: Python-SQLite integration - features of SQLite data types, introduction to SQL commands - SELECT, DELETE, UPDATE, INSERT. Python functions for SQLite operations - database connection, database and table creation, selection, query, fetching results - insertion and deletion of data using Python - displaying data from SQLite in webpage. Case study - server MVC design pattern - Django.

References

1. James Governor, Web 2.0 Architectures: What Entrepreneurs & Information Architects Need to Know, 1st Edition, Shroff Publisher & Distributors, ISBN: 8184047355.
2. S. V. Subrahmanya and B. V. Kumar, Web Services: An Introduction, 2nd Edition, Tata Mc-graw Hill Publishing Co. Ltd, ISBN: 1259002764.
3. Web 2.0, http://en.wikipedia.org/wiki/Web_2.0
4. Web Services, http://www.tutorialspoint.com/webservices/
5. Ron Schmelzer, Michael Qualls, Sam Hunting, David Houlding, Madhu Siddalingaiah, Jason Bloomberg, Travis Vandersypen, Chad Darby and Diane Kennedy, XML and Web Services Unleashed, Sams, ISBN: 0672323419.
6. Sandeep Chatterjee, James Webber, Developing Enterprise Web Services: An Architect's Guide, 1st Edition, Pearson India, ISBN: 8131713172.
7. The Python Tutorial, http://docs.python.org/3.3/tutorial/
8. Allen Downey, Jeffrey Elkner and Chris Meyers, How to Think Like a Computer Scientist: Learning with Python, Createspace, 2009, ISBN: 1441419071. Online Version: http://openbookproject.net/thinkcs/python/english3e/
9. Python Documentation. A vailable at http://www.python.org/doc/
10. Swarooph CH, A Byte of Python. Available at http://swaroopch.com/ notes/python/
11. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson Education, ISBN: 8131711889.

FCSS3E02e – COMPUTER GRAPHICS

Hrs/Week: 4 (4L) **Credit: 4**

Objectives:

- To understand the fundamentals of the modern computer graphics.
- To pipeline the mathematics of affine transformations in three dimensions.
- To understand the common data structures to represent and manipulate geometry, colour and light representation and manipulation in graphics systems.
- To have an exposure to programming in OpenGL.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basics of computer graphics, different graphics systems and applications of computer graphics
CO2	Extract scene with different clipping methods and its transformation to graphics display device
CO3	Explore projections and visible surface detection techniques for display.
CO4	Explore object representations and surface detection methods.
CO5	Understand techniques and OpenGL programming concepts

Course Outline

Unit I: Introduction – Application of computer graphics, Video Display Devices- refresh CRT, raster and random scan display, color CRT, flat panel, LCD, LED, DVST. Raster - Scan Systems-video controller, display processor, Random-Scan Systems.

Unit II: 2D Graphics: Line drawing algorithms - DDA, Bresenham's - Midpoint Circle drawing algorithm -Filling-Scan line polygon fill algorithm, boundary fill algorithm, floodfill algorithm, 2D Transformations-translation, rotation, scaling, shearing and reflection, composite transformations. 2D Viewing -the viewing pipeline, viewing coordinate reference frame, window-to- viewport coordinate transformation. Clipping-point clipping, Cohen Sutherland line clipping, Sutherland Hodgeman polygon clipping, text clipping.

Unit III: 3D Graphics: 3D Transformations- translation, rotation, scaling, shearing and reflection,3D Viewing-viewing pipeline, viewing coordinates, projections- parallel & perspective projections.

Unit IV: 3D object representation - wireframe model, curve representation, surfaces, spline representation, bezier curves, cubic spline. Visible surface detection methods- classification, back-face detection, Z-buffer algorithm.

Unit V: Discrete Techniques and OpenGL programming - Texture mapping, Bit and Pixel operations, Compositing, Sampling and Aliasing Techniques. Introduction to OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL - GL, GLU & GLUT, a few examples of OpenGL programs.

References:

1. DonaldHearnandM.PaulineBaker,*ComputerGraphics*,2ndEdition,PrenticeHall, ISBN: 0135309247.
2. Donald D. Hearn, M. Pauline Bakerand Warren Carithers, *Computer Graphicswith Open GL*, 4th Edition, Prentice Hall, ISBN:9780136053583.
3. Hill, *Computer Graphics using OpenGL*, 3rd Edition, Prentice Hall of India Private Ltd. New Delhi, ISBN: 8120338294.
4. Mason Woo, Jackie Neider, Tom Davis, Dave Shreiner, Dave Shriner and Tom David, *Open GLProgramming Guide*,6thEdition, Person,ISBN:9780201604580.
5. *The Official Guide to Learning OpenGL*, Version 1.1, Available at http://www.glprogramming.com/red/.
6. Shreiner and Angel, *Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL*, 6th Edition, Pearson Education, ISBN: 0132545233.

FCSS3E02f – DATA WAREHOUSING AND DATA MINING

Hrs/Week: 4 (4L) **Credit: 4**

Objectives

- To provide the fundamentals on information retrieval and data mining techniques
- To focus on practical algorithms of textual document indexing, relevance ranking, web usage mining, text analytics, as well as their performance evaluations.
- To give an exposure to the fundamentals of Data Analytics.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basic concepts of Data mining and warehousing.
CO2	Identify the different techniques of data preprocessing.
CO3	Analyze patterns that can be discovered by classification and clustering.
CO4	Understand data mining techniques of clustering.
CO5	Identify complex data types based on spatial and web mining

Course Outline

Unit I: Data warehouse - definition - operational database systems Vs data warehouses - multidimensional model - from- tables and spreadsheets to Data Cubes - schemas for multidimensional databases - measures - concept hierarchies - OLAP operations in the multidimensional data model - data warehouse architecture.

Unit II: Data mining - introduction - definition - data mining functionalities - major issues in data mining - data pre-processing - data cleaning - data integration and transformation - data reduction - data discretization and concept hierarchy generation. Association rule mining - efficient and scalable frequent item set mining methods - mining various kinds of association rules - association mining to correlation analysis - constraint- based association mining.

Unit III: Classification and prediction - issues regarding classification and prediction - classification by decision tree introduction - Bayesian classification - rule based classification
- classification by back propagation - support vector machines - associative classification - lazy learners - other classification methods - prediction - accuracy and error measures - evaluating the accuracy of a classifier or predictor - ensemble methods - model section.

Unit IV: Cluster analysis - types of data in cluster analysis - a categorization of major clustering methods - partitioning methods - hierarchical methods - density-based methods - grid-based methods - model-based clustering methods - clustering high dimensional data - constraint-based cluster analysis - outlier analysis, Regression, Summarization.

Unit V: Graph mining - mining object, spatial, multimedia, text and web data - multidimensional analysis and descriptive mining of complex data objects - spatial data mining - multimedia data mining - text mining - mining the World Wide Web, Social Network Analysis.

References:

1. Jain Pei, Jiawei Han and Micheline Kamber, *Data Mining Concepts and Techniques*, 3rd Edition, Elsevier, ISBN: 9380931913.
2. Alex Berson and Stephen J. Smith, *Data Warehousing, Data Mining & OLAP*, Computing Mcgraw-Hill, ISBN: 0070062722.
3. K.P. Soman, Shyam Diwakar and V. Ajay, *Insight into Data mining Theory and Practice*, 1st Edition, Prentice Hall of India, ISBNy.8120328973.
4. G. K. Gupta, *Introduction to Data Mining with Case Studies*, 3rd Edition, PHI Learning Pvt. Ltd, ISBN: 8120350022.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *Introduction to Data Mining*, 1st Edition, Pearson India, ISBN: 9332518653.

FCSS4P01 – PROJECT WORK

Hrs/Week: 15 (7L+8P) **Credit: 8**

Objectives:

- To give a practical exposure to the process of software development life cycle.
- To develop a quality software solution by following the software engineering principles and practices. Students are also encouraged to take up a research oriented work to formulate a research problem and produce results based on its implementation/simulation/experimental analysis.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Demonstrate a depth of knowledge of modern technology
CO2	Practice to communicate effectively and to present ideas clearly and coherently to specific audiences in both the written and oral forms
CO3	Understand the project requirements, reflect on their learning and take appropriate actions to implement it
CO4	Estimate, plan, calculate, and adjust project variables
CO5	Understand the importance of iteration, evaluation and prototyping in design of a software system

Course Outline

Major project work is to be done individually by each student, under the guidance of a faculty member of the concerned department.

Guide has to constantly monitor the works done by the student, imparting him/her the necessary inputs for the successful completion of the project work. Students can either take up a real-life application oriented project work or research and development project. The student can formulate a project problem with the help of her/his guide and submit the project proposal of the same. Approval of the project proposal is mandatory. If approved, the student can commence working on it, and complete it.

Guidelines for Submission ofReport

The distinguishing mark of a dissertation is an original contribution to knowledge. The dissertation is a formal document whose sole purpose is to prove that you have made an original contribution to knowledge. Failure to prove that you have made such a contribution generally leads to failure.

It is a test of the student's ability to undertake and complete a sustained piece of independent research and analysis / application development, and to write up the work in a coherent form according to the rules and conventions of the academic community. The role of the supervisor too is very crucial in this context.

A satisfactory dissertation should not only be adequate in its methodology, in its analysis and in its argument, and adequately demonstrate its author's familiarity with the relevant literature; it should also be written in correct, coherent language, in an appropriate style, correctly following the conventions of citation. It should, moreover, have a logical and visible structure and development that should at all times assist the reader understands the arguments being presented. The layout and physical appearance of the dissertation should also conform to university standards.

The dissertation is to be prepared in TEX format (either Latex or a suitable Windows TEX variant). The format of the report is included in Appendix A. Students are also encouraged to present their work in IT fest/conference/workshop/journal with the assistance and guidance of the supervisor. This should pave as a good start for the student in the art of publishing/presenting his/her work to the outside world. Due weightage is accommodated for publications out of the project work in the final evaluation.

FCSS4E03a – DATA COMPRESSION

Hrs/Week: 5 (5L) **Credit: 3**

Objectives

- To understandthephysicalsignificance of somebasicconcepts of informationtheory including entropy, average mutual information and the rate distortion bound.
- To learnthe design of entropycodes including Huffmancodes and arithmetic coding.
- To understand the operation of lossless compression schemes.
- To understand the operation of popular lossy compression schemes including delta modulation, differential pulse code modulation, transform coding, and vector quantization.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand various database systems, data models and schemas.
CO2	Understand database architecture, ER and duties of DBA.
CO3	Analyze compression techniques for strings and images
CO4	Illustrate various relevant transforms in image compression.
CO5	Recognize video-audio file formats and the compression techniques used
CO6	Compare and analyze different algorithms used in audio and video file formats

Course Outline

Unit I: Introduction to database systems, file systems *>Vs DBMS, view of data - data abstraction, view levels, data models, instances and schemas, data independence, database languages, database architecture, database users, database administrator, role of DBA. The entity - relationship (ER) model - entity sets, relationship sets, attributes, constraints, mapping cardinalities, keys, ER diagrams, weak entity sets, strong entity sets.

Unit II: Dictionary methods - string compression, LZ77 sliding window, MZW, GIF images. Image compression - approaches to image compression, intuitive methods and image transform, test images, JPEG, progressive image compression, vector quantization.

Unit III: Wavelet methods - Fourier transform, frequency domain, Fourier image compression, CWT and inverse CWT, Haar transform, filter bank, DWT, JPEG 2000. Video compression - analogue video, composite and component video, digital video, video compression, MPEG.

Unit IV: Audio compression - sound, digital audio, human auditory system, MPEG-1 audio layer. Fractal based compression - IFS. Comparison of compression algorithms. Implementation of compression algorithms.

References

1. David Solomon, *Data Compression: The Complete Reference*, 4th Edition, Springer, ISBN: 8184898002.
2. StephenWelstead,*Fractaland WaveletImage Compression Techniques*, Lap Lambert Academic Publishing, ISBN: 384651845X.
3. Khalid Sayood, *Introduction to Data compression*, 4th Edition, Elsevier India Pvt. Ltd, ISBN: 8131234088.

FCSS4E03b – PERVASIVE COMPUTING

Hrs/Week: 5 (5L) **Credit: 3**

Objectives:

- To provide a sound conceptual foundation in the area of Pervasive Computing aspects.
- To provide the students the ability to conceptualize, analyze and design select classes of pervasive computing systems.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Familiarize conceptual foundation in pervasive computing area
CO2	Understand various application fields associated to pervasive computing
CO3	Identify the devices, interfaces, security and protocols in pervasive computing field.
CO4	Understand pervasive computing in web applications
CO5	Understand the WAP architecture, languages and security issueS
CO6	Apply knowledge on personal digital assistant devices and java programming for pervasive computing
CO7	Understand pervasive computing web application architecture, MVC and user interfaces

Course Outline

Unit I: Introduction to pervasive computing - past, present, future - the pervasive computing market, m-Business, challenges and future of pervasive computing. Application examples of pervasive computing: retail, airline check-in and booking, sales force automation, healthcare, tracking, car information systems, Email access via WAP and voice.

Unit II: Device technology for pervasive computing - hardware, human-machine interfaces, biometrics, operating systems, Java for pervasive devices, outlook. Device connectivity - protocols, security, device management.

Unit III: Web application concepts for pervasive computing - history, WWW architecture, protocols, trans-coding, client authentication via the Internet for pervasive computing. WAP and beyond - introduction, components of the WAP architecture, WAP infrastructure, WAP security issues, Wireless Markup Language, WAP push, products, i-Mode, outlook.

Unit IV: Web voice technology - basics of speech recognition, voice standards, speech applications, speech and pervasive computing, security personal digital assistants - history, device categories, personal digital assistant operating systems, device characteristics, software components, standards, mobile applications and personal digital assistant browsers. Server side programming (Java) for pervasive computing - Java 2 Enterprise Edition (Overview), servlets, Enterprise Java Beans, Java Server Pages, Extensible Markup Language, Web Services, Model-View-Controller pattern.

Unit V: Pervasive web application architecture - background, scalability & availability - development of pervasive computing web applications, pervasive application architecture - example pervasive application - introduction, user interface overview, architecture, implementation. Access from PCs - smart-card authentication via the Internet, ordering goods. Access via WAP - WAP functionality, implementation - access from personal digital assistants - extending the example application to personal digital assistants, implementation for synchronized devices, implementation for intermittently connected devices, implementation for connected devices - access via voice: extending theexample application to voice access, implementation.

References:

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec and Klaus Rindtorff, *Pervasive Computing: Technology and Architecture of Mobile Internet Applications*, 14th Edition, Pearson Education, ISBN: 8177582801.
2. Stefen Poslad, *Ubiquitous Computing: Smart Devices, Environments and Interactions*, Wiley India Pvt Ltd, ISBN: 8126527331.
3. Guruduth S. Banavar, Norman H. Cohen and Chandra Narayanaswami, Pervasive Computing: *An Application-Based Approach*, Wiley-Blackwell, ISBN: 0471777404.
4. Frank Adelstein, S K S Gupta, GG Richard and L Schwiebert, *Fundamentals of Mobile and Pervasive Computing*, Tata McGraw-Hill, New Delhi, ISBN: 0070603642.

5. Genco and S. Sorce, *Pervasive Systems and Ubiquitous Computing*, 1st Edition, WIT Press, ISBN: 1845644824.
6. Somprakash Bandyopadhyay, Amitava Mukherjee and Debashis Saha, *Networking Infrastructure for Pervasive Computing Enabling Technologies and Systems*, 1st Edition, ISBN: 8184898037.

FCSS4E03c – SYSTEM SECURITY

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: To provide an understanding of the differences between various forms of computer security, where they arise, and appropriate tools to achieve them.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Familiarize with different types of securities in information systems, security goals and CIA.
CO2	Illustrate computer system threats and various types of system attacks
CO3	Identify different issues associated with system attacks and how attacking occurs; and various types of attackers
CO4	Provide knowledge in operating system security, file protections, security assurance
CO5	Understand important elements of Database security
CO6	Define security planning, various types of security policies and risk analysis

Course Outline

Unit I: Notion of different types of securities - information security - computer security - security goals, relation between security, confidentiality, integrity, availability and authorization, vulnerabilities - principles of adequate protection. Notions of operating security, database security, program security, network security attacks - threats, vulnerabilities and controls. The kind of problems - interception, interruption, modification, fabrication. Computer criminals - amateurs, crackers, career criminals. Methods of defence

- control, hardware controls, software controls, effectiveness of controls.

Unit II: Program security - secure programs - fixing faults, unexpected behaviour, types of flaws. Non-malicious program errors - buffer overflows, incomplete mediation. Viruses and other malicious code - kinds of malicious code, how viruses attach, how viruses gain control, prevention, control example - the brain virus, the internet worm, web bugs. Targeted malicious code - trapdoors, Salami attack. Controls against program threats - development controls, peer reviews, hazard analysis.

Unit III: Operating system security - protected objects and methods of protection - memory address protection - fence, relocation, base/bounds registers, tagged architecture, segmentation, paging.Control ofaccesstogeneralobjects- directory, accesscontrollist. File protection mechanism - basics forms of protection, single permissions. Authentication - authentication basics, password, authentication process challenge - response, biometrics. Trusted operating systems - security policies for operating systems, models of security - requirement of security systems, multilevel security, access security, limitations of security systems. Trusted operating system design - elements, security features, assurance, system flaws and assurance methods.

Unit IV: Database Security - security requirements - integrity of database, confidentiality and availability, reliability and integrity, sensitive data, interface, multilevel database, proposals for multilevel security.

Unit V: Administrating security - security planning - contents of a security planning, team members, commitment to a security plan, business continuity plans. Risk analysis - the nature of risk, steps of risk analysis. Arguments for and against risk analysis, organizational security policies - purpose and goals of organizational security. Audience, characteristics ofa good security policy. Nature of security policies - data sensitivity policy, government agency IT security policy. Physical security - natural disaster, human vandals, interception of sensitive information.

References

1. C. P. Pfleeger and S. L. Pfleeger, Security in Computing, 4th Edition, Pearson India, ISBN: 9788131727256.
2. Matt Bishop, Computer Security: Art & Science, 1st Edition, Pearson, ISBN: 0201440997.
3. William Stallings, Cryptography and Network Security: Principles and Practice, 6th Edition, Pearson India, ISBN: 9332518777.
4. Michael E. Whitman and Herbert J. Mattord, Principles of Information Security, 4th Edition, Ceneage Learning India Pvt Ltd, ISBN:8131516458.

FCSS4E03d – MOLECULAR SIMULATION AND MODELLING

Hrs/Week: 5 (5L) **Credit: 3**

Objectives:

- To understand application of simulation techniques to study molecular dynamics and derive properties.
- Tolearnandapplythe statisticalapproachesandmodelsforphylogeneticanalysisand tree reconstruction.
- To understand the basis and nature of protein-proteininteractions.
- To understand principles of decking simulations.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand different molecular modelling methods and model types.
CO2	Illustrate concepts, principles of mathematical modelling and discrete system simulation.
CO3	Analyze different mapping techniques and Microarray technology
CO4	Analysis of different prediction strategies of Structural Modelling
CO5	Demonstrate protein structure classification and prediction
CO6	Familiarize steps in molecular visualization, protein family databases, software tools and basic operations

Course Outline

Unit I: Overview of molecular modelling - molecular modelling methods - semi-empirical method and empirical method. Model Type - static, dynamic and probabilistic models. Models of growth and decay

Unit II: System modelling - concept, principles of mathematical modelling, static physical model, stochastic activities, continuous and discrete simulation. Discrete system simulation - probability concepts in simulation, random number generations and their testing, stochastic variable generation. Model execution - event driven versus time driven.

Unit III: Computational gene mapping - genetic mapping, gene expression, gene prediction methods, gene prediction tools, mutational analysis, introduction to restriction mapping and map assembly, mapping with restriction fragment fingerprints, Lander - Waterman statistics. Software Packages for Phylogenetic Analysis - PHYLogeny Inference Package (Phylip), Phylogenetic Analysis using Parsimony (PAUP) and Phylogenetic Analysis by Maximum Likelihood (PAML). Microarray technology - techniques for microarray data analysis - microarray databases. Scatter Plots, Principal Component A nalysis, Cluster Analysis, Applications of Microarray Technology.

Unit IV: Structural Modelling: Protein structure prediction - Prediction of protein secondary structure from the amino acid sequences. Prediction of three dimensional protei n structure. Protein structure classification: Two major classification schemes - CATH and SCOP. Protein structure prediction: Steps involved in homology modeling. Protein- Protein Interactions: Prediction methods for Protein-Protein interactions. Protein- protein interaction Databases. Computer Assisted Drug Design (CADD): Protein based drug design cycle, drug discovery pipeline. Docking Simulations: Rigid docking and Flexible docking.

Unit V: Molecular Visualization: Visualization of protein structure, Methods of studying proteins, Proteomics databases, Protein family databases, PDB file format. Software tools for 3D molecular graphic visualization: Rasmol - basic operations and steps in Rasmol to visualize the molecule, advantages of Rasmol, advantages of Swiss-PdbViewer.

References:

1. Stephen Misener and Stephen A. Krawetz, Bioinformatics: Methods and Protocols, 1st Edition, Humana Press, iSBN: 1617371564.
2. Geoffrey Gordan, System SimuS&nr 2nd Edition,' PHI, ISBN: 9788120301405.
3. Tamar Schlick, Molecular Modeling and Simulation: An Interdisciplinary Guide, 2nd Edition, Springer, ISBN: 14w1426902.
4. Narsingh Dev, System Modelling with Digital Computer, PHI, ISBN: 0138817898.
5. Andrew Leach, Molecular Modelling: Principles and Applications, Prentice Hall. 2nd Edition, ISBN: 81317286092001.
6. Prakash S Lohar, Bioinformatics, MJP publishers, Chennai, ISBN: 9788180940668.
7. H-D Holtje, Molecular Modeling - Basic Principles and Applications, 3rd Edition, Wiley-VCH, ISBN-13: 9783527315680.
8. AlanHinchliffe,MolecularModellingforBeginners,2ndEdition,JohnWileyand Sons Ltd, ISBN: 9780470513149.
9. N Cohen, Guidebook on Molecular Modeling in Drug Design, 1st Edition, ISBN :9780121782450
10. Masatoshi Nei and Sudhir Kumar, Molecular Evolution and Phylogenetics, Oxford University Press, ISBN: 0195135857.
11. Asheesh Shanker, Vinay Sharma and Ashok Munjal, A Textbook of Bioinformatics, 1st Edition, Rastogi Publications, New Delhi, ISBN: 9788171339174.
12. Des Higgins (Ed), Willie Taylor (Ed), Bioinformatics: Sequence, Structure and Databanks - A Practical Approach, 3rd Edition, New Delhi Oxford University Press, ISBN: 0195667530.

FCSS4E03e – FUNDAMENTALS OF BIG DATA

Hrs/Week: 5 (5L) **Credit: 3**

Objectives:

- To cover the basics of big data.
- To familiarize with big data technology and tools.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand basic concepts of Bigdata, its dimensions and currently available other Databases.
CO2	Describe bigdata analytics and familiarize data analytics using a tool – R
CO3	Understand NOSQL databases and introduce MongoDB
CO4	Understand in basic functions of NOSQL database
CO5	Illustrate the basics of the HADOOP Ecosystem
CO6	Understand the elementary concepts of MapReduce

Course Outline

Unit I: Introduction to Big Data – definition & importance of Big Data - four dimensions of Big Data - volume, velocity, variety, veracity – importance of big data – structureddata, unstructured data - the role of a CMS in big data management - integrating data types into a big data environment - distributed computing and Big Data. Big Data stack – layer 0,1 and 2 – Big Datamanagement – operationaldatabases – relationaldatabases– nonrelational databases – NoSQL - key-value pair databases – document databases - columnar databases - graph databases - spatial databases.

Unit II: Big Data analysis - basic analytics - operationalized analytics - modifying business intelligence products to handle Big Data - Big Data analytics examples - Analytics solutions - text analytics - exploring unstructured data - understanding text analytics analysis and extraction techniques - the extracted information - text analytics tools for Big Data - custom applications for Big Data analysis - R Environment - Google Prediction API - Characteristics of a Big Data Analysis Framework.

Unit III: NoSQL databases - types - Advantages over Relational Databases - MongoDB - introduction - MongoDB philosophy - the data model - designing the database - collections - documents - data types - the _id Field - indexes - viewing available databases and collections - opening a database - inserting data - querying for data - retrieving documents - aggregation commands - grouping results - conditional operators - specifying an array of matches - applying criteria for search - $slice - $size - $exists - $type - $elemMatch - $not (meta- operator) - update() - save() - $inc - $set - $unset - $push - $pushAll - $addToSet - removing elements from an array atomic operations - modifying and returning a document atomically - renaming a collection - removing data - referencing a database - implementing index-related functions - min() and max().

Unit IV: Hadoop - history - components - HDFS - MapReduce Basics - origins of MapReduce map function - reduce function - putting them together - Hadoop common components - application development in Hadoop - Pig and Pig Latin - Load - Transform - Dump and Store - Hive - Jaql - getting our data into Hadoop - basic copy data - Flume - Zookeeper ^ HBase -Oozie - Ltycene - Avro.

Unit V: Understanding MapReduce - key/value pairs - the Hadoop Java API for MapReduce - the Mapper class - the Reducer class - the Driver class - writing simple MapReduce programs - Hadoop-provided mapper and reducer implementations - Hadoop- specific data types - the Writable and WritableComparable interfaces - wrapper classes - Input/output - InputFormat and RecordReader - OutputFormat and RecordWriter. Implementing WordCount using streaming - analyzing a large dataset - summarizing the UFO data - summarizing the shape data - a relational view on data with Hive - creating a table for the UFO data - inserting the UFO data - redefining the table with the correct column separator - creating a table from an existing file - SQL views.

References

1. Hurwitz, Alan Nugent, Fern Halper and Marcia Kaufman, *Big Data for Dummies,* ISBN: 9781118504222.
2. Eelco Plugge, Peter Membrey and Tim Hawkins, *The Definitive Guide to MongoDB*: *The NoSQL Database for Cloud and Desktop Computing*, 1st Edition, Apress, ISBN: 9781430230519.
3. Chris Elaton, Derk Deroos, Tom Deutsch, George Lapis and Pual Zikopoulos, *Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*, 1st Edition, ISBN: B006UWBBO6.
4. Garry Turkington, *Hadoop Beginner's Guide*, Packt Publishing Ltd, ISBN: 1849517304.

FCSS4E03f – WEB ENGINEERING

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: To understand the concepts, principles, strategies, and methodologies of web applications development.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand basic concepts Web engineering
CO2	Describe Requirements Engineering (RE) for web applications and familiarize Web application architecture and architecture for multimedia data
CO3	Understand NOSQL databases and introduce MongoDB
CO4	Understand the basics of Modelling web applications and web application design
CO5	Understand the elementary concepts of testing web applications

Course Outline

Unit I: Web Engineering (WE) – introduction – motivation – categories & characteristics of web applications – product related, usage related and development related – evolution of WE.

Unit II: Requirements Engineering (RE) for web applications - introduction - fundamentals - sources of requirements - RE activities - RE specifications in WE - RE principles for web applications - adapting RE methods for web applications development - requirement types, notations, tools.

Unit III: Web application architecture - introduction - fundamentals - definition of architecture - developing and characterising architectures - components of a generic web application architecture - layered architecture - database centric architecture - architecture for web document management - architecture for multimedia data.

Unit IV: Modelling web applications - introduction - modelling specifics in WE - levels – aspects phases of customizations - modelling requirements - hypertext modelling - hypertext structure modelling concepts - access modelling concepts. Web application design - web design from an evolutionary perspective - information design - software design merging information design & software design - problems and restrictions in integrated web design - a proposed structural approach - presentation design - presentation of nodes and meshes - device independent development - approaches - interaction design - user interaction - user interface organization - navigation design - deigning a link representation - designing link internals - navigation and orientation - structural dialog for complex activities - interplay with technology and architecture - functional design.

Unit V: Testing web applications - introduction - fundamentals - terminology - quality characteristics - test objectives - test levels - role of tester - test specifics in we - test approaches
- conventional, agile - test schemes - three test dimensions - applying the scheme to web applications - test methods and techniques - link testing - browser testing - usability testing
- load, stress and continues testing - testing security - test- driven development. Web project development - scope - refining frame work activities - building a WebE team - risk management - making schedule - managing quality, change - project tracking.

References

1. Gerti Kappel, Birgit Proll, Siegried Reich and Werner Retschitzegger, *Web Engineering: The Discipline of Systematic Development of Web Applications*, John Wiley and Sons Ltd, ISBN: 9780470064894.
2. Roger S Pressman and David Lowe, Web Engineering: A Practitioner's Approach, 1st Edition, Tata Macgraw Hill Publications, ISBN: 9780073523293.
3. Leon Shklar and Rich Rosen, *Web Application Architecture: Principles, Protocols and Practices,* 2nd Edition, Wiley, ISBN: 047051860X.
4. Guy W Leeky-Thompson, *Just Enough Web Programming with XHTML, PHP, and MySQL,* 1st Edition, Cenagage Learning, ISBN: 159863481X.
5. Anders Moller and Michael Schwartzbach, *An Introduction to XML and Web Technologies*, 1st Edition, Pearson Education, New Delhi, 2009.
6. Chrits Bates, *Web Programming: Building Internet Applications*, 3rd Edition, Wiley India Edition, ISBN: 8126512903. MySQL, 1st Edition, Cenagage Learning, ISBN: 159863481X.

FCSS4E04a – DIGITAL IMAGE PROCESSING

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: To be familiar with processing of the images, recognition of the pattern and their applications.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the fundamental concepts of a digital image processing
CO2	Apply various image enhancement techniques
CO3	Describe various image enhancement techniques
CO4	Implement algorithms for handling intensive image restoration problems.
CO5	Identify and compare various image segmentation and representation techniques
CO6	Understand various image compression procedures

Course Outline

Unit I: Introduction- digitalimagerepresentation - fundamentalstepsinimageprocessing - elements of digital image processing systems - digital image fundamentals - elements of visual perception - a simple image model - sampling and quantization - basic relationship between pixels - image geometry.

Unit II: Image transforms - introduction to Fourier transform - discrete Fourier transform (DFT) - properties DFT- other separable image transforms - Walsh, Hadamard and Discrete Cosine transforms. Hotelling transform.

Unit III: Image enhancement - basic grey level transformation - histogram equalization - image subtraction - image averaging - spatial filtering - smoothing, sharpening filters Laplacian filters. Enhancement in the frequency domain - frequency domain filters smoothing, sharpening filters - homomorphic filtering.

Unit IV: Image restoration - model of Image degradation/restoration process - noise models inverse filtering - least mean square filtering - constrained least mean square filtering. Edge detection - thresholding - region based segmentation - boundary representation.

Unit V: Image compression - fundamental concepts of image compression - compression models - information theoretic perspective. Lossless compression - Huffman coding - arithmetic coding - bit plane coding - run length coding. Lossy compression - transform coding - image compression standards.

References

1. Richard E Woods and Rafael C Gonzalez, *Digital Image Processing*, 3rd Edition, Pearson Education Singapore Pte Ltd, ISBN: 8131726959.
2. B. Chanda and D.D. Majumder, *Digital Image Processing and Analysis*, 2nd Edition, PHI Learning Pvt Ltd, ISBN: 8120343255.
3. A.K. Jain, *Fundamentals of Digital Image Processing*, 2nd Edition, PHI Learning Pvt Ltd, ISBN: 8120309294.
4. W.K. Pratt, *Digital Image Processing: PIKSScientific Inside*, 4th Edition, John Wiley, ISBN: 0471767778.
5. MilanSonka,VaclavHlavacandRogerBoyle,*ImageProcessingAnalysisandMachine Vision*, 3rd Edition, Ceneage Learning India Pvt Ltd, ISBN: 8131518833.

FCSS4E04b – ADVANCED TOPICS IN DATABASE DESIGN

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: Tostudytheadvanceddatabasetechniquesbeyondthefundamentaldatabase techniques.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand the basic concepts of the database and data models. Design a database using ER and EER diagrams
CO2	Familiarize the students to OPPS Database concepts and its features
CO3	Understand the concepts of Object relational and extended database
CO4	Describe the basics of Client server, distributed and parallel Databases.
CO5	Exemplify XML data model and how-to retrieval information in Databases

Course Outline

Unit I: The Extended Entity Relationship model and object model - The ER model revisited, motivation for complex data types, user defined abstract data types and structured types, subclasses, super classes, inheritance, specialization and generalization, constraints and characteristics of specialization and generalization, relationship types of degree higher than two.

Unit II: Object-Oriented databases - overview of object-oriented concepts, object identity, object structure, and type constructors, encapsulation of operations, methods, and persistence, type hierarchies and inheritance, type extents and queries, complex objects, database schema design for OODBMS, OQL, persistent programming languages, OODBMS architecture and storage issues, transactions and concurrency control, example of ODBMS.

Unit III: Object relational and extended relational databases - database design for an ORDBMS - nested relations and collections, storage and access methods, query processing and optimization, an overview of SQL3, implementation issues for extended type - systems comparison of RDBMS, OODBMS and ORDBMS.

Unit IV: Parallel and distributed databases and client-server architecture - architectures for parallel databases, parallel query evaluation, parallelizing individual operations, sorting, joins, distributed database concepts, data fragmentation, replication and allocation techniques for distributed database design, query processing in distributed databases, concurrency control and recovery in distributed databases. An overview of client-server architecture.

Unit V: Object databases on the web and semi structured data - web interfaces to the web, overview of XML - structure of XML data, document schema, querying XML data - storage of XML data, XML applications - the semi structured data model, implementation issues, indexes for text data. Enhanced data models for advanced applications - active database concepts, temporal database concepts, spatial databases concepts and architecture, deductive databases and query processing, mobile databases, geographic information systems.

References:

1. Elmasri and Navathe, *Database Systems - Models, Languages, Design and Application Programming*, 6th Edition, Pearson India, ISBN: 8131792471.
2. Raghu Ramakrishnan and Johannes Gehrke, *Database Management Systems*, 3rd Edition, McGraw - Hill Education, ISBN: 9339213114.
3. Korth, Silberchatz and Sudarshan, *Database System Concepts*, 6th Edition, McGraw- Hill Education India Pvt. Ltd, ISBN: 9332901384.
4. Alexis Leon and Mathews Leon, *Database Management System*, 1st Edition, Vikas Publishers, ISBN: 8182092221. L»r
5. PeterRobandCoronet, *DatabaseSystems, Design, ImplementationandManagement*, 5th Revised Edition, Course Technology, ISBN: 061906269X.
6. C J Date, *Introduction to Database Systems*, 8th Edition, Addison-Wesley, ISBN: 0321197844. FCSS4E01c | Software Development for Portable Devices

FCSS4E04c –- ADVANCED MACHINE LEARNING

Hrs/Week: 5 (5L) **Credit: 3**

Unit I :Introduction to Elementary Linear Algebra, Probability and Machine Learning

Introduction to Linear Algebra: Matrices, Vector spaces, Orthogonality, Determinants, Overview of Eigenvalues and Eigenvectors. Fundamentals of Probability:- Axioms of probability, Conditional probability, Random variables, Probability distributions and Density functions, Joint distri- bution and density function, Conditional distribution, Bayes' rule, Ex- pectation and Variance. Distributions: Bernoulli, Binomial, Multinom- inal, Uniform, Normal, Chi-Square, t and F. Introduction to Machine Learning:- Concept of learning the task, inductive learning and hypoth- esis space, different machine learning approaches, types of learning; su- pervised, unsupervised and reinforcement, machine learning applications

Unit II :Supervised Learning

Learning a class from example, learning multiple classes and multi-labels, model selection and generalization, linear regression and feature selec- tion, Bayesian learning, Decision Tree learning, classification tree and regression tree, multivariate methods for learning, multivariate classifi- cation and regression

Unit III : Unsupervised Learning

clustering; mixture densities, k-means clustering, expectation maximiza- tion algorithm, mixture latent variable models, Latent Dirichlet Allo- cation, spectral and hierarchical clustering, Dimensionality reduction; principal component allocation, linear discriminant analysis, canonical correlation analysis.

Unit IV : Reinforcement Learning and Design and Analysis of ML Experiments

Single state case: K-Armed Bandit, Elements of reinforcement learn- ing, model-based learning, temporal difference learning, generalization, partially observable states. Setting a machine learning platform: training, validation and testing, over-fitting and under-fitting, different types of error calculation. Cross-validation and resampling methods, Perfor- mance Analysis and accuracy measures: evaluation of machine learning algorithms, Binomial, Approximate Normal and t-tests

Unit V : Introduction to Artificial Neural Networkand Deep Learn- ing Concepts

Understanding brain, perceptron, Multi-Layer perceptron as universal approximator, the general architecture of an artificial neural network, feedforward and back-propagation, different linear and nonlinear activa- tion functions for binary and multi-class and multi-label classification. Fundamentals of deep learning, Deep Feedforward Networks, Regulariza- tion for Deep Learning, Optimization for Training Deep Models, Intro- duction to Convolutional Networks, Sequence Modeling using Recurrent Nets, overview of LSTM and Bi-LSTM.

References:

1. Ethem Alpaydin, Introduction to Machine Learning- 3rd Edition, PHI.
2. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1st Ed.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning), MIT Press, 2016.
4. Kuntal Ganguly, Learning Generative Adversarial Networks, Packt Publishing, 2017
   Gilbert Strang, Linear algebra and its applications, Fourth Edition, Cengage Learning, 2006.

FCSS4E04d – STORAGE AREA NETWORKS

Hrs/Week: 5 (5L) **Credit: 3**

Objectives:

- Understand Storage Area Networks (SAN) characteristics and components.
- Learn about the SAN architecture andmanagement.
- Understand about designing and building SAN.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand basic networking and SAN topologies
CO2	Illustrate SAN basics technology and configuration
CO3	Understand storage networking architecture and SAN emerging technologies
CO4	Illustrate the storage infrastructure and management activities
CO5	Demonstrate how to build SAN and security guidelines

Course Outline

Unit I: Basic networking concepts and topologies - OSI reference model, common network devices, network topologies, MAC standards - need for storage networks – storage devices - techniques evolution - benefits of SANs - SAN components and building blocks - fibre channel basics - fibre channel topologies, fibre channel layers, classes of service SAN topologies.

Unit II: SAN fundamentals - SAN operating systems software and hardware types of SAN technology - technology and configuration, high scalability and flexibility standards - storage managementchallenges-networkedstorageimplementationchallenges-storagesubsystems for video services.

Unit III: Storage networking architecture storage in storage networking - challenges, cost and performance - Network in storage networking - fibre channel, emerging SAN interconnect technologies - basic software, advanced software, backup software implementation strategies.

Unit IV: Storage network management in-band management out-of-band management - SNMPHTTP - TELNET storage network management issues - storage resource management - storage management, storage, systems and enterprise management integration.

Unit V: Designing and building a SAN - design considerations - business requirements - physical layout, placement, storage, pooling, data availability, connectivity, scalability, migration, manageability, fault tolerance and resilience - prevention of congestion - routability - backup and restoration - SAN security & iSCSI technology - basic security guidelines - implementing SAN security - backup and restoration in iSCSI technology - future of SANS.

References

1. Meeta Gupta, *Storage Area Network Fundamentals*, Cisco Press, ISBN: 158705065X.
2. John R. Vacca, *The Essential Guide to Storage Area Networks*, 1st Edition, Prentice Hall, ISBN: 0130935751.
3. Richard Barker and Paul Massiglia, *Storage Area Network Essentials*: *A Complete Guide to Understanding and Implementing SANs*, Wiley India Pvt Ltd, ISBN: 8126518588.
4. Tom Clark, *Designing Storage Area Networks: A Practical Reference for Implementing Fibre Channel and IP SANs*, 2nd Edition, Addison Wesley Professional, ISBN: 0321136500.
5. Robert Spalding, *Storage Networks: The Complete Reference*, 1st Edition, Tata McGraw-Hill Education, ISBN: 0070532923.
6. Christopher Poelke and Alex-Nikitin, *Storage Area Networks for Dummies*, 2nd Edition, ISBN: 9780470385135. '
7. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka and Nils Haustein, *Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE*, Wiley India Pvt Ltd, ISBN: 8126518324.

FCSS4E04e – SEMANTIC WEB

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: To discover the capabilities and limitations of semantic web technology for different applications.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand semantic web basics
CO2	Represent data from a chosen problem in XML with appropriate semantic tags
CO3	Conceptualize the phases of ontology learning, algorithm and evaluation
CO4	Understand ontology management, tools and development
CO5	Describe the implementation details of web services and security issues

Course Outline

Unit I: Components - types - ontological commitments - ontological categories - philosophical background - knowledge representation ontologies – top level ontologies - linguistic ontologies - domain ontologies - semantic web - need - foundation - layers - architecture.

Unit I: Languages for semantic web and ontologies - web documents in XML – RDF – schema – web resource description using RDF - RDF properties – topic maps and RDF – overview – syntax structure – semantics – pragmatics - traditional ontology languages – LOOM - OKBC – OCML - Flogic Ontology Markup Languages – SHOE – OIL – AML

- OIL – OWL.

Unit III: Ontology learning for semantic web - taxonomy for ontology learning - layered approach - phases of ontology learning - importing and processing ontologies and documents

- ontology learning algorithms - evaluation.

Unit IV: Ontology management and tools - overview - need for management - development process - target ontology - ontology mapping - skills management system - ontological class - constraints - issues. Evolution - development of tools and tool suites - ontology merge tools - ontology based annotation tools.

Unit V: Applications - web services - semantic web services - security issues - current trends.

References

1. Asuncion Gomez-Perez, Oscar Corcho and Mariano Fernandez-Lopez, *Ontological Engineering: withexamplesfromtheareas of Knowledge Management, e- Commerce and the Semantic Web*, 1st Edition, Springer, ISBN: 1849968845.
2. Grigoris Antoniou and Frank van Harmelen, *A Semantic Web Primer*, The MIT Press, ISBN: 0262012103.
3. Liyand, *Introduction to the Semantic Web and Semantic Web Services*, Chapman, ISBN: 1584889330.
4. Alexander Maedche, *Ontology Learning for the Semantic Web*, Springer, 2002nd Edition, ISBN: 0792376560.
5. John Davies, Dieter Fensel and Frank Van Harmelen, *Towards the Semantic Web: Ontology - Driven Knowledge Management*, 1st Edition, Wiley, ISBN: 0470848677.
6. Dieter Fensel, Wolfgang Wahlster, Henry Lieberman and James Hendler, *Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential*, The MITPress, ISBN: 9780262562126.

FCSS4E04f – ADVANCED JAVA PROGRAMMING

Hrs/Week: 5 (5L) **Credit: 3**

Objectives: To learn the advanced features of Java programming language that equip the students to develop web based applications with RDBMS.

Course Outcomes

COs	COURSE OUTCOMES
CO1	Understand advanced concept of Java Programming, RMI and servlets
CO2	Develop manipulate servlets and configuration
CO3	Illustrate the basic functionalities of JNDI and EJB
CO4	Develop JSP pages by understanding the technology and execution
CO5	Understand the basics of ORM environment configuration mappings and HQL foundations

Course Outline

Unit I: RMI & Servlets - introduction, architecture, defining remote objects, creating stubs and skeletons, serializable classes, accessing remote objects, factory classes, dynamically loaded classes, RMI activation, registering remote objects.

Unit II: Servlets, generic servlet, servlets that access request headers, develop servlets that manipulate response headers, HTTP servlets, forms, HTTP protocols - configuring Tomcat Server, servlet context, servlet context listener, servelet chaining.

Unit III: JNDI & EJB - architecture, context initial context class, objects in a context, binding objects, accessing directory services, attributes and attribute interface modifying directory entities, creating directories entities. EJB roles, architecture, container, implementing a basic EJB object, implementing session beans, implementing entity bean, deploying an enterprise bean object.

Unit IV: Java Server Pages (JSP) - developing JSP pages, technology, syntax using scripting elements, syntax using the courier page directive, create and use JSP error pages, building reusable web presentation, components, JSP technology syntax using the include directive, JSP technology syntax using the jsp:include standard action, developing JSP Pages using custom tags, problem with JSP technology scriptlet code, given an existing custom tag library, develop a JSP page using the library, developing a simple custom tag, structure and execution of a custom tag in a JSP page, tag handler class for a simple empty custom tag, custom tag that includes its body in the contour of the HTTP response, tag library description for a simple, empty custom tag.

Unit V: Hibernate - ORM overview - Hibernate overview, environment, configuration, sessions, persistent class - mapping files - mapping types - examples - O/R mappings - annotations - Hibernate Query Language - Hibernate criteria - queries - Hibernate Native SQL, caching, batch processing, interceptors.

References

1. Jason Hunter and William Crawford, *Java Servlet Programming*, 2nd Edition, O'Reilly Media, ISBN: 0596000405.
2. Karl Moss, *Java Servlets*, McGraw-Hill, ISBN: 0074637398.
3. Barry Burd, *JSP: JavaServerPages*, IDG Books, ISBN:0764535358.
4. Prashant Sridharan, *Javabeans Developer's Resource*, ISBN: 0138873089.
5. Chuck Cavaness, *Programming Jakarta Struts*, 2nd Edition, O'Reilly Media, ISBN: 0596006519.
6. Madhusudhan Konda, *Just Hibernate: A Lightweight Introduction to the Hibernate Framework*, Oreilly Meida, ISBN: 9781449334376.

APPENDIXA_Guidelinesfor Project Report& Layout

Cover Page & First Page

<<TITLE>>

A PROJECT REPORT

SUBMITTED BY

<<NAME OF THESTUDENT>>

FOR THE AWARD OF THE

DEGREE OF MASTER OF SCIENCE (M.SC.) IN

COMPUTER SCIENCE

(ST. JOSEPH"S COLLEGE (AUTONOMOUS),
DEVAGIRI, CALICUT)

<<COLLEGE EMBLEM>>

<<NAME OF THE DEPARTMENT>>

<<NAME OF THE INSTITUTION>>
(AFFILIATED TO THE UNIVERSITY OF CALICUT)
<<ADDRESS>>

MONTH YEAR

Acknowledgement

ACKNOWLEDGEMENT

I would like to thank ………..

Date: Name of the Student

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Declaration by the Student

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person or material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Date: Signature:
Name
: Reg.
No.:

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Certificate from Guide & HoD

CERTIFICATE

This is to certify that the project report entitled <<TITLE HERE>> submitted by <<Name of the Student>> (Register Number: << Reg, No>>) to St. Joseph's College (Autonomous), Devagiri for the award of the degree of Master of Science (M.Sc.) in Computer Science is a bonafide record of the project work carried out by him/her under my supervision and guidance. The content of the report, in full or parts have not been submitted to any other Institute or University for the award of any other degree or diploma.

Signature	Signature
<<Name Project Guide>>	<<Name of the HOD>>
<<Designation>>	<<Designation>>

Place:
Date:

PROJECT EVALUATION REPORT OF THE EXAMINERS

Certified that the candidate was examined by us in the Project Viva Voce Examination held on .... and his/her Register Number is ....

Examiners:

1.
2.

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ABSTRACT

The abstract is a very brief summary of the report's contents. It should be about half a page long. Somebody unfamiliar with your project should have a good idea of what it's about having read the abstract alone and will know whether it will be of interest to them.

An abstract is a section at the beginning of a report, dissertation, thesis or paper summarising the contents, significant results and conclusions of said document. It allows people to rapidly ascertain the documents purpose and if the document will be useful for them to read.

The abstract is not the same as a summary in the sense you are think of. It is a standalone account of the document giving purpose of the work (objectives), method used, scope of the work, results, conclusions and recommendations.

The abstract, although it comes first logistically, always should be written at the completion of the other chapters of the project report. It needs to be written last because it is the essence of your report, drawing information from all of the other sections of the report. It explains why the experiment was performed and what conclusions were drawn from the results obtained.

A general guideline for an abstract has five sections or areas of focus: why the experiment was conducted; the problem being addressed; what methods were used to solve the problem; the major results obtained; and the overall conclusions from the experiment as a whole.

Do not be misled, however, from this list into thinking that the abstract is a long section. In fact, it should be significantly shorter than all of the others. All of this information should be summarized in a clear but succinct manner if the abstract is going to be successful. An estimated average length for all of this information is only a single paragraph. Although this may seem as though it is a short length to contain all of the required information, it is necessary because it forces you to be accurate and yet compact, two essential qualities.

There are many useful web pages such as http://writing2.richmond.edu/training/proiect/ biologv/abslit.html to get few sample abstracts and the common mistakes we make when we write an abstract.

List of Figures

LIST OF FIGURES

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List of Tables

LIST OF TABLES

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CHAPTER 1

INTRODUCTION

This is a general introduction about the project. Briefly summarize the relevance and background information about the proposed work. It should have the following sections.

1. About the proposed work, underlying technologies and techniques – outline briefly the technological/engineering/scientific/socioeconomic/relevance or significance of the project work being reported.
2. Project Profile – Tile, Area and Category and other relevant information.
3. About the Organization – to whom the Project Work is carried out.
4. Major Contributions of the Project Work.

CHAPTER 2

PROBLEM DEFINITION AND METHODOLOGY

This chapter is meant for giving a detailed description about the problem. This chapter includes the following subsections.

1. Problem Definition
2. Objectives
3. Motivation
4. Methodology
5. Scope

CHAPTER 3

REQUIREMENT ANALYSIS AND SPECIFICATION

This chapter includes the following subsections.

1. Requirement Analysis/Literature Review
2. Existing System
3. Proposed System
4. Requirement Specification
    a. Functional Requirements
    b. Non-functional Requirements
    c. Environmental Details (Hardware & Software Requirements)
5. Feasibility Study
    a. Technical Feasibility
    b. Economical Feasibility
    c. Operational Feasibility
6. Project Planning and Scheduling
    a. PERT Chart
    b. GANTT Chart
7. Software Requirement Specifications (IEEE format preferred)

CHAPTER 4

REQUIREMENTANALYSIS AND SPECIFICATION

This chapter includes the following subsections.

1. Users of the System
2. Modularity Criteria
3. Architecture Diagrams (whichever of the following if applicable)
    a. DFD
    b. UML Diagrams
    c. Flowchart
4. User Interface Layout
5. Structure of Reports Being Created
6. Database Design
    a. List of Entities and Attributes
    b. E R Diagram
    c. Structure of Tables

CHAPTER 5

IMPLEMENTATION

This chapter is about the realisation of the concepts and ideas developed earlier. It can also describe any problems that may have arisen during implementation and how you dealt with them.

Do not attempt to describe all the code in the system, and do not include large pieces of code in this section. Instead pick out and describe just the pieces of code which, for example:

- Are especially critical to the operation of the system;
- You feel might be of particular interest to the reader for some reason;
- Illustrate a non-standard or innovative way of implementing an algorithm, data structure, etc.

You should also mention any unforeseen problems you encountered when implementing the system and how and to what extent you overcame them. Common problems are:

- Difficulties involving existing software, because of, e.g.,
    - its complexity,
    - lack of documentation;
    - lack of suitable supporting software;
    - over-ambitious project aims.

A seemingly disproportionate amount of project time can be taken up in dealing with such problems. The Implementation section gives you the opportunity to show where that time has gone.

Complete source code should be provided separately as an appendix. This chapter includes the following subsections.

1. Brief description about the Tools/Scripts for Implementation
2. Module Hierarchy
3. Coding
4. Problems Encountered

CHAPTER 6

TESTING

This chapter includes the following subsections.

1. Test Plans
2. Unit Testing
    a. Test Items (Test Cases)
3. Integration Testing
4. System Testing
    a. Test Items (Test Cases)
5. Implementation - Changeover Plans

CHAPTER 7

CONCLUSION

The purpose of this section is to provide a summary of the whole thesis or report. In this context, it is similar to the Abstract, except that the Abstract puts roughly equal weight on all report chapters, whereas the Conclusion chapter focuses primarily on the findings, conclusions and/or recommendations of the project.

There are a couple of rules for this chapter:

- All material presented in this chapter must have appeared already in the report; no new material can be introduced in this chapter (rigid rule of technical writing).
- Usually, you would not present any figures or tables in this chapter (rule of thumb).

Conclusions section can have the following (typical) content. These contents must not be given in bulleted format.

- Re-introduce the project and the need for the work though more briefly than in the introduction.
- Reiterate the purpose and specific objectives of your project.
- Recap the approach taken similar to the road map in the introduction.
- However, in this case, you are re-capping the data, methodology and results as you go.
- Summarize the major findings and recommendations of your work.

Future Enhancements

Identify further works that can be added to make your system to meet the challenges of tomorrow. You can also include whatever requirements you could not fully due to the scarcity of time/resources.

BIBLIOGRAPHY

Ideas or contents taken from other sources should be properly cited. It is important that you give proper credit to all work that is not strictly your own, and that you do not violate copyright restrictions.

References should be listed in alphabetical order of authors' surname, and should give sufficient and accurate publication details. IEEE format is to be followed while preparing citations.

PUBLICATIONS OUT OF THE PROJECT WORK

A list of publications made or communicated out of the work done in the project is to be included here.

GENERAL INSTRUCTIONS

1. All chapters should contain an introduction and summary (summarizes the entire chapter content in one or two lines)sections.
2. Students have to take care that only chapters/sections relevant to their work are to be included in their report.
3. Instead of merely replicating the definitions for these sections from standard text books of Software Engineering, the student has to describe the information related to his/her work (For eg, Feasibility study should be about how the proposed work is technically/economically/operationally feasible).
4. Figures and tables are to be clear and legible.
5. Citations are to be provided wherevernecessary.
6. Important code, screenshots, report formats and glossary of technical terms are to be attached as Appendices A, B, C and D respectively.