ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.Tech.

Computer Science and Engineering

Aditya Institute of Technology and Management

(An Autonomous Institution)

Approved by AICTE, Recognized under 2(f) 12(B) of UGC,

Permanently Affiliated to JNTUGV – Vizianagaram,

K.Kotturu, Tekkali, Srikakulam - 532201, Andhra Pradesh.

ADITYA INSTITUTE OF TECHNOLOGY AND MANAGEMENT (AUTONOMOUS)

Approved by AICTE, Accredited by NBA & NAAC, Recognised under 2(f)12(b) of UGC, Permanently Affiliated to JNTUGV, Vizianagaram.
K.Kotturu, Tekkali, Srikakulam-532201, Andhra Pradesh

Academic Regulations for **M.Tech**
(Effective for the students admitted into first year from academic year **2022 – 2023**)

The M.Tech Degree of the **Aditya Institute of Technology and Management** (Autonomous), Tekkali shall be conferred on candidates who are admitted to the program and fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS:

Admission to the above program shall be made subject to the eligibility, qualifications and specialization prescribed by the University from time to time. Admissions shall be made on the basis of merit / rank obtained by the qualifying candidate in GATE / PGCET, subject to reservations prescribed by the Govt. of AP from time to time.

2.0 AWARD OF M. Tech DEGREE:

2.1 A student shall be declared eligible for award of the M.Tech degree, if he/she pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years.

2.2 A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

2.3 **The student shall register for all 68 credits and secure all the 68 credits.**

3.0 ATTENDANCE:

3.1 The minimum instruction for each semester 90 clear instruction days.

3.2 A candidate shall be deemed to have eligibility to write End Semester examinations if he/she has put in a minimum of 75% of attendance in aggregate of all the subjects.

3.3 Condonation of shortage of attendance up to 10% (65% and above, and below 75%) may be given by the College academic committee.

3.4 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representations by the candidate with supporting evidence.

3.5 Shortage of attendance below 65% shall in NO case be condoned.

3.6 A candidate shall not be promoted to the next semester unless he/she fulfills the attendance requirements of the present semester.

3.7 A stipulated fee shall be payable towards condonation of shortage of attendance.

4.0 COURSE OF STUDY:

The following specializations are offered at present for the M.Tech course of study.

1	VLSI System Design
2	Power Electronics and Drives
3	Computer Science and Engineering
4	Structural Engineering
5	Thermal Engineering

4.1 A standard academic format common for all PG programmes describing numbers of credits, weightage for lecture, laboratories work and projects have been fixed considering the scope of study. The position and sequence of study of core courses and elective courses are made to ensure sequential and integral learning. The focus on advance study in core courses through theory and laboratories work supported by study on relevant programme specific electives are incorporated. The selection of unique courses in the basket of elective is a special feature of curriculum ensuring flexibility and diversity. The emphasis on understanding advanced Concepts of PG course is ensured through elaborate practical work conducted through actual/virtual laboratory experiments. The concept of designing experiments and developing concept application is made part of learning process. The PG course is spread over two years in four semesters and inclusion of Minor project, Audit course, Open elective, Technical Seminar and Dissertation are the special features of this curriculum. The contents of course are unitized to facilitate its execution. The list of suggested reading is also made part of the curriculum.

4.2 The students are asked to learn IPR/ research methodology to understand the importance and process of creation of patents through research. The introduction of One Audit course covering subjects of developing desired attitude among the Learners is on the line of initiatives such as English for research paper writing, Disaster management, and Constitution of India and Personality development through life enlightenment skills. The courses included under open electives are of importance in the context of special skill development and they are on Industrial safety, Operation research, Composite materials and Waste to Energy. These courses shall make students capable to work in industrial environment.

4.3 The introduction of Minor project ensures preparedness of students to undertake major projects/ dissertation. Students are encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break. The dissertation/major project work of PG programme of one-year duration is given strong weightage in the curriculum. It is expected to undertake industrially relevant problem to develop an optimal solution through extensive research work. The students and faculty can design the research project in consultation with industry preferably in the region.

5.0 EVALUATION:

The performance of the candidate in each semester shall be evaluated subject-wise with a maximum of 100 marks for theory and 100 marks for laboratory, on the basis of continuous Internal Evaluation and Semester End Examination.

5.1 For Theory Courses, **40** marks shall be for internal evaluation and **60** marks for end semester examination. Out of **40** internal marks **30** marks are assigned for subjective

exam, **5** marks for assignments and **5** marks for seminars. The internal evaluation for **30** marks shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other immediately after the completion of instruction. Each midterm examination shall be conducted for duration of **120** minutes and question paper shall contain **4** questions. The student should answer all **4** questions.

5.2 For courses like **Research Methodology & IPR** and **Open Elective,** the pattern of midterm and end examinations is similar to regular theory courses and the valuation is purely internal. Evaluation is based on continuous assessment.

5.3 Audit course is one among the compulsory courses and does not carry any Credits and no semester end examination.

5.4 For laboratory courses, **40** marks shall be for internal evaluation and **60** marks for end semester examination. Out of **40** internal marks **20** marks are assigned based on day-to-day evaluation and **20** are assigned based on the internal test. The end examination shall be conducted by the teacher concerned and an external examiner.

5.5 For Minor Project, **40** marks shall be for internal evaluation and **60** marks for end semester examination. The end semester examination (Viva-Voce) shall be conducted by a committee. The committee consists of an External examiner, Head of the department and Supervisor of the minor project. The internal evaluation shall be made on the basis of seminar given by each student on the topic of his/her minor project, which was evaluated by Departmental committee. The Departmental Committee consists of Head of the Department, supervisor and one other senior faculty member from the Department. Out of **40** internal marks **10** marks allotted for literature survey, **15** marks for results and analysis and **15** marks for seminar.

5.6 For Technical Seminar there will be only internal evaluation for **100** marks. A candidate has to secure a minimum of **50%** marks to be declared successful. For evaluation the candidate has to collect literature on a topic, prepare the document, submit it to the Department in a report form and shall make an oral presentation before the Departmental Committee. The Departmental Committee consists of Head of the Department and two other senior faculty members from the department.

5.7 A candidate shall be deemed to have secured the academic requirement in a subject if he/she secures a minimum of 40% of marks in the end semester examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.8 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.7) he has to reappear for the supplementary examination in that subject in the next academic year.

6.0 EVALUATION OF DISSERTATION Phase – 1/DISSERTATION Phase – 2 WORK

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Dissertation Review Committee.

6.1 A DISSERTATION Review Committee **(DRC)** shall be constituted with Principal as chair Person, Head of the department, Supervisor and one senior faculty member of the concerned department.

6.2 **Registration of DISSERTATION:** A candidate is permitted to register for the Dissertation after satisfying the attendance requirement of all the subjects (theory and practical subjects) in Second semester.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his supervisor, the title, objective and plan of action of his dissertation work to the Dissertation Review Committee for its approval. After obtaining the approval of the Committee the student can initiate the dissertation work after the second semester end examinations.

6.4 Every candidate shall work on dissertation approved by the DRC of the Department.

6.5 If a candidate wishes to change his supervisor or topic of the dissertation he can do so with approval of the DRC. However, the Dissertation Review Committee (DRC) shall examine whether the change of topic/supervisor leads to a major change of his initial plans of project proposal. If so, his date of registration for the dissertation work starts from the date of change of Supervisor or topic as the case may be.

6.6 A candidate shall submit status report in two stages at least with a gap of 3 months between them.

6.7 The work on the dissertation shall be initiated in the beginning of the III semester and the duration of the dissertation is for two semesters. The candidate shall identify the problem, Literature survey, design/modeling part of the problem i.e. almost 35% of his dissertation work should be completed in the III semester itself and it will be evaluated by DRC as Dissertation Phase – 1. If the candidate fails to get the satisfactory report, he has to re-register for the dissertation work.

6.8 A candidate shall be allowed to submit the dissertation report only after fulfilling the attendance requirements of all the semesters with approval of DRC and not earlier than 40 weeks from the date of registration of the dissertation work. For the approval of DRC the candidate shall submit the draft copy of dissertation to the Principal (through Head of the Department) and shall make an oral presentation before the DRC.

6.9 The Candidate may be permitted to submit the Dissertation Report, if only the student pass in all subjects and work is Published/Accepted to be published in a Journal / International conference of repute and relevance.

6.10 Three copies of the Dissertation Report certified by the Supervisor shall be submitted to the College.

6.11 The Dissertation shall be adjudicated by external examiner from outside the college.

6.12 The viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner outside the college.

The Board shall jointly report candidates work as:

- **A.** Excellent
- **B.** Good
- **C.** Satisfactory
- **D.** Unsatisfactory

Head of the Department shall coordinate and make arrangements for the conduct of viva-voce examination. If the report of the viva – voice is unsatisfactory, the candidate will

retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate may be asked to submit a new Dissertation proposal to DRC starting with 6.4

7. Method of Awarding Letter Grades and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his/her performance as per the grading system given below.

Table: Grading System for M.Tech. Programme

Percentage	Level	Letter Grade	Grade Points
>= 90%	Outstanding	A+	10
80 to <90%	Excellent	A	9
70 to <80%	Very Good	B	8
60 to <70%	Good	C	7
50 to <60%	Fair	D	6
< 50%	Fail	F	0
-	Absent	AB	0

7.1 Calculation of Semester Grade Points Average (SGPA)* for semester

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as below:

$$SGPA = \frac{\Sigma(CR \times GP)}{\Sigma CR}$$ (for all courses passes in semester)

Where **CR** = Credits of a Course
GP = Grade points awarded for a course

SGPA is calculated for the candidates who passed all the courses in that semester.

7.2 Calculation of Cumulative Grade Points Average **(CGPA)** and Award of Division for Entire Programme.

The CGPA is calculated as below:

$$CGPA = \frac{\Sigma(CR \times GP)}{\Sigma CR}$$ (for entire programme)

Where **CR** = Credits of a course
GP = Grade points awarded for a course

CGPA is calculated for the candidates who passed all the courses till that semester.

As per the AICTE regulations, conversion of CGPA into equivalent percentage as follows:

Equivalent Percentage = (CGPA – 0.75) x 10

After a student has satisfied the requirement prescribed for the completion of the programme and is eligible for receiving the award of M.Tech. Degree, he shall be placed in one of the below divisions:

Table: Award of Divisions

Class Awarded	CGPA Secured	Remarks
First Class with distinction	≥ 7.75 (Without any supplementary appearance)	From the **CGPA** secured from **68** Credits
First Class	≥ 6.75	
Second Class	≥ 6.0 and < 6.75	

8.0 WITH-HOLDING OF RESULTS:

If the candidate has not paid any dues to the college or if any case of indiscipline is pending against him / her, the result of the candidate will be withheld and he/she will not be allowed into the next higher semester. The issue of the degree is liable to be withheld in such cases.

9.0 TRANSITORY REGULATIONS:

Candidate who have discontinued or have been detained for want of attendance or who have failed after having undergone the course are eligible for admission to the same or equivalent subjects as and when subjects are offered, subject to 5.8 and 2.0.

10.0 GENERAL:

10.1 The academic regulations should be read as a whole for purpose of any Interpretation.

10.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

10.3 The Institute may change or amend the academic regulations and syllabus at any time and the changes and amendments made shall be applicable to all the students with effect from the date notified by the college.

10.4 Wherever the word he, him or his occur, it will also include she, her and hers.

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ADITYA INSTITUTE OF TECHNOLOGY & MANAGEMENT, TEKKALI – 532201

(An Autonomous Institution)

AR – 22 Regulations - M.Tech. Course Structure

I Year I Semester

S.No.	CODE	COURSE	L	T	P	Credits
1	22MCS1001	Mathematical Foundations of Computer Science	3	-	-	3.0
2	22MCS1002	Advanced Algorithms and Design	3	-	-	3.0
3	xxxxxxxxxx	Program Elective – I	3	-	-	3.0
4	xxxxxxxxxx	Program Elective – II	3	-	-	3.0
5	22MCC1001	Research Methodology and IPR	2	-	-	2.0
6	xxxxxxxxxx	Audit Course	2	-	-	0.0
7	22MCS1101	Advanced Algorithms and Design Lab	-	-	4	2.0
8	22MCS1102	Program Elective Lab	-	-	4	2.0
		Total	**16**	**-**	**8**	**18.0**

Program Elective – I and II (Any Two Courses can be chosen from the pool)

S.No.	CODE	COURSE
i)	22MCS1003	High Performance Computing
ii)	22MCS1004	**Artificial Intelligence**
iii)	22MCS1005	Soft Computing
iv)	22MCS1006	**Data Warehousing and Data Mining**
v)	22MCS1007	Distributed Data Bases
vi)	22MCS1008	Cryptography and Network Security

Audit Course

S.No.	CODE	COURSE
i)	22MAC1001	English for Research Paper Writing
ii)	22MAC1002	Disaster Management
iii)	22MAC1003	Constitution of India
iv)	22MAC1004	Personality Development through Life Enlightenment Skills.

I Year II Semester

S.No.	CODE	COURSE	L	T	P	Credits
1	22MCS1009	Machine Learning	3	-	-	3.0
2	22MCS1010	Object Oriented Software Engineering	3	-	-	3.0
3	xxxxxxxxxx	Program Elective III	3	-	-	3.0
4	xxxxxxxxxx	Program Elective IV	3	-	-	3.0
5	xxxxxxxxxx	Program Elective V	3	-	-	3.0
6	xxxxxxxxxx	Open Elective	3	-	-	3.0
7	22MCS1103	Machine Learning Lab	-	-	4	2.0
8	22MCS1201	Minor Project	-	-	4	2.0
		Total	**18**	**-**	**8**	**22.0**

Program Elective – III, IV and V(Any Three Courses can be chosen from the pool)

S.No.	CODE	COURSE
i)	**22MCS1011**	Cloud Computing
ii)	**22MCS1012**	Sensor Networks and Internet of Things
iii)	**22MCS1013**	Computer Vision and Image Processing
iv)	**22MCS1014**	**Natural Language Processing**
v)	**22MCS1015**	GPU Computing
vi)	**22MCS1016**	**Block Chain Technology**
vii)	**22MCS1017**	Big Data Analytics
viii)	**22MCS1018**	Software Testing Methodologies
ix)	**22MCS1019**	Optimization Techniques

Open Elective

S.No.	CODE	COURSE
i)	**22MOE1001**	Industrial Safety
ii)	**22MOE1002**	Operations Research
iii)	**22MOE1003**	Composite Materials
iv)	**22MOE1004**	Waste to Energy

II Year I Semester

S.No.	CODE	COURSE	L	T	P	Credits
1	**22MCS2202**	Technical Seminar	-	-	4	2.0
2	**22MCS2203**	Dissertation Phase - I	-	-	20	10.0
		Total	**-**	**-**	**24**	**12.0**

II Year II Semester

S.No.	CODE	COURSE	L	T	P	Credits
1	**22MCS2204**	Dissertation Phase – II	-	-	32	16.0
		Total	**-**	**-**	**32**	**16.0**

NOTE: L: Lecture T: Tutorial P: Practical

Mathematical Foundation of Computer Science

Subject Code: 22MCS1001

L	T	P	C
3	0	0	3

Course Objectives

- Understand the theory and techniques of logic, set theory, graphs and trees
- Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems
- Communicate mathematical ideas

Course Outcomes:

After completion of this course, the Students will be able to:

1. Apply, equivalence formula, tautological implications in finding normal forms, theory of inference and differentiate propositional logic and predicates.
2. Apply, Rules of inference on Predicates, Automatic Theorem of Proving.
3. Explain the basic properties of relations (POSETS, LATTICES and apply the same in solving the problems) and functions.
4. Identify the basic properties of graphs and related structures and solve the related problems.
5. Describe the basic properties of Planar graphs, Trees and solve minimum cost spanning tree problems.
6. Solve and formulate, generating functions and recurrence relations.

Unit – I

Mathematical Logic : Statements and notations, Connectives, Well formed formulas, Truth Tables, tautology, equivalence implication, Normal forms..

Unit – II

Predicates: Predicative logic, Free & Bound variables, Rules of inference, Consistency, proof of contradiction, Automatic Theorem Proving.

Unit – III

Relations: Properties of binary Relations, equivalence, compatibility and partial ordering relations, Hasse diagram, Lattice and its Properties.

Unit – IV

Graph Theory I: Graph terminology, Types of graphs, Vertex degree and Handshaking property, Matrix representation of graphs: Adjacency Matrices, Incidence Matrices, Connected graphs, Isomorphism of graphs, Subgraphs, Euler graph, Hamiltonian path and circuits,

Unit – V

Graph Theory II:Planar and Non Planar graphs:- Euler's formula, Dual of planar graph, Graph coloring, (Chromatic number),Map coloring

Trees: Definition and properties, Tree traversing (preorder, inorder, postorder),Graph traversal techniques, Spanning Tree, Minimum cost spanning trees(Prim's & Kruskal's algorithm).

Unit – VI

Combinatorics: Generating Function of Sequences, Calculating coefficient of Generating function, Partial Fractions, Recurrence relations: First order and second order Linear Homogeneous and Non-Homogeneous recurrence relations, Method of generating functions

Text Books

1. J.P.Tremblay & R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science" Mc.Graw Hill, 1975.
2. Kolman, Busby Ross, "Discrete Matheamatical Structures", Prentice Hall International.
3. D.S.Chandrasekharaiah, "Mathematical Foundation of Computer Science" Prism Publications 2009

Reference Books

1. V. Krishnamurthy, "Combinatories:Theory and Applications", East-West Press.
2. Seymour Lipschutz, M.Lipson, "Discrete Mathemataics" Tata Mc Graw Hill, 2005.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Mc.Graw Hill, 2002.

Advanced Algorithms and Design

Subject Code: 22MCS1002

L	T	P	C
3	0	0	3

Course Objectives

The objective of this course is to teach students various data structures and to explain them algorithms for performing various operations on data structures and to:

- Identify various memory models to represent static and dynamic Hashed structures.
- Study how to balance a Binary Search trees and 2-3 and so on other Trees
- Distinguishes various graph algorithms and techniques for finding minimum path.
- Understand the mapping of real-world problems to algorithmic solutions.

Course Outcomes

After completion of this course, the Students will be able to:

1. Demonstrate and Outline different types of Hashing and Sorting techniques.
2. Analyze how to optimize various operations on different trees by balancing.
3. Apply different graph algorithms for solving real world problems:
4. Compare different pattern matching algorithms.
5. Develop and implement solutions to problems by applying different design strategies like Greedy and Dynamic programming techniques.
6. Generate state space tree to solve different problems using Backtracking and formulate solutions using Branch-and-Bound technique to solve various design problems.

Unit – I

Preliminaries of algorithms, algorithm analysis and complexity; Hashing: Hash tables representation, hash functions, Hashing techniques; Sorting: Review & Analysis of various sorting algorithms; topological sorting;

Unit – II

Representation & efficient operations on Dictionaries, Sets; Trees: Basic concepts, terminology, Binary Tree representation; Properties, Insertion and Deletion operations on various Balanced Trees: Binary Search tree, AVL Trees, Splay trees, 2-3 trees.

Unit – III

Basic Concepts, representation of graphs: Adj. Matrices and Adj. Lists; Graph traversals: DFS and BFS; Minimum Cost Spanning Trees- Prim's & Kruskal's Algorithm;

Unit – IV

Text Processing: Pattern matching algorithms-Brute force, the Boyer Moore algorithm, the Knuth-Morris-Pratt algorithm. Tries: Definition and concepts of digital search tree, Binary trie, Patricia, Multi-way tree.

Unit – V

Introduction to greedy paradigm: Shortest Path in Graphs: Dijkstra's Algorithm; Dynamic Programming Paradigm: All Pairs Shortest Paths Problem: Floyd's Algorithm, Wars hall's Algorithm.

Unit – VI

Backtracking: General method: Iterative & Recursive Methods, Applications: n–Queen problem, Sum Of Subsets Problem, Graph Colouring; Branch and Bound: General method: LC Search Algorithm, Applications - Travelling sales person problem, 0/1 knapsack problem using LCBB & FIFOBB.

Text Books

1. S.Sahni, , “Data structures, Algorithms and Applications in C++”, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithms", 2009, 4th edition, Pearson Education India.

Reference Books

1. Mark Allen Weiss , “Data structures and Algorithm Analysis in C++” , Pearson Education. Ltd., Second Edition.
2. Adam Drozdek, Thomson , “Data structures and algorithms in C++”, 3rd Edition,

High Performance Computing

Subject Code: 22MCS1003

L	T	P	C
3	0	0	3

Course Objective:

- To learn different parallel programming models and the usage of OpenMP, Pthreads, and TBB Libraries.

Course outcomes:

After completion of this course, the Students will be able to:

1. Describe the features of parallelism and parallel platforms.
2. Design and analyze parallel algorithms for real world problems and implement them on available parallel computer systems.
3. Optimize the performance of a parallel program to suit a particular hardware and software environment.
4. Analyze the communication overhead of interconnection networks and modify the algorithms to meet the requirements.
5. Design algorithms suited for Multicore processor systems using OpenMP,MPI, and threading techniques.
6. Generate parallel programs for matrix, graph and sorting problems using OpenMP, MPI, PThreads languages/libraries.

Unit – I

Introduction: Implicit parallelism, Limitations of memory system performance, control structure, communication model, physical organization, and communication costs of parallel platforms, Routing mechanisms for interconnection networks, mapping techniques.

Unit – II

Parallel algorithm design: Preliminaries, decomposition techniques, tasks and interactions, mapping techniques for load balancing, methods for reducing interaction overheads, parallel algorithm models.

Unit – III

Basic communication operations: Meaning of all-to-all, all-reduce, scatter, and gather, circular shift and splitting routing messages in parts. Analytical modeling of parallel programs: sources of overhead, performance metrics, the effect of granularity on performance, scalability of parallel systems, minimum execution time, minimum cost-optimal execution time, asymptotic analysis of parallel programs.

Unit – IV

Programming using message passing paradigm: Principles, building blocks, MPI, Topologies and embedding, Overlapping communication and computation, collective communication operations, Groups and communicators

Unit – V

Programming shared address space platforms: Threads, POSIX threads, Synchronization primitives, attributes of threads, mutex and condition variables, Composite synchronization constructs, OpenMP. Multi-core Programming: Multi-core processor, CPU Cache, Cache coherence protocols, Memory Consistency Models, An Overview of Memory Allocators, Programming Libraries- PThreads, TBB, OpenMP.

Unit – VI

Dense Matrix Algorithms: matrix vector multiplication, matrix-matrix multiplication, solving system of linear equations, **Sorting:** Sorting networks, Bubble sort, Quick sort, Bucket sort and

other sorting algorithms. Graph algorithms: Minimum spanning tree, single source shortest paths, all-pairs shortest paths, Transitive closure, connected components, algorithms for sparse graphs.

Text Books

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar : Introduction to Parallel Computing, Second Edition Pearson Education – 2007.
2. Michael J. Quinn (2004), Parallel Programming in C with MPI and OpenMP McGraw-Hill International Editions, Computer Science Series.

Reference Books

1. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, *Heterogeneous Computing with OpenCL*, McGraw-Hill, Inc. Newyork , 2011.
2. Jason Sanders, Edward Kandrot, *CUDA By Example – An Introduction to General-Purpose GPU Programming*, Addison Wesley, 2011.

Artificial Intelligence

Subject Code: 22MCS1004

L	T	P	C
3	0	0	3

Course Objective

- The student should be made to study the concepts of Artificial Intelligence.
- The student should be made to learn the methods of solving problems using Artificial Intelligence.
- The student should be made to introduce the concepts of Expert Systems and machine learning.

Course Outcomes

After completion of this course, the Students will be able to:

1. Understand the characteristics of AI problems.
2. Study various heuristic algorithms.
3. Apply predicate logic to solve problems.
4. Represent the knowledge using various structured approaches.
5. Develop a reasoning mechanism using different statistical concepts.
6. Illustrate the architecture of an expert system.

Unit – I

Introduction: AI Problems, State Space Search: water-jug problem, Production systems: Control strategies: BFS, DFS; Problem characteristics; Production system characteristics

Unit – II

Heuristic Search Techniques– Generate & Test, Hill Climbing, Best first, A* algorithm, Constraints satisfaction, Min-max Algorithm

Unit – III

Representation of Knowledge: Issues in Knowledge representation, Approaches to Knowledge representation, Knowledge representation using Predicate logic, Unification Algorithm, Resolution, Procedural Vs Declarative knowledge

Unit – IV

Structured Knowledge Representation- Semantic Nets, Frames, Conceptual Dependencies, Forward Vs Backward chaining, matching

Unit – V

Statistical Reasoning: Bayesian Theorem, Bayesian Network, Dempster-Shafer theory.
Planning and Machine Learning: Basic plan generation systems - Strips – Advanced plan generation systems – K strips, Machine learning, adaptive Learning.

Unit – VI

Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XOON:
Expert systems shells.

Text Book

1. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2013.(Units - I, II, IV & V).
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2017.

Reference Books

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.
3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.
4. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach, Fourth Edition, Pearson, 2020

Reference Link

1. https://swayam.gov.in/nd1_noc19_me71/previe
2. https://ai.google/

Soft Computing
(Program Elective)

Subject Code: 22MCS1005

L	T	P	C
3	0	0	3

Course Objective

Introduce students to soft computing concepts and techniques and foster their abilities in designing and implementing soft computing based solutions for real-world problems

Course Outcomes

After completion of this course, the Students will be able to:

1. To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
2. Appreciation of basic knowledge about the theory and key algorithms that form the foundation for artificial neural network and practical knowledge of learning algorithms and methods
3. Understand learning rules for each of the architectures and learn several neural network paradigms and its applications
4. Know how to apply Neural Networks and Genetic Algorithms to different problem areas
5. Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
6. Evaluate and compare solutions by various soft computing approaches for a given problem

Unit – I

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

Unit – II

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

Unit – III

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

Unit – IV

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

Unit – V

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

Unit – VI

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques

Text Books

1. Jyh: Shing Roger Jang, Chuen:Tsai Sun, Eiji Mizutani, Neuro: Fuzzy and Soft Computing®, Prentice: Hall of India,2003.
2. 2. George J. Klirand BoYuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications ®, Prentice Hall, 1995.

Reference Books

1. Artificial Intelligence and SoftComputing- Behavioural and Cognitive Modelling of the Human Brain- Amit Konar, CRC press, Taylor and Francis Group.
2. A first course in Fuzzy Logic-Hung T Nguyen and Elbert A Walker, CRC. Press Taylor and Francis Group.
3. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford Univ. Press.

Data Warehousing and Data Mining
(Program Elective)

Subject Code: 22MCS1006

L	T	P	C
3	0	0	3

Course Objective

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for Data science;
- Produce Python code to statistically analyze a dataset;
- Critically evaluate data visualizations based on their design and use for communicating. stories from data;

Course Outcome

After completion of this course, the Students will be able to:

1. Understand the evolutionary path that has led to the purpose of adapting to Data Warehouse and Data Mining techniques in various domains
2. Identify the need of Data Warehouse tools and techniques for designing and developing different types of databases
3. Compare and evaluate different Data Mining techniques for knowledge discovery
4. Comprehend the importance and role that Data Warehouse and Data Mining play in various fields
5. Comprehend the importance and role that Data Warehouse and Data Mining play in various fields
6. Discuss various case studies to identify the needs and patterns for business domains

Unit – I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

Unit – II

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

Unit – III

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining

Unit – IV

Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Backpropagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods

Unit – V Cluster Analysis Introduction : Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data,

Mining Streams, Time Series and Sequence Data: Mining Data Streams, Mining Time-Series Data.

Unit – VI

Applications and Trends in Data Mining: Data Mining Applications, Data Mining System Products and Research Prototypes, Additional Themes on Data Mining and Social Impacts of Data Mining.Text Books

Text Books:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier,2nd Edition, 2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.

Reference Books:

1. Data Mining Techniques – Arun K Pujari,2nd edition, Universities Press.
2. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.
3. Insight into Data Mining,K.P.Soman,S.Diwakar,V.Ajay,PHI,2008.
4. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition

Distributed Data Bases
(Program Elective)

Subject Code: 22MCS1007

L	T	P	C
3	0	0	3

Course Objective

The aim of this module is to build on the previous background of database systems by Deepening the understanding of the theoretical and practical aspects of the database technologies, showing the need for distributed database technology to tackle deficiencies of the centralized database systems and finally introducing the concepts and techniques of distributed database including principles, architectures, design, implementation and major domain of application

Course Outcome

After completion of this course, the Students will be able to:

1. Identify the introductory distributed database concepts and its structures, design and management
2. Produce query processing techniques in DDBMS.
3. Explain Distributed Transaction management
4. Interpret Reliability and concurrency control mechanisms
5. Assess Architectural issues of distributed databases
6. Summarize Query processing, Transaction Management, Concurrency Control and Recovery issues in Distributed Multi-DBMSs.

Unit – I

Features of Distributed versus Centralized Databases, Principles of Distributed Databases, Levels Of Distribution Transparency, Reference Architecture for Distributed Databases, Types of Data Fragmentation, Integrity Constraints in Distributed Databases, Distributed Database Design.

Unit – II

Translation of Global Queries to Fragment Queries, Equivalence transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries

Unit – III

The Management of Distributed Transactions, A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions

Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

Unit – IV

Reliability, Basic Concepts, Non blocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection

Unit – V

Architectural Issues, Alternative Client/Server Architectures, Cache Consistency, Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution, Transaction Management, Transaction Management in Object DBMSs, Transactions as Objects

Unit – VI

Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues Transaction Management Transaction and Computation Model, Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation and Interoperability, Object Management Architecture CORBA and Database interoperability, Distributed Component Object Model, COM/OLE and Database Interoperability, PUSH-Based Technologies

Text Books

1. Distributed Databases Principles & Systems, Stefano Ceri, Giuseppe Pelagatti,TMH. . Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez , Pearson Education, 2nd Edition. 2007
2. M. Tamer OZSU and Patuck Valduriez: Principles of Distributed Database Systems, Pearson Edn. Asia, 2001.

Reference Books

1. Distributed Database Systems,Chanda Ray,Pearson. 1st Edition 2009
2. Distributed Database Management Systems,S.K.Rahimi and Frank.S.Haug,Wiley. **2010**

Cryptography and Network Security
(Program Elective)

L	T	P	C
3	0	0	3

Subject Code: 22MCS1008

Course Objectives

- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms.
- Understand the basic categories of threats to computers and networks
- Describe public-key cryptosystem.
- Describe the enhancements made to IPv4 by IPSec
- Understand Intrusions and intrusion detection
- Discuss the fundamental ideas of public-key cryptography.
- Generate and distribute a PGP key pair and use the PGP package to send an encrypted email message.

Course Outcomes

After completion of this course, the Students will be able to:

1. Recall different Security Attacks, Services and Mechanisms
2. Classify and explain categories of different encryption and decryption techniques
3. Identify the authentication applications such as Kerberos and x.509 directory services
4. Analyze the representation of PGP and S/MIME
5. Familiar with the importance of IP Security and Web Security
6. Exposed to viruses and related threats and design principles of firewalls

Unit – I

Introduction: Security Attacks, Security Services and Security Mechanisms, A Model for Network security. Non-Cryptographic Protocol Vulnerabilities – DoS, DDoS, Session Hijacking and Spoofing, Software Vulnerabilities – Phishing, Buffer Overflow, Format String Attacks, SQL Injection, **Basics of Cryptography:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Other Cipher Properties – Confusion, Diffusion, Block and Stream Ciphers.

Unit – II

Secret Key Cryptography: DES, Strengths of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, Blowfish, IDEA, CAST-128 and AES

Unit – III

Public-Key Cryptography: Public Key Cryptography Principles, RSA, Diffie-Hellman Key Exchange, Introduction to Elliptic Curve Cryptography

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – Message Authentication Requirements and Functions, Digital Signatures, DSS.

Unit – IV

Authentication Applications – Kerberos, Key Management and Distribution, X.509 Authentication Service, Public Key Infrastructure. Electronic Mail Security - Pretty Good Privacy, S/MIME

Unit – V

IP Security: Overview, Architecture, AH Protocol, ESP Protocol

Web Security: Considerations, **SSL:** Architecture, Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol, **TLS**, **SET:** Overview, Dual Signatures, Payment Processing.

Unit – VI

Intruders: Intrusion Techniques, Password Protection, Intrusion Detection.

Viruses and Related Threats: Malicious Programs, The Nature of Viruses, Types of Viruses.

Firewalls: Design Principles, Characteristics, Types of Firewalls, Firewall Configurations. **Trusted Systems.**

Text Books:

1. Network Security Essentials: Applications and Standards, William Stallings, Pearson Education.
2. Cryptography and Network, 2nd Edition, Behrouz A. Fourouzan and Debdeep Mukhopadhyay, McGraw-Hill, 2010.

Reference Books:

1. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson Education.
2. Michael E. Whitman and Herbert J. Mattord. 2011. <i>Principles of Information Security (4th. ed.). Course Technology Press, Boston, MA, USA.
3. Introduction to Cryptography, Buchmann, Springer.

Research Methodology and IPR

Subject Code: 22MCC1001

L	T	P	C
2	0	0	2

Course Outcomes:
After completion of this course, the Students will be able to:

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Unit – I
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Unit – II
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an Illustration

Unit – III
Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework,Developing a conceptual framework, Writing about the literature reviewed, analysis Plagiarism, and Research ethics.

Unit – IV
Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Unit – V
Nature of Intellectual Property: Patents, Designs, Trade 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 Patent Cooperation Treaty (PCT).

Unit – VI
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.

Text Books

1. Kothari, C.R.. (2004). *Research methodology : Methods and techniques* (2nd revised edition). New Delhi: New Age International (P) Limited, Publishers.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Reference Books

1. Research Methodology, Paneersevam, 2nd Edition, PHI.
2. Research Methodology, Chawla and Sondhi, Vikas ppublication House, 2011.
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

English for Research Paper Writing
(Audit Course)

Subject Code: 22MAC1001

L	T	P	C
2	0	0	0

Course Objectives

- To make students understand significance of improving writing skills and level of readability
- To assist students learn about what to write in each section of their papers
- To aid students realize importance of reviewing literature for a paper writing
- To help students acquire skills required for writing a Title, Abstract and Introduction
- To enable students obtain skills needed when writing methods, results, discussions and conclusions
- To get students ensure paper is written in the best possible manner

Course Outcomes

After completion of this course, the Students will be able to:

1. Students will be able to write paper with clarity and brevity
2. Students will be able to interpret their findings in their own way unaffected by external factors
3. Students will be able to get accurate results with an astute understanding of the subject
4. Students will be able to begin paper writing more aptly
5. Students will be able to write methods, results, discussions and conclusion in their paper more logically
6. Students will be able to use phrases competently to express their ideas

Unit – I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit – II

Clarifying Who Did What, Highlighting Findings, Hedging and Criticizing,Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

Unit – III

Review of the Literature, Methods, Results, Discussion, Conclusions, Final Check

Unit – IV

Key skills needed when writing a Title, an Abstract, an Introduction and a Review of the Literature

Unit – V

Skills needed when writing Methods, Results, Discussions and Conclusion

Unit – VI

Useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission

Text Books

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

Disaster Management
(Audit Course)

Subject Code: 22MAC1002

L	T	P	C
2	0	0	0

Course Objectives
Students will be able to:

- To understand basic concepts, definitions and Terminologies used in Disaster Management.
- To Understand Types and Categories of Disasters and its Impact.
- To promote Prevention and Preparedness for disaster
- To undertake Mitigation & Risk Reduction steps to prioritize Rescue and Relief operation, Rehabilitation & Reconstruction
- To understand the seismic zoning of India and various seismic vulnerable locations
- To know the statistical approach on land slides

Course Outcomes
After completion of this course, the Students will be able to:

1. Know the Disaster Concepts to Management.
2. Ability to Categorize Disasters & Preparedness plans for disaster response.
3. Ability to analyze seismic vulnerable location in various parts of India
4. Monitoring and evaluation plan for disaster response, setting up of early warning systems for risk reductions
5. Ability to analyze seismic vulnerable location in various parts of India
6. Analyze the statistical approach on land slides

Unit – I
Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels

Unit – II
Overview of Disaster situations in India: Vulnerability profile of India and vulnerability mapping including disaster – prone areas, communities, places.

Unit – III
Disaster preparedness – ways and means; skills and strategies; rescue, relief, reconstruction and rehabilitation.

Unit – IV
Case studies: Lessons and experiences from various important disasters in India.

Unit – V
Seismic vulnerability of urban areas.: Seismic response of R.C. frame buildings with soft first storey. Preparedness for natural disasters in urban areas. Sulbh technology for sanitation improvement in urban habitat. Landslide hazards zonation mapping and geo-environmental problems associated with the occurrence of landslides.

Unit – VI
Statistical approach to study landslides: Landslide casual factors in urban areas. Roads and landslide hazards in Himalayas. Lateral strength of masonry walls. A numerical model for post earthquake fire response of structures. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Response of buried steel pipelines carrying water subjected to earthquake ground motion. Preparedness and planning for an urban earthquake disaster. Urban settlements and natural hazards. Role of knowledge based expert systems in hazard scenario.

Text Books

1. Natural Hazards in the Urban Habitat" by Iyengar, C.B.R.I., Tata McGraw Hill.
2. Natural Disaster management", Jon Ingleton(Ed), Tulor Rose
3. Disaster Management", R.B. Singh (Ed), Rawat Publications,2006
4. Anthropology of Disaster management", Sachindra Narayan, Gyan Publishing House,2000

Constitution of India
(Audit Course)

Subject Code: 22MAC1003

L	T	P	C
2	0	0	0

Course Objectives
Students will be able to:

- To help Students regulate their behavior in a social environment as Engineering Professionals.
- To make students aware of the impact of taking social, legal and Administrative decisions about their profession.
- To understand the political and constitutional parameters in work environment.
- To understand the need and strengths of our nation and adopt their knowledge for future career.

Course Outcomes:
After completion of this course, the Students will be able to:

1. Realize the rigidness of our Indian Politics and Administrative aspects.
2. A Student can understand our nation federalism.
3. Can assess different types of risks involved in misadministration.
4. Can create competitive advantage.
5. Summarizes the legal, Administrative, Political and Financial aspects for betterment of the National building.
6. To assess the growth of Indian opinion regarding modern Indian intellectuals' Constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism

Unit – I
Introduction: Historical perspective of the constitution of India - Salient features of The Indian Constitution –Features: Fundamental Rights (Article 12 to 35), Duties (51 A – 1976 emergency) and Directive principles (Article 36 to 51) of State Policy - Articles 14 to 18- Articles 19 - Article 21

Unit-II
Amendment Procedure of The Indian Constitution: 42nd amendment (Mini Constitution) - 44thamendment (1978 – Janatha Govt.)

Unit – III
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of ElectedRepresentative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials andtheir roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit – IV
Parliamentary form of Govt. In India: President of India - Emergency provisions - National Emergency – Article 352 President Rules – Article 356 - Financial Emergency – Article 360Prime Minister and Cabinet - Supreme Court of India (Indian Judiciary)

Unit – V
Indian Federalism: Union – State relations; - Legislative, Administrative and Financial relations. LokSabha, RajyaSabha, VidhanSabha & VidhanParishad - Composition; Speaker, Chairman, Privileges, Legislative procedure.

Unit – VI

Parliamentary Committees: Public Accounts Committee - Estimates Committee - Committee on Public Undertakings. - Election commission of India (Article -324) - Comptrollar and Auditor General (CAG) of India
(Article – 148 to 150) - Finance Commission (Article – 280) - NeethiAayog (Planning Commission) and - Political Parties.

Text Books:

1) D.D Basu – Indian Constitution.
2) Dr. D. Surannaidu – Indian PoliticalSystem.
3) MadhavKhosla – The IndianConstitution.

Reference Books:

1) The Constitution of India, 1950 (Bare Act), Government Publication.
2) M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Personality Development through Life Enlightenment Skills
(Audit Course)

Subject Code: 22MAC1004

L	T	P	C
2	0	0	0

Course Outcomes:

After completion of this course, the Students will be able to:

1. Realize that everyone is responsible for creating his/her own personality.
2. Gain knowledge of the importance of developing virtues like wisdom and courage and knowing what are good acts (do's) and bad acts (don'ts).
3. Understand the key message of Bhagavad Gita which is experiencing spiritual oneness by practicing any or all of the karma, bhakti, dhyana or raja, and jnana yogas.
4. Know the vedantic perspective of lifewith regards to understanding human nature, art of living and technique of self-unfoldment.
5. Realize the goal and means to attain self-realization which is the only way to attain liberation.
6. Become aware that sub-conscious mind which is full of desires is the main obstacle for self-realization and spiritual practices help in eliminating these desires.

Unit – I

Personality Development: It is Personality that Matters – Laws of Personality Development – Different Layers of Personality – Pleasure is not the Goal – How to Change Our Character – Control Your Negative Emotions – Change Yourself First – Take Whole Responsibility of Yourself.

Unit – II

Holistic Personality Development: (from BhartruhariNeetiSatakam)
Wisdom (Verses 19, 20, 21, 22) – Pride & Heroism (Verses 29, 31, 32) – Virtues (Verses 26, 28, 63, 65) – Don'ts (Verses 52, 53, 59) – Do's (Verses 71, 73, 75, 78)

Unit – III

Bhagavad Gita:

Chapter 2 – Verses 17, 56, 62, 68

Chapter 3 – Verses 13, 21, 27, 35, 36, 37, 42

Chapter 4 – Verses 18, 38, 39

Chapter 6 – Verses 5, 13, 17, 23, 35

Chapter 12 – Verses 13, 14, 15, 16, 17, 18

Chapter 18 – Verses 37, 38, 45, 46, 48, 63

Unit – IV

Vedantic Perspective of Life: Brief discussion of major topics in
Understanding Human Nature – Art of Living – Technique of Self Unfoldment

Unit – V

Vivekachudamani: Self-realization is the means of liberation – Means to Self-realization – Qualifications of a Spiritual Aspirant – 4-fold Spiritual Discipline

Unit – VI

Mind and Its Mysteries: What is Mind? Mind and body, Mind and food – Mental faculties – Theory of perception, Memory, Imagination, Thought-Culture, Desires – Cultivation of Virtues, Control of Senses and Mind – Concentration, Meditation and Enlightenment.

Text Books

1. Personality Development, Swami Vivekananda, Advaita Ashrama Publication, ISBN 978817552246
2. Three Satakam of Bharatrhari (Niti, Srngara, Vairagya), P. Gopinath, Rashtriya Sanskrit SansthanPubllication.
3. Bhagavad Gita, Swami Swarupananda, Advaita Ashram Publication.
4. Vedanta – Science of Life, 3 Vols, Swami Chinmayananda, Chinmaya Mission Pub (Vol1 – Understanding Human Nature, Vol2 – Art of Living, Vol3 – Technique of Self-Unfoldment)
5. Message of Vivekachudamani, Swami Ranganadhananda, Advaita Ashrama Publication, ISBN 817553089
6. Mind, Its Mysteries and Control, Swami Sivananda, Divine Life Society Publication.

Reference Books:

1. https://archive.org/download/satakasofbhartri00bharuoft/satakasofbhartri00bharuoft.pdf
2. Bhagavad Gita – Sadhaka Sanjivani, Swami Ramsukhdas, Gita Press Publication (1080, 1081)
3. The Goal and The Way, Swami Satprakashananda, Ramakrishna Math Publication
4. Spiritual Quest, Swami Tapasyananda, Ramakrishna Math Publications, ISBN 8171204562
5. Mind According to Vedanta, Swami Satprakashanada, Ramakrishna Math Publication, ISBN 8171206506

Advanced Algorithms and Design Lab

Subject Code: 22MCS1101

L	T	P	C
0	0	4	2

Course Objectives

The main objectives of this course are:

- Solve real-world problems by reasoning about data structure choices, choose appropriate Implementations, and analyze the costs associated with those choices.
- To make the students write various programs and ADTS for all data structures.
- Think critically for improvement in solutions.

Course Outcomes

After completion of this course, the Students will be able to:

1. Apply critical thinking skills and creativity to solve the problems.
2. Design of hash tables, including collision avoidance and resolution schemes.
3. Demonstrate the use of balanced trees and Paraphrase the underlying organization of the AVL, 2-3 trees.
4. Develop shortest path algorithms like Warshall's, Floyd's, Dijkstra's on graphs
5. Generates searching algorithms for websites to match the specified string, numeric or both in an application.

List of Experiments

1. Write a program to implement Multi-way Merge -sort.
2. Write a program to implement functions of Dictionary using Hashing (division method, Multiplication method, Universal hashing).
3. Write a program to implement skip list.
4. Write a program to perform various operations i.e, insertions and deletions on AVL trees
5. Write a program to perform various operations i.e., insertions and deletions on 2-3 trees.
6. Write a program to implement Prim's algorithm to generate a min-cost spanning tree.
7. Write a program to implement Kruskal's algorithm to generate a min-cost spanning tree.
8. Write a program to implement Dijkstra's algorithm.
9. Write a program to implement Floyd's algorithm.
10. Write a program to implement Warshall's algorithm
11. Write a program to implement operations on binary heap (min).
12. Write a program to implement Priority Queues.

Text Books

1. S.Sahni, , "Data structures, Algorithms and Applications in C++", University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2. Michael T.Goodrich, R.Tamassia and Mount, "Data structures and Algorithms in C++, Wiley student edition, John Wiley and Sons.

Reference Books

1. Horowitz, Sahni, and Mehta, "Fundamentals of Data Structures in C++".
2. Roberge, J., "Data Structures in C++: A Laboratory Course".

Machine Learning

Subject Code: 22MCS1009

L	T	P	C
3	0	0	3

Course Objective

- To understand how to design a learning system and what are concept learning tasks
- To analyze how to apply decision tree learning in classification tasks.
- To understand predicate logic as one of the knowledge representation techniques.
- To gain an insight into the role played by neural networks in machine learning.
- To learn the concepts of genetic algorithm and genetic programming.
- To learn the concept of reinforcement Learning.

Course Outcomes

After completion of this course, the Students will be able to:

1. Have a broad understanding of machine learning algorithms and their use in data-driven knowledge discovery and program synthesis.
2. Identify, formulate and solve machine learning problems that arise in practical applications
3. Understand instance based learning algorithms.
4. Design a neural network to solve classification and function approximation problems.
5. Build optimal classifiers using genetic algorithms.
6. Understand how to apply a variety of Reinforcement learning algorithms to data.

Unit – I

Introduction – Well defined learning problems, Designing a Learning System, Machine learning: what and why? ypes of machine learning,Issues in Machine Learning;**Concept Learning Task** - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias

Unit – II

Decision Tree Learning - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; **Artificial Neural Networks** – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule, Backpropagation Algorithm, Convergence, Generalization

Unit – III

Evaluating Machine Learning algorithms and Model Selection, Ensemble Methods (Boosting, Bagging, Random Forests),Learning set of rules-

Unit – IV

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning.
Instance-Based Learning: Introduction, k-Nearest Neighbour Learning, Locally Weighted Regression.

Unit – V

Genetic Algorithms: Motivation, Genetic Algorithms, An Illustrative Example, Hypothesis Space Search, Genetic Programming.

Analytical Learning: Introduction**,**Learning with perfect domain theories,Remarks on explanation based learning ,explanation based learning of search control knowledge.

Unit – VI

Reinforcement Learning: Introduction, Learning Task Q Learning**,** on deterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming.

Text Books

1. Tom M. Mitchell, Machine Learning, McGraw Hill Education (India) Private Limited, 2013.

Reference Books

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Object Oriented Software Engineering

Subject Code: 22MCS1010

L	T	P	C
3	0	0	3

Course Outcome

After completion of this course, the Students will be able to:

1. Understand the Object Oriented Paradigm
2. Analyze and Specify software requirements through an SRS document
3. Model the object oriented software systems using Unified Modeling Language (UML)
4. Apply various testing strategies to ensure the software quality.
5. Estimate the cost of constructing object oriented software
6. Design large-scale, reusable and complex software systems with Design and Architectural patterns.

Unit – I

Object oriented Paradigm, Object oriented Concepts, Classes, Objects, Attributes, Methods and services, Messages, Encapsulation, Inheritance, Polymorphism,

Unit – II

Object Oriented Analysis, Domain Analysis, Generic Components of OOA model, OOA Process, Object Relationship model, Object Behavior Model.

Unit – III

Object Oriented Design: Design for Object-Oriented systems, The Generic components of the OO design model, The System design process, The Object design process, Object Oriented Programming.

Unit – IV

Testing of OOA and OOD models, Object-Oriented testing strategies, Test case design for OO software.

Unit – V

Technical Metrics for Object Oriented Systems: The Intent of Object Oriented metrics, The distinguishing Characteristics, Metrics for the OO Design model, Class-Oriented metrics, Operation-Oriented Metrics, Metrics for Object Oriented testing, Metrics for Object Oriented projects.

Unit – VI

Design Patterns-Creational Patterns, Structural patterns, Behavioral Patterns, Architectural patterns, Pattern systems, idioms, patterns and Software Architecture.

Text Books

1. Stephen R.Schach, Object Oriented and Classical Software Engineering, 5th Edition, McGraw-Hill, 2001.
2. Erich gamma, Richard Helm, Ralph Johnson and John Vissides, Design Patterns –Elements of Reusable Object Oriented Software, Pearson Education, 1994

Cloud Computing
(Program Elective)

Subject Code: 22MCS1011

L	T	P	C
3	0	0	3

Course objective

- Understand various basic concepts related to cloud computing technologies
- Understand the underlying principle of cloud virtualization and data visualization.
- To enable students exploring some important cloud applications
- To gain competence in Cloud Security and Open Cloud delivering highly-interactive Web applications
- To understand and be able to cloud environment is collaborating with various webmail services and databases
- To understand internal and external Compliance

Course Outcome

After completion of this course, the Students will be able to:

1. Understanding the key dimensions of the challenge of Cloud Computing
2. Assessment of the economics , financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
4. Understand various cloud computing security controls recommendation
5. Evaluate various storage classifications and technologies.
6. Analyze the policies of cloud computing

Unit – I

Introduction to Cloud Computing: Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing

Unit – II

Cloud Computing Architecture: Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model

Cloud Deployment Models

Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise

Unit – III

Using Cloud Services Collaborating on Calendars, Schedules, Task Management, Event Management, Contact Management, Project Management

Unit – IV

Cloud security Cloud Security Risks , Security: The Top Concern for Cloud Users, Privacy and Privacy Impact Assessment, Trust, Operating System Security, Virtual Machine Security

Unit – V

Storage Systems Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., Apache Hadoop, *NoSQL* Databases

Unit – VI

Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance (GRC),Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

Text Books

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Recursive press
2. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
3. Michael Miller, Cloud Computing: "Web-Based Applications That Change the Way You Work and Collaborate Online",1st Edition, Pearson Education, New Delhi, 2009.
4. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.

Reference Book

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammarai selvi, TMH
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance , Tim Mather, O'Reilly Media

Reference Links:

1. http://nptel.ac.in/courses/106106129/28

Sensor Networks and Internet of Things
(Program Elective)

Subject Code: 22MCS1012

L	T	P	C
3	0	0	3

Course Objective

- To teach the concepts and working of Wireless Sensor networks, databases for sensor networks and Applications, Smart Objects and IoT Architectures, various IOT-related protocols, IoT Security and Vulnerability issues.

Course Outcome
After completion of this course, the Students will be able to:

1. Summarize the concepts and applications of Wireless Sensor Networks.
2. Discriminate various WSN routing protocols.
3. Explain Sensor Network Databases.
4. Understand Smart Objects and IoT Architectures.
5. Analyze Internet connectivity principles.
6. Assess IoT Security and Vulnerabilities Solutions.

Unit – I
Wireless Sensor Networks: Introduction, Advantages of Sensor Networks: Energy advantage, Detection advantage, Collaborative Processing, Sensor Network Applications.

Unit – II
Networking Sensors: Key assumptions, Medium Access Control: The S-MAC Protocol, IEEE 802.15.4 standard and ZigBee, Geographic Energy-Aware Routing: Unicast Geographic Routing, Routing on a Curve, Energy minimization Broadcast, Energy-Aware Routing to a Region.

Unit – III
Sensor Network Databases: Sensor database Challenges, High-Level database Organization, In-Network Aggregation, Data-Centric Storage, Distributed Hierarchical Aggregation, Temporal Data.

Unit – IV
Internet of Things: An Overview, IoT Conceptual Framework, IoT architectural view, Technology behind IoT, Sources of IOT, M2M communication, Examples of IoT.

Unit – V
Internet connectivity principles: Introduction, Internet connectivity, Internet-Based communication, IP addressing in the IoT, Media Access Control, Application layer Protocols.

Unit – VI
IoT Privacy, Security and Vulnerabilities Solutions: Introduction, Vulnerabilities Security Requirements and Threat Analysis, IoT security Tomography and Layered Attacker Model, Identity management and Establishment, Access control and Secure message communication.

Text books

1. Feng ZHAO, Leonidas GUIBAS, “Wireless Sensor Networks”, ELSEVIER, 2004.
2. Raj Kamal, “INTERNET OF THINGS”, McGraw Hill Education private Limited, 2017.

Reference books

1. Fei Hu, XiaojunCao, "Wireless Sensor Networks: Principles and Practice" , CRC Press, Taylor & Francis Group, 2010
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things –A hands-on approach", Universities Press, 2015

Web Links

1. *https://nptel.ac.in/courses/106105160/21*
2. *https://onlinecourses.nptel.ac.in/noc19_cs31*

Computer Vision and Image Processing
(Program Elective)

Subject Code: 22MCS1013

L	T	P	C
3	0	0	3

Course Objectives:

- Understand the geometric relationships between 2D images and the 3D world.
- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Hands-on experience in using computers to process images.
- Formulate solutions to general image processing problems
- Familiar with image manipulations and analysis

Course Outcomes:

After completion of this course, the Students will be able to:

1. Develop practical skills necessary to build computer vision applications.
2. Demonstrate different transformation of images
3. Apply spatial domain techniques for image enhancement.
4. List the Image Compression Techniques.
5. Implement Various Morphological Algorithms on binary images.
6. Classify Various Image Segmentation Techniques.

Unit – I

What is Computer Vision; Real-World Applications; Image formation model: sampling and quantization; aliasing;

Unit – II

2D Geometric transformations: Translation, Scaling and Rotation; Image Transforms: 2D-DFT and properties, Discrete Cosine Transform, Discrete Wavelet Transform

Unit – III

Enhancement Basic Transformations, Histogram processing, Subtraction and Averaging, Spatial Filtering: Smoothening & Sharpening.

Unit – IV

Image Compression: Redundancy & Remedy, Compression Models; LZW Coding, Bit-Plane Coding, JPEG std.

Unit – V

Image Morphology: Basic Operations, Dilation and erosion, opening and closing, Hit or Miss, Morphological algorithms- Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons.

Unit – VI

Segmentation: Detection of discontinuities- edge linking and boundary detection-Thresholding-based Region- Based Segmentation- Region growing, Region Splitting and Merging.

Text Books

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
2. Digital Image Processing – R.C. Gonzalez & R.E. Woods, Addison Wesley / Pearson Education, 3rd Edition, 2010.

Reference Books

1. S Jayaraman, S Esakkirajan, T Veerakumar, “Digital Image Processing”, 2011, Tata McGraw Hill.
2.E. R. Davies, “Computer Vision: Principles, Algorithms, Applications, Learning”, 5th edition, 2018, Elsevier

Natural Language Processing
(Program Elective)

Subject Code: 22MCS1014

L	T	P	C
3	0	0	3

Course Objectives

This course will enable students to

- Learn introduction to classical and modern techniques in NLP.
- Understand Word level analysis.
- Learn how to employ literary-historical NLP-based analytic techniques named entity recognition.
- Understand sentiment analysis and topic modelling.
- Introduction to text visualisation techniques and clustering the documents.
- Understand the use of Cross Lingual Information Retrieval (CLIR).

Course Outcomes

After completion of this course, the Students will be able to:

1. Describe the fundamental concepts and techniques of natural language processing.
2. Demonstrate N-Grams, TF-IDF and POS.
3. Illustrate how to collect data from social media, web and other sources using APIs, web-scraping.
4. Describe sentiment analysis and topic modelling.
5. Classify the text and visualisation.
6. Differentiate Multilingual and Cross Lingual Information Retrieval (CLIR).

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Unit – I

Introduction to NLP: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM, Tokenization, Morphology fundamentals, Morphology Paradigms.

Unit – II

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff -Word Classes, TF-IDF, Features, Word Vectors, Part-of-Speech Tagging, Rule-based, stochastic and Transformation-based tagging.

Unit – III

Data Collection and Software tools: Data Collection using API, Social Media, Web scraping; Software tools such as NLTK; Named EntityRecognition.

Unit – IV

Fundamentals of sentimental analysis and topic modeling: Sentiment Analysis; Block diagram of sentiment analysis, Applications, Topic Modeling, Goals of topic modeling; Stylometry.

Unit – V

Introduction to text classification and visualisation: Text classification, Text Visualization; Dendograms, PCA, Plotting the Text; Document Clustering;

Unit – VI

Machine Translation: Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

Text Books

1. Dan Jurafsky and James H. Martin. Speech and Language Processing (3rd ed. draft)
2.Jacob Eisenstein. Natural Language Processing
3.Delip Rao and Brian McMahan. Natural Language Processing with PyTorch

Reference Books

1.Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning

Reference Links

1. https://nptel.ac.in/courses/106/105/106105158/ A course on Nautrual Language Processing, by Prof. Pawan Agrawal, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/106/106106211/ A course on Applied Nautral Laguage Processing, Prof. Rameseshan Ramchandran, IIT Madras.

GPU Computing
(Program Elective)

Subject Code: 22MCS1015

L	T	P	C
3	0	0	3

Course Objective

- To learn parallel programming with Graphics Processing Units (GPUs).

Course outcomes

After completion of this course, the Students will be able to:

1. Develop parallel programs using Open CL library.
2. Analyze for the performance of GPU memory hierarchy.
3. Learn concepts in parallel programming, implementation of programs on GPUs, Debugging, and profiling parallel programs.
4. Generate parallel programs for matrix, graph and sorting problems using Cuda library.
5. Develop mixed mode programs for Multi-core and GPGPU systems.
6. Compare the performance of different algorithms for the numerical and data processing problems on GPU and suggest methods for improving the performance.

Unit – I

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.

Unit – II

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.

Unit – III

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.

Unit – IV

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.

Unit – V

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning.

Unit – VI

Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing.

Text Books:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

Reference Books:

1. Benedict R Gaster, Lee Howes, David R Kaeli Perhaad Mistry Dana Schaa, *Heterogeneous Computing with OpenCL*, MGH, 2011.
2. Jason Sanders, Edward Kandrot, *CUDA By Example – An Introduction to General-Purpose GPU Programming*, Addison Wesley, 2011.
3. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, TMH, 2004.

Block Chain Technology
(Program Elective)

Subject Code: 22MCS1016

L	T	P	C
3	0	0	3

Course Objective

- To understand the technology behind blockchain
- To comprehend the issues related to blockchain
- To study the real-world applications of blockchain

Course Outcomes
After completion of this course, the Students will be able to:

1. Understand the requirements of the basic design of blockchain
2. Identify the need of blockchains to find the solution to the real-world problems
3. Summarize the working of blockchain
4. Recognize the underlying technology of transactions, blocks, proof-of-work, and consensus building
5. Design and implement new ways of using blockchain for applications other than crypto currency
6. Categorize and implement the various platforms

Unit – I
Introduction: Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchainstack, benefits and challenges

Unit – II
Blockchain: How do they work? What is a Blockchain? Public Ledgers, Blocks in a Blockchain, Blockchain as public ledgers, Transactions, Distributed consensus. Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory

Unit – III
Blockchain Architecture and Use cases: Design methodology for Blockchain applications, Blockchain application templates, Blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems

Unit – IV
Smart contracts: Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mist wallet, smart contract examples, smart contract patterns

Decentralized applications (Dapps) Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps

Unit – V
Advanced topics: Byzantine fault tolerance, proof-of-work vs proof-of-stake, Security and Privacy of Blockchain, smart contract vulnerabilities, Scalability of Blockchain

Unit – VI
Blockchain for real-world applications: Manufacturing and production, supply chain management, logistics and transportation, Internet of things, e-voting, healthcare, product life cycle, knowledge and innovation management, new business models and applications

Text Book

1. Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.

Reference Books:

1. Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2. Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3. Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017, The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology,William Mougayar, Wiley, 2016.
4. Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.

Big Data Analytics
(Program Elective)

Subject Code: 22MCS1017

L	T	P	C
3	0	0	3

Course Objective

- Understand big data for business intelligence. Learn business case studies for big data analytics. Understand no SQL big data management. Perform map-reduce analytics using Hadoop and related tools

Course Outcomes

After completion of this course, the Students will be able to:

1. Describe big data and use cases from selected business domains
2. Explain NoSQL big data management
3. Install, configure, and run Hadoop and HDFS
4. Perform map-reduce analytics using Hadoop
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
6. Analyze MAP-REDUCE programming model for better optimization

Unit – I

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

Unit – II

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peerpeer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Unit – III

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

Unit – IV

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

Unit – V

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.

Unit – VI

Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Text Books

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
6. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
7. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
9. Alan Gates, "Programming Pig", O'Reilley, 2011.

Software Testing Methodologies
(Program Elective)

Subject Code: 22MCS1018

L	T	P	C
3	0	0	3

Course Objectives:

- To discuss the distinctions between testing and defect testing.
- To describe the principles of different testing techniques.
- To describe domain and interface testing.
- 4 .To understand the path product and regular expressions.
- Methods and tools of logic based testing and state graph.
- To describe graph matrix and its applications.

Course Outcomes:
After completion of this course, the Students will be able to:

1. Classify different types of bugs and able to explain the purpose of testing.
2. Identify& differentiate transaction flow, dataflow in a better way during testing .
3. Explain Nice and ugly domains.
4. Calculate the mean processing time and weight.
5. Identify the states of a product whether good or bad.
6. Design optimal graph with node reduction procedure.

Unit – I
Introduction : Purpose of Testing, Dichotomies, Model for Testing, Consequences of Bugs, Taxonomy of Bugs , Flow Graphs and Path testing : Basics concepts of Path Testing, Predicates, Path Predicates and Achievable Paths, Path Sensitizing, Path Instrumentation, Application of Path Testing.

Unit – II
Transaction Flow Testing : Transaction Flows, Transaction Flow Testing Techniques.
Dataflow Testing:- Basics Of Dataflow Testing, Strategies in Dataflow Testing, Application of Dataflow Testing.

Unit – III
Domain Testing: Domains and Paths, Nice & Ugly Domains, Domain Testing, Domains and Interfaces Testing, Domains and Testability.

Unit – IV
Paths, Path products and Regular expressions : Path Products & Path Expression, Reduction Procedure, Applications, Regular Expressions & Flow Anomaly Detection.

Unit – V
Logic Based Testing : Overview, Decision Tables, Path Expressions, KV Charts, Specifications.
State, State Graphs and Transition Testing : State Graphs, Good & Bad State Graphs, State Testing, Testability Tips.

Unit – VI
Graph Matrices and Application : Motivational overview, Matrix of graph, Relations, Power of a Matrix, Node Reduction Algorithm, Building Tools.

Text Books
1. Software Testing techniques - Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech. second edition.

Reference Books

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille)
3. Software Testing in the Real World – Edward Kit, Pearson.

Optimization Techniques
(Program Elective)

Subject Code: 22MCS1019

L	T	P	C
3	0	0	3

Course Outcomes
After completion of this course, the Students will be able to:

1. Student can able to building with their day to day applications with Optimization methods.
2. Student should be able to understand and apply the concept of optimized search methods.
3. Student should be able to understand and implement the concept of Learning Programming algorithms.
4. Student should be able to identify the feasible solution with transportation problems.
5. Student should be able to model engineering minima/maxima problems as optimization problems.
6. Student should be able to implement optimization algorithms.

Unit – I
Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

Unit – II
Multi variable non-linear unconstrained optimization: Direct search method – Uni-variant method – pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

Unit – III
Linear Programming: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system

Unit – IV
Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. (Including assignment and travelling salesman problems) (No degeneracy problems)

Unit – V
Integer Programming: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method Stochastic programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co-variance, joint probability distribution- stochastic linear, dynamic programming.

Unit – VI
Geometric Programming: Polynomials – arithmetic – geometric inequality – unconstrained G.Pconstrained G.P (<= TYPE ONLY) Non-traditional optimization Techniques: Genetic Algorithms-Steps-Solving simple problems Comparisons of similarities and dissimilarities between traditional and non-traditional techniques-Particle Swarm Optimization (PSO)-Steps(Just understanding)- Simulated Annealing-Steps-Simple problems.

Text Books:

1. Optimization for Engineering Design: Algorithms and Examples 2nd Edition – 2012 by K. Deb PHI publications 2012.
2. Engineering Optimization: Theory and Practice, Fourth Edition by Singiresu S. Rao Copyright © 2009 by John Wiley & Sons, Inc

Reference Books:

1. Methods of Optimization by GR WALSH 1st Edition Wiley-Blackwell (1975) ISBN-13: 978-0471919247.
2. An Introduction to Optimization, 2ed by Stanislaw, H. Zak Edwin K.P. Chong WILEY 2010.
3. Model Building in Mathematical Programming by H. Paul Williams (Author) 5th Edition Copy Right WILEY 2013.
4. Discrete Optimization (Computer Science and Scientific Computing) Kindle Edition by R. Gary Parker , Ronald L. Rardin
5. Integer and Combinatorial Optimization 1st Edition by Laurence A. Wolsey , George L. Nemhauser Publisher: Wiley-Interscience; 1 edition (1999) ISBN-13: 978-0471359432.

Industrial Safety
(Open Elective)

Subject Code: 22MOE1001

L	T	P	C
3	0	0	3

Course Outcomes:
After completion of this course, the Students will be able to:

1. Understand the types, causes and preventive steps of mechanical and electrical hazards.
2. Identify types of maintenance and apply relevant tools of maintenance.
3. Understand the types, causes, applications of wear and types and prevention methods of corrosion
4. Understand the concepts of fault tracing and decision tree for different machine tools
5. List the applications of periodic maintenance.
6. Illustrate the applications of preventive maintenance.

Unit – I
Industrial safety Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and
safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

Unit – II
Fundamentals of maintenance engineering Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit – III
Wear and Corrosion and their prevention Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit – IV
Fault tracing Fault tracing-concept and importance, decision tree concept, need and applications,
sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit – V
Periodic and preventive maintenance Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

Unit – VI

Procedure for periodic and preventive maintenance Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research
(Open Elective)

Subject Code: 22MOE1002

L	T	P	C
3	0	0	3

Course Outcomes
After completion of this course, the Students will be able to:

1. Formulate, solve linear programming problem using graphical and simplex method along with its Big-M and 2-Phase variations.
2. Solve both balanced and unbalanced transportation and assignment problems.
3. Students should able to apply the concept of non-linear programming
4. Compute queue performance characteristics for various queuing models.
5. Solve game theory problems by applying standard solution methods.
6. Calculate critical path for a given network using PERT and CPM techniques.

Unit – 1
Linear Programming: Introduction to linear programming problem formulation, Graphical solution, Simplex method, Artificial variables techniques, Degeneracy.

Unit – II
Transportation Problem: Formulation, Optimal solution, unbalanced transportation problems, Degeneracy.

Assignment Problem: Formulation, Optimal solution, Traveling salesman problem.

Unit - III
Nonlinear Programming Problems: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem.

Unit – IV
Queuing Theory: Characteristics of Queuing models, Classification, (M/M/1):(FCFS/∞/∞), (M/M/1):(FCFS/N/∞), (M/M/C):(FCFS/∞/∞) models.

Unit – V
Theory of Games: Introduction, Two-person Zero-sum games, Maximum-Minimax principle, Games without saddle points, Mixed Strategies, m x 2 & 2 x n games, Graphical solutions, Dominance property, Algebraic solutions to rectangular games.

Unit – VI
Network models: Project network, CPM and PERT, Critical path scheduling, Cost considerations in project scheduling.

Text Books:

1. Introduction to Operations Research by Prem Kumar Gupta, D.S. Hira, S. Chand Publishers
2. Operations Research, S.D.Sharma, Kedarnath Ramanadh Pub.

References Books:

1. Operations Research, J.K. Sharma, MacMilan Pub.
2. Operations Research by P. Rama Murthy, New Age Pub.
3. CPM & PERT, L.S. Srinath, Affiliated East West Press Pu

Composite Materials
(Open Elective)

Subject Code: 22MOE1003

L	T	P	C
3	0	0	3

Course Outcomes:
After completion of this course, the Students will be able to:

1. Illustrate the concept and classification of composites
2. Understand fundamental fabrication processes for polymer matrix,
3. Analyze the strengthening mechanism and structural effect on properties of composite materials.
4. Understand the fundamental concepts of metal matrix, and ceramic matrix composites
5. Understand and Predict elastic properties of long fiber and short fiber composites.
6. Design different types of composite by apply the micromechanics principles.

Unit – I
Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit – II
Reinforcements and the reinforcement matrix interface: natural fibers; synthetic organic fibers – aramid, polyethylene; and synthetic inorganic fibers – glass, alumina, boron, carbon, silicon based fibers; particulate and whisker reinforcements, reinforcement-matrix interface – wettability, interfacial bonding, and methods for measuring bond strength.

Unit – III
Metal Matrix Composites: Introduction, important metallic matrices; metal matrix composite processing: solid state processing – diffusion bonding, powder metallurgy; liquid state processing – melt stirring, compocasting (rheocasting), squeeze casting, liquid infiltration under gas pressure; deposition – spray co-deposition and other deposition techniques like CVD and PVD; in situ processes. Interface reactions.

Properties of MMCs – physical properties; mechanical properties like elastic properties, room temperature strength and ductility, properties at elevated temperatures, fatigue resistance.

Unit – IV
Ceramic Matrix Composites: Introduction; processing and structure of monolithic materials – technical ceramics, glass-ceramics. Processing of ceramics: conventional mixing and pressing – cold pressing and sintering, hot pressing, reaction bonding processes, techniques involving slurries, liquid state processing – matrix transfer moulding, liquid infiltration, sol-gel processing, vapour deposition techniques like CVD, CVI, liquid phase sintering, lanxide process and in situ processes. Processing, properties and applications of alumina matrix composites - SiC whisker reinforced, zirconia toughened alumina; Glass-ceramic matrix composites; Carbon-carbon composites - porous carbon-carbon composites, dense carbon-carbon composites.

Unit – V
Polymer Matrix Composites: Introduction; polymer matrices – thermosetting, thermoplastic, rubbers. Processing of PMCs , Processing, properties and applications of fibre-reinforced

epoxies, PEEK matrix composites, rubber matrix composites. Damping characteristics. Environmental effects in polymer matrix composites. Recycling of PMCs.

Unit – V

Micromechanics of unidirectional composites: micromechanics models for stiffness – longitudinal stiffness, transverse stiffness, shear modulus, Poisson's ratio.

Text Books:

1. Composite Materials: Engineering and Science, by Matthews and Rawlings, CRC Press.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Reference Books:

1. Composite Materials Science and Engineering, K.K.Chawla, Springer.
2. An Introduction to composite material, by D.Hull and T.W. Clyne, Cambridge University press.
3. Metal Matrix Composites, Thermomechanical Behaviour by M.Taya, and R.J.Arsenault, Pergamon Press, Oxford.
4. Fundamentals of Metal Matrix Composites by S.Suresh, A.Martensen, and A.Needleman, Butterworth, Heinemann
5. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.

Waste to Energy
(Open Elective)

Subject Code: 22MOE1004

L	T	P	C
3	0	0	3

Course Objective:
To deal with various types of wastes generated in the contemporary world and technological options of their exploitation for obtaining useful energy, minimization of wastes.

Course Outcomes:
At the end of the course, students will be able to:

1. Diagnosis the different wastes and their conversion devices.
2. Assess the diverse pyrolysis types of biomass and production methods of different fuel oils.
3. Evaluate the gasification methods of biomass, their design, construction and operation.
4. Suggest the combustion processes of biomass, their design, construction and operation.
5. Analyze the types of biogas plants.
6. Design and develop the biomass conversion processes.

Unit – I
Introduction to Energy from Waste: Classification and Characterization of waste as fuel – Agro based, Forestresidue, Industrial waste – Municipal Solid Waste Conversion devices – Incinerators, gasifiers, digesters.

Unit – II
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications- Oil from waste plastics - Alcohol production from biomass - Bio diesel production.

Unit – III
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit – IV
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs,fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit – V
Biogas: Properties of biogas (Calorific value and composition) - Types of biogas Plants – Applications - Technologyand status of Biogas plants - Bio energy system - Design and constructional features - Biomass energy program in India.

Unit – VI
Biomass: Biomass resources and their classification - Biomass conversion processes – Thermo-chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Urban waste to energy conversion.

Text Books

1. Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store - Reprint - 2011.
2. Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons – Reprint - 1987.
3. Harker, J.H. and Backhusrt, J.R., "Fuel and Energy", Academic Press Inc – Reprint - 1981.
4. EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science – Reprint - 1984.

References Books

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
4. Mondal, P. and Dalai, A., “Utilization of natural resources”, CRC Press – Published – 2017.
5. Young G.C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons – Reprint – 2010.

Machine Learning Lab

Subject Code: 22MCS1103

L	T	P	C
0	0	4	2

Course objectives

This course will enable students to

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice.

List of Experiments

1. The programs can be implemented in either JAVA or Python.
2. For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.
3. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

1. Implement and demonstratethe **FIND-Salgorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm**to output a description of the set of all hypotheses consistent with the training examples.

3. Write a program to demonstrate the working of the decision tree based **ID3 algorithm**. Use an appropriate data set for building the decision tree and apply this knowledge toclassify a new sample.

4. Build an Artificial Neural Network by implementing the **Backpropagation algorithm** and test the same using appropriate data sets.

5. Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the **naïve Bayesian Classifier** model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8. Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using ***k*-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9. Write a program to implement ***k*-Nearest Neighbour algorithm** to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.