REGULATIONS AND SYLLABUS
of

**Master of Technology
in
Computer Science and Technology**

(w.e.f. 2019-20 admitted batch)

A University Committed to Excellence

M.Tech. in Computer Science and Technology
(CST)REGULATIONS
(w.e.f. 2019-20 admitted batch)

1. ADMISSION

Admission into M.Tech. in Computer Science and Technology (CST) program of GITAM (Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

A pass in B.E./B.Tech./AMIE in any branch of Engineering or its equivalent or MCA/MSc.

Admissions into M.Tech. will be based on thefollowing:

(i) Score obtained in GAT (PG), ifconducted.
(ii) Performance in Qualifying Examination /Interview.
(iii) Candidates with valid GATE score shall be exempted from appearing or GAT(PG).

The actual weight age to be given to the above items will be decided by the authorities at the time of admissions.

3. CHOICE BASED CREDIT SYSTEM

Choice Based Credit System (CBCS) was introduced with effect from 2015-16 admitted batch and revised with effect from academic year 2019-20 in order to promote:

- Student centered Learning
- Activity based learning
- Students to learn courses of their choice
- Cafeteria approach

Learning objectives and outcomes are outlined for each course to enable a student to know what he/she will be able to do at the end of the program.

4. STRUCTURE OF THE PROGRAM

The Program Consists of

i) Core Courses (compulsory) which give exposure to a student in core subjects related area.

ii) Program Electives.

iii) Open Electives

iv) Mandatory and Audit Courses

Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week.

In general, credits are assigned to the courses based on the following contact hours per week persemester.

- One credit for each Lecture / Tutorial hour per week.
- One credit for two hours of Practicals per week.

The curriculum of the four semesters M.Tech. program is designed to have a total of 68 credits for the award of M.Tech. degree

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register for the courses in each semester at the time specified in the academic calendar.

7. ATTENDANCE REQUIREMENTS

A student whose attendance is less than 75% in all the courses put together in any semester will not be permitted to attend the semester-end examination and he/she will not be allowed to register for subsequent semester of study. He/she has to repeat the semester along with his / her juniors.

However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance to the students whose attendance is between 65% and 74% on genuine grounds and on payment of prescribed fee.

8. EVALUATION

The assessment of the student's performance in a theory course shall be based on two components: Continuous Evaluation (40 marks) and semester-end examination (60 marks).

A student has to secure a minimum of 40% in any theory course in the two components (ref. 8.1) put together to be declared to have passed the course, subject to the condition that the student must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theory component at the semester-end examination.

Practical/ Project Work/ Viva voce/ Seminar etc. course are completely assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure Pass Grade. Details of Assessment Procedure are furnished below in Table1.

Audit courses are assessed through continuous evaluation for satisfactory or not satisfactory only. No credits will be assigned.

Table 1: Assessment Procedure

S.No.	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Evaluation
1	Theory Courses	40	Continuous Evaluation	i) Thirty (30) marks for mid Semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration.
		60	Semester-end Examination	ii) Ten (10) marks for Quizzes, Assignments and Presentations. Sixty (60) marks for Semester-end examinations
	Total	100		

2	Practical Courses	100	Continuous Evaluation	i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the semester. ii) Ten (10) marks for casestudies. iii) Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the semester) conducted by the concerned labteacher.
3	Technical Seminar (II Semester)	100	Continuous Evaluation	Through five periodic seminars of 20 marks each
4	Project Work (III Semester)	100	Continuous Evaluation	i) Forty (40) marks for periodic assessment on originality, innovation, sincerity and progress of the work, assessed by the project supervisor. ii) Thirty (30) marks for mid-term evaluation for defending the project, before a panel ofexaminers. iii) Thirty (30) marks for final report presentation and viva-voce, by a panel ofexaminers*.
5	Project Work (IV Semester)	50	Continuous Evaluation	i) Twenty (20) marks for periodic assessment on originality innovation, sincerity and progress of the work, assessed by the project supervisor. ii) Fifteen (15) marks for mid-term evaluation for defending the project, before a panel ofexaminers*. iii) Fifteen (15) marks for interim report presentation and viva-voce.
		50	Semester-end Examination	Fifty (50) marks for final project report and viva-voce examination assessed by external examiners.
	Total	100		

6	Audit Courses	100	Continuous Evaluation	Audit courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures a minimum of 40 out of 100 marks during continuous evaluation, he / she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get the degree

*Panel of Examiners shall be appointed by the concerned Head of the Department

9. PROVISION FOR ANSWER BOOK VERIFICATION AND CHALLENGE EVALUATION

If a student is not satisfied with his/her grade, the student can apply for answer book verification on payment of prescribed fee for each course with in one week after announcement of results.

After verification, if a student is not satisfied with revaluation marks/grade, he/she can apply for challenge valuation within one week after announcement of answer book verification result or two weeks after the announcement of results, which will be valued by two examiners i.e., one Internal and one External examiner in the presence of the student on payment of prescribed fee. The challenge valuation fee will be returned, if the student is successful in the appeal by securing a bettergrade.

10. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

The odd semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

The even semester supplementary examinations will be conducted after conducting regular odd semester examinations during October/November.

A student who has secured 'F' Grade in Project work shall have to improve his/her work and reappear for viva-voce after satisfactory completion of work approved by panel of examiners.

A student who hasc ompleted period of study and has "F" grade in final semester courses is eligible to appear for special examination.

11. MASSIVE OPEN ONLINE COURSES (MOOCs)

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (**MOOCs**) during the period of study. Students without any backlog courses up to first semester are permitted to register for MOOCs in second semester up to a maximum of 6 credits from program elective / open elective/audit courses. However the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency will be decided by the respective Board of Studies(BoS).

12. GRADING SYSTEM

Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table2.

Table 2: Grades and Grade Points

Sl.No.	Grade	Grade Points	Absolute Marks
1	O (outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab (Absent)	0	-

A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, and is deemed to have earned the credits assigned to that course, subject to securing a GPAof 5.0 for a Pass in the semester.

13. GRADE POINT AVERAGE

A Grade Point Average (GPA) for the semester will be calculated according to the formula:

$$GPA = \frac{\Sigma [C \times G]}{\Sigma C}$$

Where, C = number of credits for the course,
G = grade points obtained by the student in the course.

The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

CGPA required for classification of class after the successful completion of the program is shown inTable 3.

Table 3: CGPA required for Award of Class

Class	CGPA Required
First Class with Distinction	$\geq 8.0^*$
First Class	≥ 6.5
Second Class	≥ 5.5
Pass Class	> 5.0

* In addition to the required CGPA of 8.0 or more, the student must have necessarily passed all the courses of every semester in the first attempt.

14.   ELIGIBILITY FOR AWARD OF THE M.Tech. DEGREE

Duration of the program: A student is ordinarily expected to complete the M.Tech. Program in four semesters of two years. However a student may complete the program in not more than four years including study period.

However the above regulation may be relaxed by the Vice-Chancellor in individual cases for cogent and sufficient reasons.

A student shall be eligible for award of the M.Tech. Degree if he / she fulfill all the following conditions.

a)   Registered and successfully completed all the courses and project works.

b)   Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated period.

c)   Has no dues to the Institute, Hostels, Libraries, NCC / NSS etc,and

d)   No disciplinary action is pending against him /her.

15.   DISCRETIONARY POWER

Not withstanding anything contained in the above sections, the Vice Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

M.Tech. in Computer Science & Technology
Effective from academic year 2019-20 admitted batch

Semester I

S.No	Course Code	Course Title	Category	L	T	P	C
1	19ECS701	Advanced Data Structures	PC	3	0	0	3
2	19ECS703	Mathematical Foundations of Computer Science	PC	3	0	0	3
3	19ECS705	Advanced Algorithms	PC	3	0	0	3
4	19ECS7XX	Program Elective I	PE	3	0	0	3
5	19ECS7XX	Program Elective II	PE	3	0	0	3
6	19EMC741	Research Methodology and IPR	MC	2	0	0	2
7	19ECS721	Advanced Data Structures Laboratory	PC	0	0	4	2
8	19ECS727	Data Science and Machine Learning Laboratory	PC	0	0	4	2
9	19EAC7XX	Audit Course I	AC	2	0	0	0
						Total Credits: 21	

Semester II

S.No	Course Code	Course Title	Category	L	T	P	C
1	19ECS702	Soft Computing	PC	3	0	0	3
2	19ECS7XX	Program Elective III	PE	3	0	0	3
3	19ECS7XX	Program Elective IV	PE	3	0	0	3
4	19ECS7XX	Program Elective V	PE	3	0	0	3
5	19EOE7XX	Open Elective	OE	3	0	0	3
6	19ECS722	Soft Computing Laboratory	PC	0	0	4	2
7	19ECS724	Digital Forensics Laboratory	PC	0	0	4	2
8	19ECS792	Technical Seminar	PC	0	0	4	2
9	19EAC7XX	Audit Course II	AC	2	0	0	0
						Total Credits: 21	

SemesterIII

S.No	Course Code	Course Title	Category	L	T	P	C
1	19ECS891	Project Work I	PW	0	0	26	13
						Total Credits: 13	

SemesterIV

S.No	Course Code	Course Title	Category	L	T	P	C
1	19ECS892	Project Work II	PW	0	0	26	13
						Total Credits: 13	

Number of Credits

Semester	I	II	III	IV	Total
Credits	21	21	13	13	**68**

Programme Elective I

S. No.	Course Code	Course Title	Category	L	T	P	C
1	19ECS741	Machine Learning	PE	3	0	0	3
2	19ECS743	Wireless Sensor Networks	PE	3	0	0	3
3	19ECS745	Distributed Systems	PE	3	0	0	3

Programme Elective II

S. No.	Course Code	Course Title	Category	L	T	P	C
1	19ECS747	Data Science	PE	3	0	0	3
2	19ECS749	Introduction to Intelligent Systems	PE	3	0	0	3
3	19ECS751	Data Preparation and Analysis	PE	3	0	0	3

Programme Elective III

S. No.	Course Code	Course Title	Category	L	T	P	C
1	19ECS742	Advanced Wireless and Mobile Networks	PE	3	0	0	3
2	19ECS744	Secure Software Design and Enterprise Computing	PE	3	0	0	3
3	19ECS746	Computer Vision	PE	3	0	0	3

Programme ElectiveIV

S. No.	Course Code	Course Title	Category	L	T	P	C
1	19ECS748	Human and Computer Interaction	PE	3	0	0	3
2	19ECS750	GPU Computing	PE	3	0	0	3
3	19ECS752	Digital Forensics	PE	3	0	0	3

Programme Elective V

S. No.	Course Code	Course Title	Category	L	T	P	C
1	19ECS754	Mobile Applications and Services	PE	3	0	0	3
2	19ECS756	Compilers for High Performance Computing	PE	3	0	0	3
3	19ECS758	Optimization Techniques	PE	3	0	0	3

Audit Course I and II

S. No	Course Code	Course Name	Category	L	T	P	C
1	19EAC741	English for Research Paper Writing	AC	2	0	0	0
2	19EAC742	Disaster Management	AC	2	0	0	0
3	19EAC744	Value Education	AC	2	0	0	0
4	19EAC745	Constitution of India	AC	2	0	0	0
5	19EAC746	Pedagogy Studies	AC	2	0	0	0
6	19EAC747	Stress Management by Yoga	AC	2	0	0	0
7	19EAC748	Personality Development through life Enlightenment Skills	AC	2	0	0	0
8	19EAC750	Developing Soft Skills and Personality	AC	2	0	0	0

Open Electives

S. No	Course Code	Course Name	Category	L	T	P	C
1	19EOE742	Business Analytics	OE	3	0	0	3
2	19EOE746	Operations Research	OE	3	0	0	3
3	19EOE748	Cost Managementof Engineering Projects	OE	3	0	0	3

19ECS701: ADVANCED DATA STRUCTURES

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L  T  P  C
3  0  0  3
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This course provide an overall idea of to design, implement and to perform various operations like search, insert, delete etc., operations on the complex data structures. As a part string matching techniques and text data compression algorithms were also considered

Course Objectives:
- Learn to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
- Understand the necessary mathematical abstraction to solve problems.
- Familiarize with advanced paradigms and data structure used to solve algorithmic problems.
- Analyze efficiency and proof of correctness of various algorithms.

Unit I 9L

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.
Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Learning Outcomes
After completion of this unit the student will be able to
- define adt, understand hashing (L1)
- design and implement a hash function with the above collision resolution techniques(L6)

Unit II 9L

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Learning Outcomes
After completion of this unit, the student will be able to
- create and perform operations like insert, delete and search operations on skipped lists (L6)
- differentiate between singly linked list/ doubly linked list and skip list with respect to space complexity and time complexity to perform search, insert and delete operations. (L2)

Unit III 9L

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Learning Outcomes
After completion of this unit, the student will be able to
- organize data in a hierarchy form / non linear way (L4)
- perform search, insert and delete operations in the above data structures. (L4)

Unit IV 9L

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm,The Knuth- Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence
Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Learning Outcomes
After completion of this unit, the student will be able to
- perform various string handling and string matching algorithms mainly considering similarity and identity in to account. (L6)
- understand various text data compression techniques (L2)

Unit V   **6L**

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

Learning Outcomes

After completion of this unit, the student will be able to

- distinguish between one dimensional range search and two dimensional range search (l2)
- understand the database management query concepts in this domain(L2)

TextBook(s):

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in   C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Outcomes:

After completion of this course, the student will be able to

- understand the implementation of symbol table using hashing techniques.(L2)
- develop and analyze algorithms for red-black trees, b-trees and splay trees.(L3)
- develop algorithms for text processing applications.(L5)
- identify suitable data structures and develop algorithms for computational geometry problems. (L4)

19ECS703: MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

L T P C
3 0 0 3

The purpose of this course is to provide a clear understanding of the concepts that underlying fundamental concepts and tools in mathematics with emphasis on their applications to computer science. It emphasizes mathematical definitions and proofs as well as applicable methods.

Course Objectives:
- Familiarize the student about the concepts of Probability and Probabilistic Distributions.
- Evaluate principles of Random Sampling and derive the Problems
- Enable the student to interpret wider range of visual and numerical data, and carry out basic inferential procedures
- Illustrate the knowledge of mathematical modelling
- Utilize the knowledge of computing and mathematics appropriate to the discipline.
- Be familiar with the concepts of graph theory and using them in solving computer science problems.

Unit I   **7L**
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Learning Outcomes
After completion of this unit, the student will be able to
- use the axioms of probability, define conditional probability. (L2)
- write axioms, and infer meaningful conclusions about the data. (L1)
- define conditional probability and understand intuitively about the conditional probability. (L1)
- identify the need for central limit theorem. (L2)
- use probabilistic inequalities such as Chernoff bound, Markov and Chebyshev's inequalities.(L2)

Unit II   **7L**
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Learning Outcomes
After completion of this unit, the student will be able to
- understand the concepts of estimation theory. (L2)
- describe the sampling distribution of a sample proportions. (L2)
- calculate probabilities of a sample proportion. (L3)

Unit III   **9L**
Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over-fitting model assessment.

Learning Outcomes
After completion of this unit, the student will be able to
- summarize data visually and numerically. (L4)
- learn the mathematical and probabilistic foundations of statistical inference. (L1)
- reduce the dimensionality of data. (L3)
- fit the Regression lines and analyze multivariate data. (L1)

Unit IV   **8L**
Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

Learning Outcomes

After completion of this unit, the student will be able to

- apply the basic concepts of graph theory and note the different properties of graphs(L4).
- apply the basic concepts to solve combinatorial problems(L4)
- describe and solve some real time problems using concepts of graph theory(L2)

Unit V
10L

Computer science and engineering applications
Datamining,Networkprotocols,analysisofWebtraffic,Computersecurity,Softwareengin
eering,Computer architecture, operating systems, distributed systems, Bioinformatics,
Machine learning.

Learning Outcomes

After completion of this unit, the student will be able to

- compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems. (L4)
- knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. (L5)
- how machine learning algorithms works - a basic introduction. (L1)
- why we want to study big data and how to prepare data for machine learning algorithms. (L1)
- acquire strong fundamental knowledge in science, mathematics, fundamentals of computer science, software engineering and multidisciplinary engineering to begin in practice as a software engine. (L2)

Text Book(s)

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal, Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Course Outcomes:

After completing this Course, the student should be able to

- evaluate principles of random sampling and derive the problems(L4).
- understand the concepts of estimation theory (L2).
- fit the regression lines and analyse multivariate data(L3)
- compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems(L4)

19ECS705: ADVANCED ALGORITHMS

L T P C
3 0 0 3

The course is concentrated on the study and development of algorithms for solving practical problems efficiently, and the theoretical analysis of their behavior. It involves algorithm design techniques, methods for analyzing the performance of corresponding algorithms and improving their efficiency, and to provide performance guarantees.

Course Objectives:
- Introduce the advanced methods of designing and analyzing algorithms.
- Identify an appropriate algorithm and implement it for a specific problem.
- Understand different classes of problems concerning their computation difficulties.
- Solve problems using dynamic programming, network flow algorithms, graph algorithms and approximation algorithms.
- Analyze recent developments in the area of algorithmic design.

Unit I 6 L
Sorting: Review of various sorting algorithms, topological sorting
Graph**:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge weighted case (Dijkastra's), depth-first search and computation of strongly connected components, emphasis oncorrectness proof of the algorithm and time/space analysis.
Learning Outcomes
After completion of this unit the student will be able to
- describe different sorting algorithms and their time complexity(L2)
- apply various graph traversal algorithms to find shortest paths(L3)
- outline the difference between BFS and DFS algorithms(L4)
- review the correctness of algorithm time and space analysis(L2)

Unit II 8 L
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.
Learning Outcomes
After completion of this unit the student will be able to
- calculate the maximum matching in graph related problems(L3)
- compute algorithms for maximum weight and maximal independent set. (L3)
- apply MST for real world problems(L3)
- discover augmenting paths in graphs using various algorithms(L3)

Unit III 9 L
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond- Karp maximum-flow algorithm.
Matrix Computations**:** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix.
Learning Outcomes
After completion of this unit the student will be able to

- solve network flow problems using network flow algorithms(L3)
- implement divide and conquer paradigm for matrix multiplication(L3)
- analyze how efficiency can be achieved by matrix computation algorithms(L4)

Unit IV   **10 L**

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base- representation and modulo-representation. Application: Interpolation problem.

Learning Outcomes:

After completion of this unit the student will be able to
- practice more examples on dynamic programming(L3)
- determine shortest paths in a graph using dynamic programming(L5)
- assess various representations of data(L5)
- develop algorithms for interpolation problems(L6)

Unit V   **9 L**

Linear Programming: Geometry of the feasibility region and Simplex algorithm

NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following

topicsbasedontimeandinterest.Approximationalgorithms,RandomizedAlgorithms,InteriorPointMethod.

Learning Outcomes

After completion of this unit, the student will be able to
- explain linear programming concepts(L2)
- examine NP-hardness and NP-completeness problems (L4)
- illustrate approximation algorithms(L4)
- analyze randomized algorithms.(L4)

Text Book(s):
1.   Cormen, Leiserson, Rivest, Stein, "Introduction to Algorithms", Tata Mcgraw Hill Publishers.
2.   Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education.
3.   Kleinberg and Tardos, "Algorithm Design", Pearson Education.

Course Outcomes:

After completion of the course, students would be able to:
- analyze the complexity/performance of different algorithms. (L4)
- determine appropriate algorithm that is suitable for solving a particular set of problems. (L3)
- explain more complex algorithms and proofs in written form (L3)
- categorize different problems in various classes according to their complexity. (L4)
- design and analyze techniques for algorithms and ways to approach NP-complete problems (L6)
- apply techniques to solve new problems that may arise in various applications (L3)

. **19EMC741: RESEARCH METHODOLOGY AND IPR**

L   T   P   C
2   0   0   2

This course introduces the student, to the fundamentals of research, research process, technical writing and intellectual property rights. Students will be able to use this knowledge to gain interest in their subject area and pursue their career in research.

Course Objectives
- To familiarize the meaning, objectives and sources of research
- To acquaint the student with the importance and methods of literature review/research ethics
- To impart the knowledge of technical writing for preparing reports, presentations, research proposals, conference/journal publications
- To introduce the terminology and process of obtaining intellectual property rights
- To expose the intricacies in the process of obtaining patent rights

Unit I   **5L**
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Learning Outcomes
After the completion of this unit, the student will be able to
- define the meaning of a research problem (L1)
- list the different sources of research problem (L2)
- enumerate the different criteria of good research and list the different errors in selecting research problem (L2)
- contrast the different approaches of research (L3)
- compare the different methods for data collection and analysis (L5)

Unit II   **5L**
Effective literature studies approaches, analysis Plagiarism, Research ethics

Learning Outcomes
After the completion of this unit, the student will be able to
- list and elaborate the different steps of the research process (L1)
- explain the importance of carrying out an effective literature review (L2)
- identify the research gaps from literature review (L5)
- describe the ethical principles to be following during research process and authorship (L2)
- define the terminology and list the methods to avoid being accused of plagiarism (L1)
- list the different types of research misconduct (L2)

Unit III   **5L**
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Learning Outcomes
After the completion of this unit, the student will be able to

- list the attributes, reasons and guidelines for effective technical writing (L1)
- contrast between conference paper, technical presentation and journal paper (L3)
- choose a particular research contribution for patenting or journal publication (L4)
- describe the terminology related to citation, citation index, h-index etc (L2)

Unit IV   **5L**
Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. **International Scenario**: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the codes and standards in building intellectual property rights(L2)
- list the subject, importance and requirements for of patentability(L1)
- explain the process of patenting and commercialization in academia(L2)
- enumerate the procedure for application preparation, filing and grant of Patents(L2)

Unit V   **8L**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. **New Developments in IPR**: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Outcomes
After the completion of this unit, the student will be able to
- explain the scope of patent rights(L2)
- describe the process for licensing and transfer of technology(L2)
- identify the sources of patent information and databases(L1)
- elaborate the administration of patent system(L2)
- describe the new developments in IPR in computer software, biological systems etc(L3)

Text Book(s):
1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science and engineering students", Tata Mcgraw Hill India, 2013.
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2/e, Prentice Hall of India, 2013.
References:
1. Halbert, "Resisting Intellectual Property", Taylor and Francis Limited, 2007.
2. Mayall, "Industrial Design", McGraw Hill, 1992.
3. Niebel, "Product Design", McGraw Hill, 1974.
4. Asimov, "Introduction to Design", Prentice Hall, 1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand Publishers, 2008

Course Outcomes

After successful completion of the course, the student will be able to
- define the meaning, sources, approaches for research problems (L1)
- explain the guidelines for carrying out effective literature review and identify research gaps(L2)
- describe effective guidelines for preparing technical reports, research publications, presentations and research proposals(L2)
- describe the codes, standards and process of obtaining intellectual property rights(L3)
- enumerate the new developments of IPR in engineering systems(L3)

19ECS721: ADVANCED DATA STRUCTURES LABORATORY

L T P C
0 0 4 2

1. Develop programsfor
   a. HeapSort
   b. MergeSort
   c. Quick sort by taking random element aspivot
   d. Selection

2. Program to perform insertion, deletion and search operations on thefollowing:
   a. Single Linked List b. Doubly Linked List c. Circular Linked List

3. Implement the functions of a dictionary using Hashing.

4. Implement hash tables with linear probing and double hashing.
   Demonstration of inserting and deleting elements.

5. Skip list: Implementations and operations.

6. Develop a program to perform insertion, deletion and search operations on the followingTrees
   a. Binary SearchTree
   b. B-Trees
   c. AVLTree
   d. Red Black Trees

7. Implement the code for the following problems using DynamicProgramming:
   a. Matrix Chain MultiplicationProblem.
   b. String matching algorithm.

19ECS727: DATA SCIENCE AND MACHINE LEARNING LABORATORY

L T P C
0 0 4 2

1. Introduction to Python Libraries- Numpy, Pandas, Matplotlib,Scikit
2. Perform Data exploration and preprocessing inPython
3. Implement regularised Linearregression
4. Implement Naive Bayes classifier for dataset stored as CSVfile.
5. Implement regularized logistic regression
6. Build models using different Ensemblingtechniques
7. Build models using Decisiontrees
8. Build model using SVM with differentkernels
9. Implement K-NN algorithm to classify adataset.
10. Build model to perform Clustering using K-means after applying PCA and determining the value of K using Elbowmethod.

19ECS741: MACHINE LEARNING

LT P C
3 0 0 3

Machine Learning is the science of making machines think intelligently without being explicitly programmed. Machine learning is pervasive in everyday life today. This course is designed to enable students get in-depth understanding of different machine learning techniques including deep learning and reinforcement learning and apply them on real-life data.

Course Objectives:
- Understand the fundamental concepts of Supervised learning.
- Explore descriptive problem solving through unsupervised learning strategies.
- Acquire skills in developing as well as evaluating different machine learning models.
- Demonstrate the application of different deep learning methodologies.
- Gaingain an understanding of concepts like Reinforcement Learning and Active Learning.

Unit I   **10L**
Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class
Learning Outcomes
After completion of this unit, the student will be able to
- explain the concept of machine learning and their applications to different real world datasets. (L2)
- demonstrate the working of different supervised learning algorithms and assess their suitability to a given problem. (L3)
- extend a binary classification problem to solve a multi-class classification problem.(L3)

Unit II   **7L**
Unsupervised Learning: Clustering: K-means, Dimensionality Reduction: PCA and kernel PCA, Generative Models (Gaussian Mixture Models and Hidden Markov Models)
Learning Outcomes
After completion of this unit, the student will be able to:
- demonstrate the working of different dimensionality reduction techniques on high-dimensional datasets (L3)
- illustrate the working of Generative Models mathematically. (L3)

Unit III   **6L**
Evaluating Machine Learning algorithms, Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests)
Learning Outcomes
After completion of this unit, the student will be able to:
- interpret ensemble models as a function of different weak classifiers. (L3)
- compare the performances of different classification models. (L4)

Unit IV   **9L**
Modeling Sequence/Time-Series Data, Deep Learning (Deep generative models, Deep Boltzmann Machines, Deep auto-encoders, Applications of Deep Networks) and Feature Representation Learning
Learning Outcomes

After completion of this unit, the student will be able to:
- understand the methods for handling time series and sequence data. (L2)
- demonstrate the working of different deep learning approaches on complex data. (L3)

Unit V   **9L**
Scalable Machine Learning (Online and Distributed Learning) Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference

Learning Outcomes
After completion of this unit, the student will be able to:
- apply reinforcement learning approach to applications like bioinformatics and personalized recommendation. (L3)
- analyses the working of Active Learning approach on complex data. (L4)

Text Book(s)
1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. Jiawei Han, Micheline Kamber, Jian Pei , Data Mining: Concepts and Techniques, 3/e, Morgan Kaufmann, 2011.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Course Outcomes:
 After successful completion of the course, the student will be able to
- relate knowledge about application of machine learning techniques to real world problems. (L3)
- apply deep learning methodologies to applications such as image recognition, video tagging etc.(L3)
- generate suitable unsupervised learning approaches to descriptive machine learning models. (L4)
- utilize supervised learning approaches to perform predictive modeling of data. (L3)
- assess different machine learning algorithms based on performance evaluation measures. (L5)

19ECS743: WIRELESS SENSOR NETWORKS

L T P C
3 0 0 3

The course is designed to enable the student to understand the sensor networking concepts. This course lays the foundation both for developing and implementing networking concepts in real time environment.

Course Objectives:
- Understand the state-of-the-art in network protocols, architectures and applications.
- Analyze existing network simulator to working environment.
- Understand the medium access control protocols and Markov chain properties.
- Learn key routing protocols for sensor networks and main design issues
- Understand the routing protocols for wireless sensor networks and advanced protocols.

Unit I   **10L**
Introduction to Wireless Sensor Networks: Course Information, Motivations, Applications, Performance metrics, History and Design factors.
Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture
Hardware Platforms: Motes, Hardware parameters
Learning Outcomes
After completion of this unit the student will be able to
- Understand the basics of wireless sensor networks (L2).
- list the applications and design factors of sensor networks (l2).
- enable the layer stack and architecture. (L2)

Unit II   **8L**
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core Unit and simulation example.
Learning Outcomes
After completion of this unit, the student will be able to
- understand the working of network simulator-3 (L2).
- develop this simulator to implement protocols (L6).
- demonstrate the simulator with examples. (L3)

Unit III   **10L**
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled
Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis
MAC Protocol Analysis: Asynchronous duty-cycled X-MAC Analysis (Markov Chain)
Learning Outcomes
After completion of this unit, the student will be able to
- understand the medium access control protocol design (L3).
- make use of markov chain to implement protocol. (L3)
- solve problems of MAC using Markov chain. (L3)

Unit IV   **7L**
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution
Learning Outcomes
After completion of this unit, the student will be able to
- understand the concept of attacks (L2).

- apply the spin: sensor protocol for information via negotiation for applications (L3).
- enable the knowledge of static and dynamic key distribution (L3)

Unit V   **10L**
Routing protocols: Introduction, MANET protocols
Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing,
Broadcast, Multicast
Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced
topics in wireless sensor networks.
Advanced Topics: Recent development in WSN standards, software applications.
Learning Outcomes
After completion of this unit, the student will be able to
- get the knowledge of manet protocols(L1).
- compare and contrast the different protocols of routing protocols of sensor networks(L5).
- make use of protocols working in real time applications(L3).

Text Book(s):
1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks –Theory and Practice",Wiley 2010.
2. KazemSohraby, Daniel Minoli and TaiebZnati, "wireless sensor networks -Technology, Protocols,and Applications", Wiley Interscience 2007.
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, "Wireless Sensor Network Technologies for the Information Explosion Era", springer 2010.

Course Outcomes:
After completion of this course, the student will be able to
- explain the basics concepts of wireless sensor networks (L2).
- understand of network simulator 3 to implement protocols of wsn (L3).
- use of medium access control protocol design issues. (L1)
- knowledge of different security concepts and attacks (L3).
- gain working of different routing protocols (L3).
- learnt advanced topics and make use of real time environment (L3).

19ECS745: DISTRIBUTED SYSTEMS

LT P C
3 0 0 3

This course will help the students to get familiar with Distributed Database System concepts, system architecture, design strategies and issues, query optimization, transaction concepts and issues in reliability.

Course Objectives:
- Understand basic concepts related to Distributed Database System and Architecture.
- Comprehend the underlying design strategies, issues and query processing.
- Demonstrate different query optimization and query optimization algorithms.
- Familiarize fundamentals of transaction management based on concurrency control and reliability.

Unit I 8L

Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts
Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues
Learning Outcomes:
After completion of this unit the student will be able to
- define the key objectives of a distributed database system.(L1)
- discuss some of the advantages of distributed database system. (L1)
- discuss some of the problems in database systems(L2)
- illustrate the architecture of distributed DBMS(L2)

UnitII 10L

Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation
Semantics Data Control: View management; Data security; Semantic Integrity Control
Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data
Learning Outcomes:
After completion of this unit, the student will be able to
- list the various design strategies and issues. (L1)
- illustrate the data control, integrity and security(L2)
- build the layers of query processing(L3)
- apply theobjectives of query processing and query decomposition. (L4)

Unit III 8L

Distributed Query Optimization: Factors governing query optimization; Centralized query optimization; ordering of fragment queries; Distributed query optimization algorithms.

Learning Outcomes:

After completion of this unit, the student will be able to

- compare the various factors governing query optimization(L2)
- build the queries.(L3)
- compare the distributed and centralized query optimization(L4)
- test for different optimization algorithms.(L4)

Unit IV   **8L**

Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.

Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management

Learning Outcomes

After completion of this unit, the student will be able to

- apply the transaction management concepts.(L4)
- apply the transaction models (L4)
- distinguish between the concurrency control in centralized ddbs (L4)
- examine the various concurrency control algorithms.(L4)

UnitV   **6L**

Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

Learning Outcomes

After completion of this unit, the student will be able to

- compare the various issues in ddbss. (L4)
- categorize the failures. (L4)
- distinguish between the reliability techniques.(L4)
- evaluate the working of commit and recovery protocols.(L5)

TextBook(s):

1. M.T. Ozsu and P. Valduriez"Principles of Distributed Database Systems", , Prentice-Hall,1991.
2. D. Bell and J. Grimson "Distributed Database Systems", Addison-Wesley,1992

Course Outcomes:

After completion of this course, the student will be able to

- define the basic concepts, advantages and the architecture of distributed dbms(L1)
- demonstrate the distributed design issues, data control and query processing issues(L2)
- identify the various distributed query optimization factors.   (L3)
- evaluate the transaction management models and concurrency control. (L4)
- elaborate on the reliabilityissues and protocols.(L4)

19ECS747: DATA SCIENCE

L T P C
3 0 0 3

The purpose of this course is to provide a clear understanding about various data analytic techniques available to solve real world business problems, communicate findings, and effectively present the results using data visualization techniques. The knowledge gained helps in applying the data science concepts and methods to solve problems in real-world contexts.

Course Objectives:
- Familiarize the student about the concepts of data visualization and formal inference procedures.
- Enable the student to interpret wider range of visual and numerical data
- Train the student on basic machine learning algorithms
- Demonstrate the Applications of Data Science, Technologies for visualization Handling of variables using Python

Unit I   **6 L**

Introduction to core concepts and technologies: Introduction, Terminology, data science Process, data science toolkit, Types of data, Example applications

Learning Outcomes:
After completion of this unit the student will be able to
- understand the basic concepts of data science(L2)
- identify the types of data(L2)

Unit II   **7 L**

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources

Learning Outcomes:
After completion of this unit the student will be able to
- understand about how to collect the data, manage the data, explore the data, store the data(L2)

Unit III   **10 L**

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Learning Outcomes:
After completion of this unit the student will be able to
- understand the basic measures of central tendency. (L2)
- classify the data using svm and navie Bayesian. (L2)

Unit IV   **11 L**

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

Learning Outcomes

After completion of this unit the student will be able to

- familiarize about the visualization of data. (L4)
- apply coding techniques to data for securing the data. (L4)

Unit V   **7 L**

Applications of Data Science, Technologies for visualisation, Bokeh (Python)

Learning Outcomes

After completion of this unit the student will be able to

- understand the various concepts of data science and can be able to handle simple applications of data science using python.(L2)

Textbooks(s):

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline. O'Reilly, 2013.
2. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, Mining of Massive Datasets. v 2.1, Cambridge University Press, 2014.

Course Outcomes:

After completing this Course, the student should be able to

- identify the types of data (L1).
- understand about how to collect the data, manage the data (L2).
- classify the data using svm and navie bayesian (L3)
- apply coding techniques to data for securing the data (L4)

19ECS749: INTRODUCTION TO INTELLIGENT SYSTEMS

L T P C
3 0 0 3

The purpose of this course is to familiarize you with the basic techniques of artificial intelligence/intelligent systems. An introduction to the theories and algorithms used to create intelligent systems. Topics include search algorithms, logic, planning, knowledge representation, machine learning, and applications from areas such as computer vision, robotics, natural language processing, and expert systems.

Course Objectives:
- Introduces students to the field of Artificial Intelligence (AI) with emphasis on its use to solve real world problems for which solutions are difficult to express using the traditional algorithmic approach.
- Explores the essential theory behind methodologies for developing systems that demonstrate intelligent behaviour including dealing with uncertainty, learning from experience and following problem solving strategies found in nature.

Unit I   **9L**
Biological foundations to intelligent systems I: Artificial neural networks, Back- propagation networks, Radial basis function networks, and recurrent networks.
Learning Outcomes
After completion of this unit the student will be able to
- demonstrate good knowledge of basic theoretical foundations inIntelligent systems, Artificial neural networks. (L3)

Unit II   **6L**
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks.
Learning Outcomes
After completion of this unit the student will be able to
- demonstrate Fuzzy inferencing, Rule-based systems. (L3)

Unit III   **8L**
Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill- climbing search. Optimization and search such as stochastic annealing and genetic algorithm.
Learning Outcomes
After completion of this unit the student will be able to
- describe the attributes of various search techniques and the situations to which they are well-suited. (L1)
- implement standard AI algorithms. (L5)

Unit IV   **9L**
Knowledge representation and logical inference Issues in knowledge representation. Structured representation,suchasframes,andscripts,semanticnetworksandconceptualgraphs.Formallogicandlogical inference. Knowledge-based systems structures, its basic components. Ideas of Black boardarchitectures.
Learning Outcomes
After completion of this unit the student will be able to
- describe and apply various techniques for logic programming and machine learning. (L3)
- apply their knowledge to design solutions to different problems. (L4)

Unit V   **10L**

Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesianreasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning. Recent trends in Fuzzy logic, KnowledgeRepresentation.

Learning Outcomes

After completion of this unit the student will be able to

- design and develop an intelligent system for a selected application. (L6)
- understand case-based reasoning - probabilistic reasoning - intelligent agents determine which type of intelligent system methodology would be suitable. (L2)

Text Book(s)

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

Course Outcomes:

After completing this Course, the student should be able to

- describe the attributes of various search techniques and the situations to which they are well-suited. (L2)
- describe and apply various techniques for logic programming and machine learning. (L2)
- implement standard AI algorithms. (L6)
- discuss the history and implications of artificial intelligence research. (L2)

19ECS751: DATA PREPARATION AND ANALYSIS

L T P C
3 0 0 3

This course provides an overview of techniques to explore, analyze, and leverage data. The goal of data preparation is to create the data and provide insight into methods for analysis and processing of the data generated by modern information systems. The data that was acquired from different sources will likely have many problems. It requires cleaning the data, and putting the data in the right format for analysis by addressing data quality issues that is checking the data for accuracy. The course also provides methods for how to prepare data for analysis, perform exploratory data analysis, and develop meaningful data visualizations.

Course Objectives:
- Learn gather data from data sources and clean the data.
- Prepare data marts and transform data for statistical analysis.
- Perform exploratory data analysis and apply statistical methods to data for further refining
- Develop meaningful Data Visualizations.
- Create visualizations by using summary statistics and visualization methods for data exploration.

Unit I   **9 L**

Data Gathering and Preparation: Introduction to Big data, Terminology, Big data life cycle, Process for Making Sense of Data, Describing Data, Data sources, Data understanding, Data preparation

Learning Outcomes

After completion of this unit the student will be able to
- outline the different characteristics of data(L2)
- summarize the process of preparing the data(L4)
- collect the data from different sources(L2)
- classify and describe the data types of raw data(L2)

Unit II   **9 L**

Data Cleaning: Data Tables, Graphs, Understanding Relationships, Visualizing Relationships between Variables, Calculating Metrics about Relationships, Data Visualization

Learning Outcomes

After completion of this unit, the student will be able to
- examine the data formats in the tables(L4)
- identify the relationships and their measures of data variables(L4)
- modify the relationships for analysis purpose(L6)
- construct visualizations to find the relationships. (L6)

Unit III   **8 L**

Exploratory Analysis: Descriptive statistics, inferential statistics, comparative statistics, Clustering and association

Learning Outcomes

After completion of this unit, the student will be able to
- understand different statistical methods used to prepare data(L2)
- apply statistical methods on data for further analysis(L4)
- use hypothesis tests to re-verify the data(L3)
- develop clusters and associations for the data(L5)

Unit IV   **10 L**
Visualization: Designing visualizations, Time series, Geo-located data
Learning Outcomes
After completion of this unit, the student will be able to
- use various time series in visualization(L3)
- distinguish various forms of visualizations(L4)
- design data visualizations for complex datasets(L6)
- generate visualizations for geo located data(L6)

Unit V   **8 L**
Correlations and connections, Hierarchies and networks, interactivity
Learning Outcomes
After completion of this unit the student will be able to
- understand the concept of correlations and connections.(L2)
- explain how interactivity can be used for visualization. (L4)
- imagine the basic hierarchies in a network for interactivity.(L5)

Textbook(s):
1. Glenn J. Myatt, Making sense of Data I: A practical Guide to Exploratory Data Analysis and Data Mining, 1/e,2/e, A John Wiley & Sons, Inc., Publication, 2014.
2. Glenn J. Myatt, Making sense of Data II: A practical Guide to Exploratory Data Analysis and Data Mining, A John Wiley & Sons, Inc., Publication, 2009.
3. Ben Fry, Visualizing Data: Exploring and Explaining Data with the pre processing Environment, O'REILLY MEDIA,2008.
4. Tamraparni Dasu, Exploratory Data Mining and Data Cleaning, A John Wiley & Sons, Inc.

Course outcomes:
After completing this Course, the student should be able to
- familiarize in converting data into valuable information. (L1)
- develop strategies for dealing with imperfect data. (L5)
- distinguish clustering and association and apply them in solving statistical problems. (L2)
- design visualizations for exploratory analysis. (L3)
- review the concept of correlations and connections for geo located data. (L3)
- visualize the basic hierarchies in a network for interactivity. (L2)

19ECS702: SOFT COMPUTING

LTP C
3 0 0 3

This course gives an introduction to some fields in soft computing with its principal components of Fuzzy logic, Neural Networks and Genetic Algorithms. It also focuses on simple implementation of neural networks and fuzzy logic using Matlab/Python. This course would be quite useful to study the fundamental concepts of soft computing for the pursuit of allied research also.

Course Objectives:
- Understand the fundamental concepts of soft computing and machine learning
- Perform operations on fuzzy sets
- Develop neural networks algorithms in machine learning
- Illustrate and apply genetic algorithms in machine learning
- Get practical exposure to implement artificial neural networks and fuzzy logic through matlab/Python

Unit I 7L

Introduction to Soft Computing and Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Learning outcomes

After completion of this unit the student will be able to
- define soft computing and neural network(L-1)
- illustrate the evolution of the field of soft computing(L-1)
- explain the basics of machine learning(L-2)

Unit II 8L

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Learning outcomes

After completion of this unit the student will be able to
- name what are fuzzy sets, fuzzy operations and relations(L-1)
- define fuzzy reasoning and fuzzy inference systems   (L-1)
- illustrate fuzzy expert systems and decision making using fuzzy logic (L-2)

Unit III 10L

Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Learning outcomes

After completion of this unit the student will be able to

- list various forms of neural networks   (L1)
- define different types of learning a neural network (L1)
- identify how autonomous agents choose optimal decisions in their environments(L3)
- go through reinforcement learning

Unit IV   5L
Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.
Learning outcomes
After completion of this unit the student will be able to
- model genetic learning method by an analogy to biological evolution(L3)
- experiment with hypothesis space search in genetic learning(L3)
- apply the concepts of genetic programming(L4)

Unit V   12L
Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic
Learning outcomes
After completion of this unit the student will be able to
- identify various fundamental concepts of Matlab/Python(L3)
- experiment with toolboxes of neural network and fuzzy logic(L3)
- inspect a simple implementation of artificial neural network and fuzzy logic(L4)

Text Book(s):
1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing®, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications®, PrenticeHall, 1995.
3. MATLAB ToolkitManual.

Course outComes:
After completion of this course, the student will be able to..
- illustrate the evolution and basics of soft computing and machine learning. (L1)
- Experiment with fuzzy sets, operations, fuzzy inference and expert systems. (L5)
- list various forms of neural networks and their learning. (L1)
- illustrate genetic algorithms and their applications. (L3)
- experiment with Matlab/Python to understand the implementation of artificial neural network and fuzzy logic. (L5)

19ECS722: SOFT COMPUTING LABORATORY

L T P C
0 0 4 2

1. Tutorial on Tensorflow
2. Tutorial onkeras
3. Implement Union, Intersection, complement and difference operations on Fuzzysets.
4. Create Fuzzy relation by Cartesian product of any two Fuzzy sets and perform Max-Min composition of any two Fuzzyrelations.
5. Build Logistic Regression Classifier using NeuralNetworks
6. Build Deep neural network forclassification
7. Build neural network for Regression
8. Build a classification model using different parameter initializationtechniques.
9. Build classification model using Mini Batch gradient and Stochastic Gradienttechniques.
10. Implement Genetic algorithm.

19ECS724: DIGITAL FORENSICS LABORATORY

L	T	P	C
0	0	3	2

The following exercises have to be performed using various software tools/utilities mentioned Software Tools:
1. CyberCheck 4.0 - AcademicVersion
2. CyberCheckSuite
3. MobileCheck
4. Network SessionAnalyser
5. Win-LiFT
6. TrueImager
7. TrueTraveller
8. PhotoExaminer Ver1.1
9. CDRAnalyzer

Forensics Exercises:
I) DiskForensics:
1. Identify digitalevidences
2. Acquire theevidence
3. Authenticate theevidence
4. Preserve theevidence
5. Analyze theevidence
6. Report the findings

II) NetworkForensics:
• Intrusiondetection
• Logging (the best way to track down a hacker is to keep vast records of activity on a network with the help ofanintrusion detection system)
• Correlating intrusion detection andlogging

II) Device Forensics
1. PDA
2. Mobilephone
3. DigitalMusic

10. PrinterForensics
11. ScannerForensics

19ECS792:TECHNICAL SEMINAR

L T P C
0 0 4 2

Each student shall survey a technical topic related to a chosen specialization and prepare/submit a report in a specified format. It is advisable for students to choose a topic of interest to be continued as M.Tech Project in the 3rd & 4th Semester. The guidelines to carry out the research shall include the following:

1. Literature Review
2. Identification of Gap
3. Objectives and Expected Outcomes
4. Methodology / Innovative solution

Each student has to prepare a power point presentation on a selected technical topic with a novelty and get it evaluated by the faculty assigned for this purpose.

19ECS742: ADVANCED WIRELESS AND MOBILE NETWORKS

LTP C
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Thecourseisdesignedtoenablethestudentto learn the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: fundamentals of cellular communication, mobile radio propagation, multiple access techniques, mobility support, channel allocation, Wireless PAN/LAN/MAN standards, mobile ad-hoc networks, wireless sensor networks, mobile networks. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures and will introduce the students to wireless networking research and guide them to investigate novel ideas in the area via semester-long research projects..

Course Objectives:
- Understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.
- Compare recent technologies used for wireless communication.
- Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks and wireless cellular networks
- Explain multiple access techniques for Wireless Communication
- Evaluate design challenges, constraints and security issues associated with wireless networks and mobile networks.

Unit I   **12L**
Introduction: Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies -CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, RadioPropagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energyetc.
Wireless Local Area Networks: IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF & PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues
Learning Outcomes
After completing this Unit, students will be able to
- demonstrate WLAN architecture. [L2]
- learn the characteristics of the wireless channel and multiple access technologies [L2]
- analyze the functionality of MAC layer of WLAN [L4]

Unit II   **10L**
Wireless Cellular Networks:1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies,
Interference and system capacity, Improving
Coverage and capacity in cellular systems, Spread spectrum Technologies.
Learning Outcomes
After completing this Unit, students will be able to
- determine the coverage and capacity of Wireless Cellular Networks. [L5]
- analyze different technologies in Wireless Cellular Networks [L4]
- compare the strategies in TCP over wireless networks [L4]
- demonstrate Cellular Architecture[L2]

Unit III   **8L**

WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE 802.22Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview
Wireless Sensor Networks: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

Learning Outcomes

After completing this Unit, students will be able to
- demonstrate WSN architecture. [L2]
- select which protocol can be used for a specific application [L4]
- evaluate the power management in WSN [L4]

Unit IV   **6L**

Wireless PANs: Bluetooth AND ZigBee, Introduction to Wireless Sensors,

Learning Outcomes

After completing this Unit, students will be able to
- demonstrate Wireless PANs technology. [L2]
- determine different protocols and sensors in Wireless communication [L5]
- compare the different sensors in wireless communication [L5]

Unit V   **6L**

Security:SecurityinwirelessNetworksVulnerabilities,Securitytechniques,Wi-FiSecurity, DoSinwireless communication.

Learning Outcomes

After completing this Unit, students will be able to
-   evaluate design challenges, constraints and security issues associated with wireless networks and mobile networks.[L4]
- learn different security techniques in Wireless communication [L2]
- compare the different DoS attacks in wireless communication [L5]

Text Book(s)
1. Schiller J., Mobile Communications, Addison Wesley2000
2. Stallings W., Wireless Communications and Networks, Pearson Education2005
3. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc2002
4. Yi Bing Lin and ImrichChlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons In2000
5. Pandya Raj, Mobile and Personal Communications Systems and Services,PHI.

Course Outcomes:

After completion of this course, the student will be able to
- demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards.[L2]
- compare different technologies used for wireless communication systems.[L5]
- explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks. [L2]
- demonstrate multiple access techniques for wireless communication [L2]
- demonstrate e design challenges, constraints and security issues associated with wireless networks and wirless cellular networks.[L2]

19ECS744: SECURE SOFTWARE DESIGN AND ENTERPRISE COMPUTING

L T P C
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The course takes a software development perspective to the challenges of engineering software systems that are secure. This course addresses design and implementation issues critical to producing secure software systems. The course deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process from requirements gathering to design, development, configuration, deployment, and ongoing maintenance.

Course Objectives:
- Fix software flaws and bugs in various software.
- Aware of various issues like weak random number generation, information leakage, poor usability, and weak or no encryption on data traffic
- Understand the Techniques for successfully implementing and supporting network services on an enterprise scale and heterogeneous systems environment.
- Learn methodologies and tools to design and develop secure software containing minimumvulnerabilities and flaws.
- Study and handle the various threats, attacks and malwares methodologies.

Unit I   **8L**
Secure Software Design: Identify software vulnerabilities and perform software security analysis, Master security programming practices, Master fundamental software security design concepts, perform security testing and quality assurance.
Learning Outcomes
After completion of this unit the student will be able to
- understand the software vulnerabilities and to know the security design concepts (L1)
- perform software security analysis, programming practices (L2)

Unit II   **11L**
Enterprise Application Development: Describe the nature and scope of enterprise software applications,Design distributed N-tier software application,Research technologies available for the Fresentation,business and data tiers of an enterprise software application, Design and build a database using an enterprise database system, Develop components at the different tiers in an enterprise system, Design and develop a multi-tier solution to a problem using technologies used in enterprisesystem,Present software solution.
Learning Outcomes
After completion of this unit the student will be able to
- understand the nature and scope of enterprise software applications (L2)
- design N-tier software application and built database system(L4)
- develop multi-tier solution to a problem using technologies used in enterprise system (L5)

Unit III   **8L**
Enterprise Systems Administration: Design, implement and maintain a directory-based server infrastructure in a heterogeneous systems environment, Monitor server resource utilization for system reliability and availability, Install and administer network services (DNS/DHCP/Terminal Services/Clustering/Web/Email).
Learning Outcomes
After completion of this unit the student will be able to
- implement a directory-based server infrastructure. (L5)
- install and monitor network services for system reliability and availability. (L6)

Unit IV   **8L**

Obtain the ability to manage and troubleshoot a network running multiple services, Understand the requirements of an enterprise network and how to go about managing them.

Learning Outcomes

After completion of this unit the student will be able to

- understand the requirements of an enterprise network (L2)
- troubleshoot a network running multiple services (L5)

Unit V   **7L**

Handle insecure exceptions and command/SQL injection, defend web and mobile applications against attackers, software containing minimum vulnerabilities and flaws.

Learning Outcomes

After completion of this unit the student will be able to

- understand the concepts of exceptions and command/SQL injection. (L2)
- handle web and mobile applications against attackers. (L4)

Text Book(s)

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones &Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, AddisonWesley

Course Outcomes:

After completion of course, students would be able to:

- differentiate between various software vulnerabilities. (L4)
- describe software process vulnerabilities for an organization. (L5)
- monitor resources consumption in a software. (L4)
- interrelate security and software development process. (L4)
- design the Software which can able to overcome all threats. (L5)

19ECS746: COMPUTER VISION

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This course introduces students the fundamentals of image formation with major ideas, methods, and techniques of computer vision and pattern recognition. It develops an appreciation for various issues in the design of computer vision and object recognition systems. The student with programming experience from implementing computer vision and object recognition applications.

Course Objectives:
- Introduce the fundamentals of image formation.
- Iintroduce major ideas, methods, and techniques of computer vision and pattern recognition.
- Develop an appreciation for various issues in the design of computer vision and object recognition systems.
- Provide with programming experience from implementing computer vision and object recognition applications.

Unit I **8L**
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis
Learning Outcomes
After completion of this unit the student will be able to
- familiar with both the theoretical and practical aspects of computing with images. (L1)
- describe the foundation of image formation, measurement, and analysis. (L1)
- implement common methods for robust image matching and alignment. (L5)

Unit II **8L**
Edge detection, Edge detection performance, Hough transform, corner detection
Learning Outcomes
After completion of this unit the student will be able to
- understand the geometric relationships between 2d images and the 3d world. (L2)
- get exposure to object and scene recognition and categorization from images (L1)

Unit III **8L**
Segmentation, Morphological filtering, Fourier transform
Learning Outcomes
After completion of this unit the student will be able to
- develop fourier transform for image processing in frequency domain. (L4)
- design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation & image representation). (L3)
- assess the performance of image processing algorithms and systems. (L1)

Unit IV **8L**
Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing
Learning Outcomes
After completion of this unit the student will be able to
- identify the limitations of vision systems.(L1)
- develop skills to implement boundary detection and motion related techniques. (L2)

Unit V   **10L**

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture f Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi- supervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

Learning Outcomes

After completion of this unit the student will be able to

- apply different de-noising models to recover original image. (L4)
- identify different pattern recognition methods and apply them in problem area. (L1)

Textbook(s):

1. Computer Vision: Algorithms and Applications by RichardSzeliski.
2. Bengio, Courville and Goodfellow, Deep Learning.
3. Fisher et al, Dictionary of Computer Vision and ImageProcessing.

Course Outcomes:

After completion of this course, the student will be able to

- identify basic concepts, terminology, theories, models and methods in the field of computer vision. (L4)
- describe known principles of human visual system. (L2)
- describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.(L2)
- design a computer vision system for a specific problem. (L5)

19ECS748: HUMAN AND COMPUTER INTERACTION

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HCI is the study of how people interact with computers and up to what level computers are for triumphant communication with human beings. It deals with the design, execution and assessment of computer systems and related phenomenon that are for human use. Because of the name, the three parts of HCI are: the user, the computer itself, and how they work together. HCI can be used in all disciplines wherever there is a possibility of computer installation.

Course Objectives:
- Learn the foundations of Human Computer Interaction
- Familiar with the design technologies for individuals and persons with disabilities
- Aware of mobile HCI.
- Design HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
- Learn the guidelines for user interface.

Unit I   **9L**
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models– frameworks – Ergonomics – styles – elements –interactivity- Paradigms.
Learning Outcomes
After completion of this unit the student will be able to
- understand the concept of I/O Channels, Memory (L2).
- learn in detail about Memory and networks (L2).
- make use of various Models. (L3)

Unit II   **12L**
InteractiveDesignbasics–process–scenarios–navigation–screendesign Iterationandprototyping.HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules– principles, standards, guidelines, rules. Evaluation Techniques – UniversalDesign.
Learning Outcomes
After completion of this unit the student will be able to
- list the Interactive Design Basics (L2).
- make use of HCI in Software Process (L3).
- understand various designing rules (L2).

Unit III   **7L**
Cognitive models –Socio-Organizational issues and stake holder requirements–Communication and collaboration models-Hypertext, Multimedia and WWW.
Learning Outcomes
After completion of this unit the student will be able to..
- make use of cognitive models (L3).
- design effective HCI for individuals and persons with disabilities (L6).

Unit IV   **8L**
Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.
Learning Outcomes

After completion of this unit the student will be able to..
- understand types of mobile applications (L2).
- develop HCI implications for designing multimedia/ ecommerce/ e-learning Web sites (L6).

UnitV   **10L**
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies. Recent Trends: Speech Recognition and Translation, Multimodal System.

Learning Outcomes
After completion of this unit the student will be able to
- make use of various Contextual tools and Overlays (L3).
- develop meaningful user interface (L6).

Text Book(s):
1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rdEdition, Pearson Education, 2004 (Unit I, II &III)
2. Brian Fling, Mobile Design and Development, First Edition,OReilly Media Inc., 2009 (Unit –IV)
3. Bill Scott and Theresa Neil, Designing Web Interfaces, First Edition, OReilly,2009.(Unit-V)

Course Outcomes:
After completion of this course, the student will be able to
- make use of various Models. (L1)
- make use of HCI in Software Process. (L1)
- design effective HCI for individuals and persons with disabilities. (L6)
- develop HCI implications for designing multimedia/ ecommerce/ e-learning Web sites. (L6)

19ECS750: GPU COMPUTING

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Most modern computers come with Graphical Processing Units (GPUs) that can be used for general purpose computing. GPUs provide much more computing power than CPUs do, by using more of their hardware resources for computing than CPUs do. GPUs deal with memory access latency primarily through multi-threading; when some threads are stalled accessing data, other threads can perform computation without a significant context-switch penalty. This course will describe different approaches to solve such problems, in order to develop efficient parallel algorithms for a variety of problems.

Course Objectives:

- Explain theoretical and empirical knowledge about graphics programming, memory management using for evaluating various parameters across the devices.
- Enable to acquire knowledge about different synchronization methods exists within the CPU and learn about common application kernels .
- Familiarize algorithms to provide parallel solutions to computationally challenging problems.
- Enable to implement such solutions on GPU using CUDA, and show effectiveness of the GPU based solutions using standard benchmarks and tools.

Unit I   **9L**

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC ,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps/ Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D/ 3D thread mapping, Device properties, Simple Programs

Learning Outcomes:

After completion of this unit the student will be able to

- show the various parallel programs. (L1)
- understand the different graphics processors(L2)
- identify the kernels and Thread mappings .(L2)
- develop simple programs(L6)

Unit II   **9L**

Memory: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the categories of memories.(L2)
- implement dynamic memory allocation (L3).
- explain arrays and pointers(L2).

Unit III   **9L**

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries(such as Thrust), and developing libraries.

Learning Outcomes:

After completion of this unit, the student will be able to
- explain the synchronization procedures(L2).
- summarize about CPU and GPU functions(L4).
- explain the concurrent data structures(L2).

UnitIV   **9L**
Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default
Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data
transfer and kernel execution, pitfalls.
Learning Outcomes:
After completion of this unit, the student will be able to
- understand the debugging process of GPU programs(L2).
- explain about pitfalls and event based synchronization(L2).

UnitV   **6L**
Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning Advanced topics:
Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous
processing
Learning Outcomes:
After completion of this unit, the student will be able to
- implement the different scenarios using graph simulations(L4)
- explain Image processing(L2).
- outline about deep learning(L2).

Text Book(s)
1. David Kirk, Wen-mei Hwu, Programming Massively Parallel Processors: A Hands-on
   Approach, Morgan Kaufman, 2010
2. Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs,
   Morgan Kaufman, 2012

Course Outcomes
After completion of course, students would be able to:
- understand the GPU and its aspects(L1)
- demonstrate synchronization and kernel functions(L3).
- determine different web based applications using deep learning (L3).

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19ECS752: DIGITAL FORENSICS

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Thecourseisdesignedtoenablethestudentto understand underlying principles and many of the techniques associated with the digital forensic practices and cybercrime, investigate attacks, handling evidences. Student can have a sneak review of Computer Forensics, Network Forensics, And Mobile Forensics.

Course Objectives:
- Familiarize the student about digital and computer forensics.
- Enable the student to learn analysis of crime scene.
- Manage and present evidences
- Demonstrate investigation process with case study.

Unit I 8L
Digital Forensics Science: Forensics science, computer forensics, and digital forensics.
Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics
Learning Outcomes
After completion of this unit, the student will be able to
- understand the functionalities of Forensic Science(L1).
- list the types of computer and digital crimes(L1).
- analyze areas that are vulnerable to cybercrimes (L5).

Unit II 8L
Cyber Crime Scene Analysis:Discuss the various courtordersetc.,methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminalinvestigation.
Learning Outcomes
After completion of this unit, the student will be able to
- understand the legal procedures to seize evidence(L2).
- learn types of information retrieval procedures from evidences (L2).
- generate necessary documents that assist criminal investigation (L3).

Unit III 10L
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, explain what the normal case would look like, define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.
Learning Outcomes
After completion of this unit, the student will be able to
- understand various Operating System functionalities (L1).
- know necessity of forensic mindset to judge the crime instincts (L1).
- learn the acts to be performed at the crime scene (L2).

Unit IV 10L
Computer Forensics: Prepare a case, begin an investigation, understand computer forensics workstations and software, conduct an investigation, complete a case, Critique a case,
Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.

Learning Outcomes

After completion of this unit, the student will be able to
- investigates and Judges a crime from a given case study (L5).
- familiarize with network forensic analysis tools (L4).

Unit V   **6L**

Mobile Forensics: mobile forensics techniques, mobile forensics tools.
Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Learning Outcomes

After completion of this unit, the student will be able to
- learn about the mobile specific forensic techniques(L2).
- acquaint with the tools that support mobile forensics (L4).
- familiarize with the various legal acts with respect to Digital Forensics (L2).

Text Book(s)

1. John Sammons, The Basics of Digital Forensics,Elsevier.
2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, LaxmiPublications

Course Outcomes:

After completion of this course, the student will be able to
- define the concept of Forensics and its associates. (L1)
- underline the need of digital forensic and role of digital evidences. (L2)
- explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection. (L3)
- recognize the importance of various digital forensic tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system. (L4)
- list the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools. (L5)

19ECS754: MOBILE APPLICATIONS AND SERVICES

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This course is designed to enable the student to deploy the mobile based applications using android operating system as platform. First the basics of mobile applications and android system are taught then application deployment is explained in terms of network perspective   and in line with the standard security protocols which can be consumed as a service.

Course Objectives:
- Familiarize the student with the basics of mobile applications and android operating system.
- Enable the student to build mobile applications.
- Explain with the features and constructs of android operating system and networking.
- Demonstrate the handling of various functionalities such as graphical user interfaces, Data framework and tools

UnitI **8L**
Introduction:IntroductiontoMobileComputing,IntroductiontoAndroidDevelopmentEnvironment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User
Learning Outcomes
After completion of this unit, the student will be able to
- gain insights on mobile computing and android environment(L1).
- understand various factors of development, framework and tools involved(L2).

Unit II **8L**
More on UIs: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal UIs, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider
Learning Outcomes
After completion of this unit, the student will be able to
- select an appropriate model of UI that suits his requirement. (L1)
- familiarize themselves with data access and content providers. (l2)

Unit III **10L**
Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony Notifications and Alarms: Performance, Performance and MemoryManagement,AndroidNotificationsandAlarms,Graphics,PerformanceandMultithreading, GraphicsandUIPerformance, AndroidGraphics.
Learning Outcomes
After completion of this unit, the student will be able to
- deal with the communication domain such telephony, notification management. (L1)
- analyse performance and memory management. (L3)

Unit IV **8L**
PuttingIt   All   Together:Packaging   and   Deploying,PerformanceBestPractices,Android FieldServiceApp, Location Mobility and Location Based Services Android
Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia

Learning Outcomes

After completion of this unit, the student will be able to
- adapt a best field practice for deployment of service apps. (L3)
- gain fundamental knowledge on android related multimedia. (L1)

Unit V   **8L**

Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, more on Security, Hacking Android

Learning Outcomes

After completion of this unit, the student will be able to
- build a final version of the app that is tested and deployed.(L5)
- deal with unforeseen circumstances such as hacking and other network related threats(L4).

Text Book(s)

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley &Sons

Course Outcomes:

After completion of this course, the student will be able to
- understand and analyze various factors of development, framework and tools involvedinmobile computing and android environment. (L4)
- select an appropriate model of UI that suits the requirement and data access and content providers. (L6)
- deal with the communication domain prospects such as telephony, notification management.Analyse performance and memory management. (L4)
- choose best field practice for deployment of service apps in android related multimedia. (L5)
- deploy a final version of the app that is tested and deployed and to deal with hacking and other network related threats. (L5)

19ECS756: COMPILERS FOR HIGH PERFORMANCE COMPUTING

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Optimizing compilers play a critical role in modern computer systems ranging from mobile devices to supercomputers. Compilers can optimize for performance, power consumption and/or code size. Practically all computer scientists and engineers may benefit for a deep knowledge of compiler optimizations: programmers and application optimizers write programs that are better optimized by the compiler, computer designers design hardware features that are easy to use by compilers, and finally compiler writers develop new compiler optimizations.

Course Objectives:
- Know the most common machine independent optimizations.
- Know scheduling techniques and register allocation for exploiting Instruction Level Parallelism
- Know the most common memory locality optimizations
- Learn the concept and compiler techniques for exploiting Data Level Parallelism
- Compiler techniques and tools for exploiting Thread Level Parallelism
- Make a technical report on some advanced compiler technique
- Make a presentation so that the other students learn some advanced compiler technique

Unit I   **7L**
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.
Learning Outcomes:
After completing the course, you will be able to
- understand large-scale simulations.(L1)
- learn parallel architecture and programming models. (L1)

Unit II   **7L**
Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph.Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use- Def Chains, FUD Chains for Arrays,
InductionVariablesUsingFUDChains,ConstantPropagationwithFUDChains, Data Dependence for Scalars.
Learning Outcomes
After completing the course, you will be able to
- learn the concept and compiler techniques for exploiting data level parallelism. (L1)
- understand Compiler techniques and tools for exploiting Thread Level Parallelism. (L2)

Unit III   **10L**
Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis. Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter- Procedural Transformations.
Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.
Learning Outcomes:
After completing the course, you will be able to
- understand the components and operation of a memory hierarchy and the range of performance issues influencing its design. (L2)
- understand compiler techniques and tools for exploiting thread level parallelism. (L2)

Unit IV   **9L**
Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from for all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

Learning Outcomes:
After completing the course, you will be able to
- understand students, learn some advanced compiler technique. (L2)
- rectify the error and bug with well-known techniques. (L5)

Unit V   **9L**
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Learning Outcomes:
After completing the course, you will be able to
- describe architectural hardware and software issues for high performance computing systems. (L5)
- explain programming models of parallelism. (L2)
- describe selected parallel algorithms and approaches for computer modelling and simulations of selected applications. (L5)

Text Book(s):
1. Michael Wolfe, High-Performance Compilers for Parallel Computing,Pearson

Course outcomes:
- learn the advantages, issues and challenges of the current processors. (L1)
- learn how to optimize a parallel code. (L1)
- understand the various parallel programming paradigms and learn how to choose the right one based on the application domain. (L1)
- implement parallel codes that are optimized for performance. (L5)

19ECS758: OPTIMIZATION TECHNIQUES

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Introduction to optimization techniques using programming. After an adequate introduction to branches of mathematical Programming and Optimization Algorithms, students will learn to solve engineering problems in the framework of optimization problems.

Course Objectives:
- Analyze real-life problems, especially, logistics problems, through the use of mathematical modeling techniques.
- Gain familiarity with various modeling techniques to build mathematical models for computer engineering problems.
- Perform evaluation and interpretation of optimization results.

Unit I   **7L**
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.
Learning Outcomes
After completion of this unit the student will be able to
- learn efficient computational procedures to solve optimization problems. (L1)
- cast engineering problems into optimization framework. (L1)

Unit I   **6L**
General Structure of Optimization Algorithms, Constraints, The Feasible Region.
Learning Outcomes:
After completion of this unit the student will be able to
- formulate a wide range of problems.(L2)
- model and give appropriate solutions to issues related to computer science. (L1)

Unit III   **11L**
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.
Learning Outcomes:
After completion of this unit the student will be able to:
- identify the mathematical nature of a given optimization problem. (L1)
- analyze a range of classes of optimization problems. (L3)

Unit IV   **12L**
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.
Learning Outcomes:
After completion of this unit the student will be able to
- develop the skills to analyse Optimization Algorithms. (L3)
- identify solution methods for the optimization problems study. (L1)

Unit V   **6L**
Real life Problems and their mathematical formulation as standard programming problems.
Learning Outcomes:
After completion of this unit the student will be able to
- model real-life problems as optimization problems. (L3)

- devise a solution method appropriate to the characteristics of a given problem . (L4)

Text Book(s):
1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN978-0-471-28366-9.
2. Andreas Antoniou , Practical Optimization Algorithms and EngineeringApplications.
3. Edwin K.,P. Chong & Stanislawh.Zak , An Introduction toOptimization.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. DynamicIdeas. ISBN978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press ISBN 978 8493- 1914-3.
6. H.PaulWilliams(2009).LogicandIntegerProgramming.Springer.ISBN978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R.Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming1958- 2008:From the EarlyYearstotheState-of-the-Art.Springer.ISBN978-3- 540- 68274-5.
8. DerSanChen;RobertG.Batson;YuDang(2010).AppliedIntegerProgramming:Modeling and Solution. JohnWileyandSons.ISBN978-0-470-37306-4

Course Outcomes:
After completion of this course, the student will be able to
- cast engineering problems into optimization framework. (L1)
- model and give appropriate solutions to issues related to computer science. (L1)
- analyze a range of classes of optimization problems. (L4)
- develop the skills to analyse optimization algorithms. (L5)
- develop solution method appropriate to the characteristics of a given problem.(L5)

19EAC741: ENGLISH FOR RESEARCH PAPER WRITING

	L	T	P	C
	2	0	0	0

This course introduces the student, to the different aspects of research paper writing including planning, preparation, layout, literature review write-up etc. Specifically the perspective and style of writing in different sections of a research paper is highlighted. Students will exposed to English language skills relevant to research paper writing.

Course Objectives:
- To write clearly, concisely and carefully by keeping the structure of the paper in mind.
- To use standard phrases in English and further improve his command over it.
- To write with no redundancy, no ambiguity and increase the readability of the paper.
- To plan and organize his paper by following a logical buildup towards a proper conclusion.
- To decide what to include in various parts of the paper.
- To write a suitable title and an abstract in order to attract the attention of the reader.
- To identify the correct style and correct tense.
- To retain the scientific value of the paper by using minimum number of words.

Unit I   5L
Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Learning Outcomes:
After the completion of this unit, the student will be able to
- To know the expectations of various journals and referees (L2)
- To know the typical structure of a paper (L3)
- Learn to put words in a sentence in the correct order (L4)
- To write short and clear sentences from the very beginning of the paper (L4)
- To increase the readability of the paper by making it easy to read and 100% clear (L4)
- Learn to be concise without losing any important content (L4)
- To avoid some typical grammar mistakes made in research papers (L4)

Unit II   5L
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Learning Outcomes:
After the completion of this unit, the student will be able to
- Learn to make useful contribution worth recommending for publication (L4)
- Learn good use of language to make readers notice the key findings (L4)
- Learn to anticipate or predict possible objections to the claims made in the paper(L5)
- To understand what is plagiarism, and how to paraphrase other people's work (L4)
- Learn to attract the right kind of readers with a suitable title(L3)
- Learn to sell the abstract to potential readers by attracting their curiosity (L2)

Unit III   **6L**
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills
are needed when writing a Title, key skills are needed when writing an Abstract, key skills are
needed when writing an Introduction, skills needed when writing a Review of the Literature.

Learning Outcomes:
After the completion of this unit, the student will be able to
  • have a deep knowledge about everything that has been previously written on the topic and
    decide   what is important to know in Introduction. (L3)
  • Learn to provide the right amount of literature regarding the sequence of events leading up to the
    current situation in the Literature review(L4)

Unit IV   **6L**
Writing Skills: skills are needed when writing the Methods, skills needed when writing the Results,
skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Learning Outcomes:
After the completion of this unit, the student will be able to
  • Learn to describe the materials used in experiments and/or the methods used to carry out the
    research (L2)
  • The key skill is in reporting the results simply and clearly (L3)
  • Learn to structure the Discussion and satisfy the typical requirements of the referees (L4)
  • Learn to provide a clear and high-impact take-home message in the conclusion (L5)

Unit V   **6L**
Good Paper Writing: Useful phrases, how to ensure paper is as good as it could possibly be the
first- time submission.

Learning Outcomes:
After the completion of this unit, the student will be able to
  • Learn various lists of frequently used phrases that have a general acceptance in all disciplines
    and use in specific sections of the paper (L3)
  • Learn various kinds of things one should look for when doing the final check (L3)

Text Book (s**):**
  1. Goldbort R, Writing for Science, Yale University Press, 2006
  2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
  3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM, Highman, 1998.

References:
  1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht
     Heidelberg London, 2011.

Course Outcomes:
    By the end of the course the students will be able to:
  •   Frame the structure of the paper precisely. (L2).
  •   Improve his command over English by using standard phrases. (L3).
  •   Avoid repetition and mistakes in the paper and increase its readability. (L3).
  •   Organize the paper logically towards a proper conclusion. (L4).
  •   Decide on the content to be included in various parts of the paper. (L5).
  •   Identify whether to use personal or impersonal style in the paper. (L5).
  •   Express the content in a clear and concise way. (L6).
  •   Attract the attention of the reader by providing a suitable title and an appropriate abstract. (L6).

19EAC742: DISASTER MANAGEMENT

                                                   L T P C
                                                   2 0 0 0

This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction.

Course Objectives
- to provide students an exposure to disasters, their significance, types & Comprehensive understanding on the concurrence of Disasters and its management.
- to ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention, risk reduction and the basic understanding of the research methodology for risk reduction measures.
- equipped with knowledge, concepts, and principles, skills pertaining to Planning, Organizing, Decision-making and Problem solving methods for Disaster Management.
- to develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I   **5L**
Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Learning Outcomes
After the completion of this unit, the student will be able to
- define the meaning, list the factors and mention the significance of disaster (L1)
- distinguish between hazard and disaster (L3)
- compare manmade and natural disaster (L3)
- list the types of disaster and describe their magnitude (L2)

Unit II   **5L**
Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

Learning Outcomes
After the completion of this unit, the student will be able to
- list the different repercussions of disasters and hazards(L1)
- describe the characteristics of natural disasters and the magnitude of their losses(L2)
- describe the characteristics of man-made disasters and the magnitude of their losses(L2)
- elaborate the outbreaks of diseases and epidemics after disasters (L3)

Unit III   **6L**
Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the seismic zones and their characteristics(L2)
• identify the areas prone to floods and droughts(L1)
• distinguish between landslides and avalanches(L3)
• identify areas prone to cyclonic and costal hazards(L4)
• enumerate the post disaster diseases and epidemics(L2)

Unit IV   **6L**
Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, media reports: governmental and Community Preparedness.

Learning Outcomes
After the completion of this unit, the student will be able to
• describe the monitoring of phenomena triggering a disaster/hazard(L2)
• evaluate the risk with the use of remote sensing and meteorological data(L5)
• list the governmental and community measures for disaster preparedness(L2)

Unit V   **6L**
Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Learning Outcomes
After the completion of this unit, the student will be able to
• define and list the elements of disaster risk(L1)
• enumerate the measures for risk reduction(L2)
• apply the techniques of risk assessment (L4)
• identify the means of people's participation in risk assessment(L2)

Text Book(s):

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal Book Company., 2008.
2. Sahni, Pardeep, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi., 2012
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep and Deep Publication, 2007.

Course Outcomes
At the end of the course, student will be able to
- Identify management activities in pre, during and post phases of Disasters. (L1)
- Plan disaster management activities and specify measure for risk reduction(L4)
- apply risk assessment techniques in real life disaster scenarios(L4)

19EAC744: VALUE EDUCATION

	L	T	P	C
	2	0	0	0

This course is intended to expose the student to the need for human values and methods to cultivate them for leading an ethical life with good moral conduct. Students taking this course will be able to experience a change in personal and professional behavior with these ethical principles guiding him throughout life

Course Objectives
- to expose the student to need for values, ethics, self-development and standards
- to make the student understand the meaning of different values including duty, devotion, self-reliance etc.
- to imbibe the different behavioral competencies in students for leading an ethical and happy life
- to expose the student to different characteristic attributes and competencies for leading a successful, ethical and happy profession life.

Unit I   7L
Values and self-development –social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

Learning Outcomes
After the completion of this unit, the student will be able to
- define the social values and individual attitudes for self development(L1)
- describe the Indian vision of humanism(L2)
- distinguish between moral and non-moral acts (L3)
- list the standards and value principles for moral conduct (L2)

Unit II   7L
Importance of cultivation of values. Sense of duty. Devotion, self-reliance. Confidence, concentration. Truthfulness, cleanliness. Honesty, humanity. Power of faith, national unity. Patriotism, love for nature, discipline.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the importance of cultivating values(L2)
- list the different traits of self-developed individual(L1)
- explain the need for loving nature/country/humanity(L2)

Unit III   7L
Personality and Behaviour Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Learning Outcomes
After the completion of this unit, the student will be able to

- describe the benefits of positivie thinking, integrity and discipline(L2)
- list the different methods for avoiding fault finding, anger(L1)
- explain the methods to overcome suffering, religious intolerance, self-destructive habits(L2)

Unit IV   **7L**
Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying   effectively.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the science of reincarnation(L2)
- explain the relation between self-management and good health(L1)
- elaborate the role of different religions in reaching the common goal(L3)
- list the different techniques for mind-control to improve personality and studies(L1)

Text Book(s):
1. Chakroborty S.K., "Values and ethics for organizations: Theory and Practice", Oxford University Press, 1998.

Course Outcomes
After successful completion of the course, the student will be able to
- describe the need for human values and methods for self development (L2)
- elaborate the different traits and benefits of a self-developed individual (L1)
- list the different attributes of self-developed individual (L1)
- elaborate the role and scope of books/faith/health/religions in character building and competence development(L3)

19EAC745: CONSTITUTION OF INDIA

	L	T	P	C
	2	0	0	0

This course is intended to expose the student to the philosophy of Indian constitution. Students will be able to understand their fundamental rights/duties and governance structure. Students also appreciate the role of election commission in establishing a democratic society.

Course Objectives
- to familiarize the student about the need for a constitution
- to make the student understand the role of constitution in a democratic society
- to acquaint the student with key constitutional features and fundamental rights of a citizen
- to impart the organs of governance and local administration hierarchy and their responsibilities
- to familiarize the student with the role, responsibilities and administration hierarchy of election commission

Unit I   5L
History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working). **Philosophy of the Indian Constitution**: Preamble, Salient Features

Learning Outcomes
After the completion of this unit, the student will be able to
- list the outline of drafting committee and their roles in the making of Indian constitution (L1)
- describe the need and role of a constitution in a democratic society(L2)
- elaborate the salient features of Indian constitution(L3)

Unit II   5L
Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Learning Outcomes
After the completion of this unit, the student will be able to
- list the fundamental rights of a citizen(L1)
- explain the intricacies in the different rights(L2)
- elaborate the fundamental duties of a citizen(L3)
- describe the principles of state policy(L2)

Unit III   6L
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Learning Outcomes
After the completion of this unit, the student will be able to
- present the hierarchy of governance (L2)
- list the role/responsibilities/powers of different organs of governance(L1)
- elaborate the guidelines for appointment/transfer of judges(L2)

Unit IV   **6L**
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the administrative organizational hierarchy of municipalities and panchayats(L2)
- appreciate the role/responsibilities/powers of mayor, CEO, elected officials(L3)
- appreciate the importance of grass root democracy(L3)

Unit V   **6L**
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the administrative hierarchy of election commission(L2)
- elaborate the roles/responsibilities/powers of election commissioners at different levels of hierarchy(L3)
- outline the welfare activities of SC/ST/OBC/Women by different bodies(L3)

Text Book(s):
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1/e, 2015.
3. M. P. Jain, Indian Constitution Law, 7/e, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes
After successful completion of the course, the student will be able to
- describe the philosophy and salient features of Indian constitution(L2)
- list the constitutional rights and duties of a citizen(L1)
- elaborate the central and local administrative hierarchy and their roles(L2)
- describe the roles/responsibilities/powers of different governing and administrative bodies(L2)
- explain the structure/functioning and power of election commission(L2)

19EAC746: PEDAGOGY STUDIES

	L	T	P	C
	2	0	0	0

This course is aimed to familiarizing the student with pedagogical principles, practices and methodologies. This course is intended for students interested in pursuing a career in teaching and research.

Course Objectives
- to familiarize the student about the need for pedagogy studies, background and conceptual framework
- to expose the student to pedagogical practices in formal/informal classrooms
- to acquaint the student with type of curriculum and guidance materials for effective pedagogy
- to familiarize the student with classroom practices and curriculum assessment procedures
- to make the student understand the effect of undertaking research on teaching quality

Unit I   **5L**
Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.
Learning Outcomes
After the completion of this unit, the student will be able to
- define the aim and rationale behind teacher education(L1)
- classify the different theories of learning (L1)
- elaborate the need and role of curriculum, teacher education (L1)

Unit II   **5L**
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.
Learning Outcomes
After the completion of this unit, the student will be able to
- describe the different pedagogical practices used by teachers in formal and informal classrooms(L1)
- explain the pedagogical practices employed in developing countries (L1)
- enumerate the duties of faculty in terms of teaching, research, consultancy, administration (L1)

Unit III   **6L**
Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
Learning Outcomes
After the completion of this unit, the student will be able to
- list the measures for effective pedagogy(L1)
- identify the different documentation required to formalize curriculum implementation and quality assessment(L1)
- describe the teachers attitudes and beliefs in pedagogic strategies(L2)

Unit IV   **6L**

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Learning Outcomes

After the completion of this unit, the student will be able to

- define the organizational hierarchy in a school administration system(L1)
- list the different barriers to learning(L3)
- enumerate the methods to overcome limited resources and handle large class sizes(L3)
- describe the follow-up support and peer-support in classroom practices(L2)

Unit V   **6L**

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Learning Outcomes

After the completion of this unit, the student will be able to

- explain the need for and role of research in teaching profession(L2)
- list the different research activities to be taken up by teachers(L1)
- describe the impact of research on teaching quality and learning process(L2)

Text Book(s):

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261, 2001
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379, 2004.
3. Akyeampong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282., 2013.
5. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell., 2001.
6. Chavan M, Read India: A mass scale, rapid, 'Learning to Read' campaign., 2003.

Course Outcomes

After successful completion of the course, the student will be able to

- describe the theories of learning and conceptual framework of pedagogy(L2)
- explain the pedagogical practices used by teachers in formal and informal classrooms(L2)
- visualize the administrative hierarchy of schools and colleges and define the role(L3)
- appreciate the need for research and define the future direction of teaching career(L3)
- describe the impact of curriculum and assessment on the teaching learning process of a student(L3)

19EAC747: STRESS MANAGEMENT BY YOGA

	L	T	P	C
	2	0	0	0

This course is aimed to familiarize the student with basic principles of yoga and different physical/mental practices for managing mind and body. This course helps the student in managing stress during education, home and workplace. Further, principles learnt in this course help in building overall personality for a stress-free, happy and independent life.

Course Objectives
- to familiarize the student about eight parts of yoga and their significance
- to expose the student to the importance and meaning of Yam and Niyam
- to make the student understand the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc
- to introduce the different yogic poses with a knowledge of their benefits for mind and body
- to familiarize the effect of different types of breathing techniques in concept and in activity

Unit I   **9L**
Definitions of Eight parts of yoga (Ashtanga).

Learning Outcomes
After the completion of this unit, the student will be able to
- list the eight parts of yoga (L1)
- describe the effects of different parts of yoga on mind and body(L2)
- elaborate the importance of yoga in stress management and personality development(L3)

Unit II   **9L**
Yam and Niyam.
Do`s and Don't's in life.
    i) Ahinsa, satya, astheya, bramhacharya and aparigraha
    ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.
Learning Outcomes
After the completion of this unit, the student will be able to
- elaborate the importance of Yam and Niyam(L2)
- describe the meaning and significance of Ahinsa, satya, astheya etc(L2)
- explain the need for shaucha, santosh, tapa, swadhyay in leading a healthy and fruitful life(L3)

Unit III   **9L**
Asan and Pranayam
    i) Various yog poses and their benefits for mind & body
    ii) Regularization of breathing techniques and its Effects-Types of pranayam.
Learning Outcomes
After the completion of this unit, the student will be able to
- demonstrate the different physical asanas and explain their physical and phychological effects(L4)
- demonstrate the different breathing techniques and describe their physical and mental effects (L4)
- distinguish between different types of pranayamam(L5)

Text Books
1. Janardan, Yogic Asanas for Group Tarining-Part-I, Swami Yogabhyasi Mandal, Nagpur
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama, Kolkata

Course Outcomes
After successful completion of the course, the student will be able to
- describe the eight parts of yoga and their significance(L1)
- explain the the importance and meaning of Yam and Niyam(L2)
- define the meaning and importance of yogic principles including Ahimsa, Satya, Astheya etc(L1)
- demonstrate the different yogic poses and explain their benefits for mind and body(L4)
- demonstrate the different types of breathing techniques and explain their physical and mental benefits(L5)

19EAC748: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

L	**T**	**P**	**C**
2	**0**	**0**	**0**

This course is aimed to familiarize the student with life enlightenment skills for personality development. This course helps the student in building his holistic personality through human values, ethics and spiritual attributes.

Course Objectives
- to familiarize the student to good personality traits through moral stories
- to make the student understand the goal of human life and importance of good personality in reaching the goal
- to expose the student to the study of Shrimad-Bhagwad-Geeta for developing his/her personality and achieve the highest goal in life
- to familiarize the student to leadership skills for driving nation and mankind to peace and prosperity
- to expose the role of Neetishatakam for developing versatile personality of students.

Unit I   **9L**
Neetisatakam-Holistic development of personality
Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's).

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the moral stories illustrating the traits of good personality(L2)
- define the meaning and importance of wisdom, pride, heroism, virtue etc(L1)
- identify do and donts in life from the foundations of human morals/ethics(L5)

Unit II   **9L**
Approach to day to day work and duties.
Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the characteristics and principles of bhakti yogam, jnana yogam and karma yogam (L1)
- identify the use of different yogic characteristics in different activities of daily life/duties(L4)
- apply the use of yogic principles for leading a stress-free, happy and fruitful life with good developed personality(L4)

Unit III   **9L**
Statements of basic knowledge.
Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. Shrimad BhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63

Learning Outcomes
After the completion of this unit, the student will be able to
- list the characteristics of role model proposed by verses of bhagavad gita(L1)
- explain the methods for obtaining life enlightenment through the practice of four yoga appropriately (L2)
- describe the characteristics of karma yogi/jnana yogi for developing leadership personality (L2)

Text Book(s):

1. Swami Swarupananda, "Srimad Bhagavad Gita", Advaita Ashram (Publication Department), Kolkata
2. P. Gopinath, Bhartrihari's Three Satakam (Niti-Sringar-vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
After successful completion of the course, the student will be able to
- List the different parables of neethisathakam and identify their morals(L1)
- enumerate the different traits of human personality for life enlightenment(L2)
- describe the leadership attributes for driving nation and mankind to peace and prosperity(L2)
- explain the applicability of different types of yoga to day-to-day work and duties resulting in responsible personality (L2)

19EAC750: DEVELOPING SOFT SKILLS AND PERSONALITY

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Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The course aims to cause a basic awareness within the students about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality.

Course Objectives
- to familiarize the student to the criteria for self assessment and significance of self-discipline
- to expose the student to attitudes, mindsets, values and beliefs
- to acquaint the student to plan career and goals through constructive thinking
- to enable the student to overcome barriers for active listening and persuasive speaking
- to familiarize the skill of conducting meetings, writing minutes and involving in active group discussions

Unit I   8L
Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline
Learning Outcomes
After the completion of this unit, the student will be able to
- identify strengths & limitations through self-assessment(L3)
- list the attributes of personalities will good will-power and self-drives(L1)
- describe the reasons for building self-esteem and self-confidence(L2)
- explain the significance of self discipline(L2)

Unit II   8L
Understanding Perceptions, Attitudes, and Personality Types: Mind-Set: Growth and Fixed; Values and Beliefs
Learning Outcomes
After the completion of this unit, the student will be able to
- define the characteristics of different perceptions, attitudes and personality types(L1)
- distinguish between fixed and growing mindsets(L3)
- define the importance and meaning of values and beliefs(L2)

Unit III   8L
Motivation and Achieving Excellence; Self-Actualisation Need; Goal Setting, Life and Career Planning; Constructive Thinking
Learning Outcomes
After the completion of this unit, the student will be able to
- describe the need for having high motivation and achieving excellence(L2)
- define the need for self-actualization(L1)
- plan the life and career goals based on self assessment(L4)
- explain the attributes of constructive thinking(L2)

Unit IV   **8L**
Communicating Clearly: Understanding and Overcoming barriers; Active Listening; Persuasive Speaking and Presentation Skills.
Learning Outcomes
After the completion of this unit, the student will be able to
• self-assess the barriers for communicating clearly (L4)
• list the attributes of active listening(L1)
• describe the minimal aspects of effective presentation(L2)
• organize ideas resulting a persuasive talk(L3)

Unit V   **8L**
Conducting Meetings, Writing Minutes, Sending Memos and Notices; Netiquette: Effective E-mail Communication; Telephone Etiquette; Body Language in Group Discussion and Interview.
Learning Outcomes
After the completion of this unit, the student will be able to
• describe the format and structure of writing meeting minutes(L2)
• identify the essential components of memos and notices(L3)
• explain the principles of effective email communication(L2)
• list the basic etiquette of telephone conversation(L1)
• describe the effective body traits during group discussion and interviews(L2)

Text Books
1. Dorch, Patricia. What Are Soft Skills? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman& Molly Hamaker. The Hard Truth about Soft Skills. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. The EQ Edge: Emotional Intelligence and Your Success. Canada: Wiley & Sons, 2006.

Course Outcomes
After successful completion of the course, the student will be able to
• carry out self assessment and describe the significance of self-discipline(L4)
• define, classify and compare attitudes, mindsets, values and beliefs(L3)
• plan career and goals through constructive thinking and personal assessment(L4)
• overcome barriers for active listening and persuasive speaking (L5)
• conduct meetings, write minutes and involve in active group discussions(L3)

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This course introduces students to the science of business analytics. The goal is to provide students with the foundation needed to apply data analytics to real-world challenges they confront daily in their professional lives. Students will learn to identify the ideal analytic tool for their specific needs; understand valid and reliable ways to collect, analyze, and visualize data; and utilize data in decision making for managing agencies, organizations or clients in their workspace

Course Objectives
- To familiarize the scope, process and advantages of business analytics
- To acquaint the student with the modeling and problem solving skills in business analytics
- To impart the organization and management of business analytics
- To introduce the forecasting models and techniques used in analytics
- To expose the formulation and decision strategies used in business analytics

Unit I   **8L**
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview
Learning Outcomes
After the completion of this unit, the student will be able to
- define the scope and process of business analytics (L1)
- choose an organizational structure to implement a business analytics process (L4)
- describe the statistical tools and methods used for data modeling and analysis (L2)
- identify the sampling and estimation requirements for data analysis (L1)

Unit II   **8L**
Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
Learning Outcomes
After the completion of this unit, the student will be able to
- identify the relationships and trends in data (L1)
- utilize linear regression methods for identifying data relationships (L4)
- list the types of data and their models used for business analytics (L1)
- describe the methods for visualization and exploration of data (L2)

Unit III   **8L**
Organization Structures of Business analytics: Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Learning Outcomes
After the completion of this unit, the student will be able to
- describe the management issues in the organization structures (L2)
- define the designing information policy and its usage (L1)
- list the methods for ensuring data quality measuring contribution (L1)
- explain the use of data mining methodologies for predictive analytics analysis (L3)
- describe the use of prescriptive analytics methods in business analytics process (L2)

Unit IV   **10L**
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
Learning Outcomes
After the completion of this unit, the student will be able to
- classify and describe the use of forecasting models (L3)
- model the use of regression forecasting with casual variables (L5)
- identify the appropriate forecasting model for a given data (L5)
- explain the use of monte carlo simulation for forecasting and identify the involved risk (L2)

Unit V   **8L**
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Learning Outcomes
After the completion of this unit, the student will be able to
- formulate decision problems (L2)
- list the decision strategies with and without probabilities (L1)
- use the decision trees for analysis (L4)
- describe the value of information, utility and its use in decision making (L4)

Textbook(s):
1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Business analytics Principles, Concepts, and Applications Pearson FT Press, 2014.
2. James Evans, Business Analytics, Pearson Education, 2013.

Course Outcomes
Upon successful completion of the course, the student will be able to
- define the scope, process and advantages of business analytics (L1)
- explain the modeling and problem solving skills in business analytics (L2)
- describe the organization and management of business analytics (L3)
- utilize the forecasting models and techniques used in analytics (L4)
- enumerate and utilize the formulation and decision strategies (L2)

19EOE746: OPERATIONS RESEARCH

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Optimization problems arise in all walks of human activity- particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

Course Objectives
- to impart knowledge on developing mathematical formulation for linear programming and transportation problem
- to familiarize the student in the construction of the required activities in an efficient manner to complete it on or before a specified time limit and at the minimum cost.
- to expose the development of mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.
- to illustrate PERT and CPM techniques for planning and implementing projects.
- To impart the knowledge of formulating and analysis of real life problems using advanced tools and techniques for resource optimization
- to provide frameworks for analyzing waiting lines using advanced queuing theory concepts

Unit I 8L
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
Learning Outcomes
After completing this unit, the student will be able to
- identify and develop operational research models from the verbal description of the real system. **[L4]**
- understand the classification systems of effective Inventory control models**[L2]**

Unit II 8L
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming
Learning Outcomes
After completing this unit, the student will be able to
- translate a real-world problem, given in words, into a mathematical formulation. **[L2]**
- utilize the mathematical tools that are needed to solve optimization problems. **[L2]**

Unit III 8L
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
Learning Outcomes
After completing this unit, the student will be able to
- describe the need and origin of the optimization methods**[L2]**

- classify optimization problems to suitably choose the method needed to solve the particular type of problem**[L3]**

Unit IV   **8L**
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
Learning Outcomes

After completing this unit, the student will be able to
- choose linear programming problems to suitably choose the method needed to solve the particular type of problem**[L1]**
- identify industrial problems involved in inventory, MRP and scheduling**[L2]**

Unit V   **8L**
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation
Learning Outcomes
After completing this unit, the student will be able to
- identify the values, objectives, attributes, decisions, uncertainties, consequences, and trade-offs in a real decision problem**[L2]**
- Apply the models to incorporate rational decision-making process in real life situations.**[L3]**
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.. **[L3]**

Text Book(s):
1. H.A. Taha, Operations Research, An Introduction, Prentice Hall of India, 2008
2. H.M. Wagner, Principles of Operations Research, Prentice Hall of India, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, 2008
4. Hitler Libermann Operations Research: McGraw Hill Publishers, 2009
5. Pannerselvam, Operations Research: Prentice Hall of India, 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India, 2010

Course Outcomes
After the successful completion of the course, the students will be able to:
- Understand the basic concepts of different advanced models of operations research and their applications. (L2)
- Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. (L4)
- Apply the models to incorporate rational decision-making process in real life situations. (L4)
- Analyze various modeling alternatives & select appropriate modeling techniques for a given situation. (L3)
- Validate output from model to check feasibility of implementations. (L5)
- Create innovative modeling frameworks for a given situation. (L6)
- Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. (L3)

19EOE748: COST MANAGEMENT OF ENGINEERING PROJECTS

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This course will equip the student with the expertise to mathematically model engineering projects and use effective methods and techniques to plan and execute engineering activities.

Course Objectives
- to introduce the basic principles of strategic cost management and the related terminology
- to familiarize the project planning and execution process involving technical/nontechnical activities
- to acquaint the student with detailed engineering activities and their cost management analysis
- to impart the knowledge of cost analysis and profit planning of engineering projects
- to familiarize the quantitative techniques for optimization of budget allocation

Unit I   **8L**
Introduction and Overview of the Strategic Cost Management Process, Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational
control; Provision of data for Decision-Making.
Learning Outcomes
After the completion of this unit, the student will be able to
- describe the cost concepts in decision making(L2)
- define the various costs involved in the cost management process(L2)
- list the objectives of cost control(L2)
- identify the different fields of a database for operational control(L2)

Unit II   **8L**
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.
Learning Outcomes
After the completion of this unit, the student will be able to
- define the meaning of a project and list the different types(L2)
- identify the measures to manage cost overruns(L2)
- describe the various stages of project execution from conception to commissioning(L2)
- plan the proper order of technical/nontechnical activities as part of project execution(L2)

Unit III   **8L**
Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Learning Outcomes
After the completion of this unit, the student will be able to
- identify the different clearance norms required in the pre-project execution phase(L2)

- describe the hierarchy of project team and identify the role of each member(L2)
- list the different contents of project contracts(L2)
- present the project cost control and planning through bar charts, network diagrams etc(L2)

Unit IV   **8L**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.

Learning Outcomes

After the completion of this unit, the student will be able to
- describe the cost behavior and profit planning(L2)
- distinguish between marginal costing and absorption costing(L2)
- analyze the variance of standard costing(L2)
- analyze the pricing strategies in project costing(L2)
- identify the quality measures satisfying the appropriate constraints(L2)

Unit V   **10L**

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory

Learning Outcomes

After the completion of this unit, the student will be able to
- define and compare the different budgeting strategies(L2)
- model the cost management as a linear programming problem(L2)
- measure the divisional profitability and decide the appropriate pricing(L2)

Textbook(s):
1. Charles T. Horngren, Srikant M. Datar, George Foster, Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2006.

References:
1. Charles T. Horngren, George Foster, Advanced Management Accounting, Greenwood Publishing, 2001.
2. Robert S Kaplan, Anthony A. Alkinson, Management & Cost Accounting, 1998.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, Wheeler Publisher, 2004.
4. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book, 2006.

Course Outcomes

After the successful completion of the course, the students will be able to
- list the basic principles of strategic cost management and define the related terminology(L1)
- plan the project execution process involving technical/nontechnical activities(L4)
- describe the detailed engineering activities and their cost management analysis(L2)
- carry out the cost analysis and profit planning of engineering projects(L5)
- utilize quantitative techniques for optimization of budget allocation(L6)

19ECS891: PROJECT WORK I

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Each student is required to submit a report of first part of project work i.e. about the problem definition, literature review and methodology to be adopted including experiments and tests to be performed on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester end.

19ECS892: PROJECT WORK II

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Each student is required to submit a detailed project report about the work on topic of project as per the guidelines decided by the department. The project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the department from time to time. The candidate shall present/publish one paper in national/international conference/seminar/journal of repute. However candidate may visit research labs/institutions with the due permission of chairperson on recommendation of supervisor concerned.