R.V.R.&J.C.COLLEGEOFENGINEERING
(Autonomous)

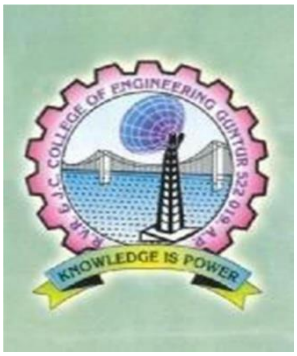
Regulations(R-21)

Scheme of Instruction, Examinations and Syllabi for

Two–year M.Tech. Degree Programme

IN

ARTIFICIAL INTELLIGENCE & DATA SCIENCE
(w.e.f. 2024-2025)



INFORMATION TECHNOLOGY
R.V.R.&J.C. COLLEGE OF ENGINEERING
Accredited by NBA and NAAC with "A" Grade
Chowdavaram, Guntur- 522019

R.V.R. & J.C. COLLEGE OF ENGINEERING :: GUNTUR
(Autonomous)

CHOICE BASED CREDIT SYSTEM REGULATIONS (R-21) for

2-YEAR MASTER OF TECHNOLOGY (M.Tech.) Degree Program

(w.e.f. the batch of students admitted into First Year M.Tech. from the academic year 2024-25)

1 MINIMUM QUALIFICATIONS FOR ADMISSION

The eligibility criteria for admission into M.Tech. Programme is as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE), Amaravati.

1.1 Category – A Seats: The seats under this category shall be filled by the Convener, PGCET Admissions.

1.2 Category – B Seats: The seats under this category shall be filled by the College as per the guidelines of APSCHE.

2 COURSES OF STUDY

M.Tech. Courses are offered in the following branches of study:

Branch of Engineering	Specialization Offered
Civil Engineering	Structural Engineering
Computer Science & Engineering	Computer Science and Engineering.
Electrical & Electronics Engineering	Power Systems Engineering.
Electronics & Communication Engineering	Communication Engineering & Signal Processing
Information Technology	Artificial Intelligence & Data Science
Mechanical Engineering	Machine Design

3 DURATION OF THE COURSE AND MEDIUM OF INSTRUCTION

3.1 The duration of the course is two academic years consisting of two semesters in each academic year.

3.2 The medium of instruction and examination is English.

4 MINIMUM INSTRUCTION DAYS

Each semester shall consist of a minimum number of 90 days of instruction excluding the days allotted for tests, examinations and preparation holidays.

5 REGISTERING THE COURSES OFFERED

5.1 A candidate has to register and secure 68 credits out of which 30 credits from laboratory courses including project work.

5.2 The structure of the M.Tech. Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects + 4 Labs (or) 3 Labs + 1 Seminar (or) 2 Labs + 2 Seminars, followed by two semesters of Dissertation.

5.3 A candidate has to register and secure at least minimum pass grade in Research Methodology & IPR Course in I Year II Semester, for which no credit is awarded.

5.4 MOOCS (Massive Open Online Courses) Requirements.

- Enrolment of MOOCS Course will be initiated from the date of commencement of class work for I Year I Semester.
- MOOCS course completion certificate of duration not less than 8 weeks, must be submitted on or before the last instruction day of II Year I Semester, for which 2 Credits will be awarded. The Grade is awarded based on the marks obtained in the MOOCS performance.
- List of organizations offering MOOCS course(s) will be announced by the respective Board of Studies at the time of commencement of class work for I Year I Semester.

5.5 Internship / Industrial Training / Professional Certification:

- Internship / Industrial Training / Professional Certification should be taken up during the summer holidays for a period of 4-8 weeks.
- Internship / Industrial Training / Professional Certification completion certificate must be sub- mitted along with a report and presentation during the II Year I Semester Internal evaluation.

5.6 Dissertation shall be carried out under the Supervision of a Faculty Member in the concerned department.

- A student may, however, in certain cases, be permitted to work on his/her dissertation at the place of employment, any recognized Institution / R&D Organization / Industry with the approval of the Head of the Department concerned and Head of the Organization / Industry. In such cases, the dissertation shall be jointly supervised by a member of the faculty and a person from the Organization / Industry.
- The student is eligible for submission of M.Tech., dissertation report at the end of the II Year II Semester if he/she passed all the credit courses in the previous semesters.
- In a special case, if any student unable to submit his/her dissertation report at the end of II Year II Semester due to any other reason permitted by the head of the institution, he/she will be allowed to submit at a later date and the viva-voce examination will be conducted separately.

5.7 The student has to publish (or) get acknowledgement for acceptance of publication in at least one paper in a Conference / peer reviewed Journal related to his / her work to get eligibility to submit the Dissertation.

6 EVALUATION

6.1 The performance of the student in each semester is evaluated subject wise. In each Semester, there shall be two Internal Examinations consists of a Sessional Test for 30 Marks and an Assignment for 10 Marks. The semester end examination is conducted for 60 marks. The Internal Evaluation for Theory subjects is based on the 80% (24 out of

30 marks) weightage given to the best of the performances and the remaining 20% (6 out of 30 marks) for the least performance, in the two midterm examinations one held in the middle of the semester and the other held immediately after the completion of the instruction. The internal evaluation for practical subjects is based on the day to day performance and semester end internal practical Examination.

6.2 The marks for Seminar will be awarded by internal evaluation by a panel of the department.

6.3 For taking the Semester end examination in any theory or practical subject, students shall be required to obtain a minimum of 50% marks in Internal evaluation in that subject failing which he / she is required to repeat the subject when next offered.

6.4 For each theory subject, there is a comprehensive Semester End Examination at the end of each Semester. In addition to the regular semester end examinations held at the end of each semester, supplementary examinations will also be conducted during the academic year. Such candidates taking the Regular/ Supplementary examinations as supplementary candidates may have to take more than one examination per day.

6.5 For each Practical course the Semester End Examination is conducted by one internal and one external examiner appointed by the Principal of the College. The duration of the examination is specified in the detailed Schemes of Instruction & Examination.

6.6 Examination in Dissertation (Phase-II) is conducted by one internal examiner and one external examiner appointed by the Principal.

6.7 The performance of the students in each semester is evaluated subject wise. The distribution of marks between internal assessment and Semester End Examination is as follows:

Nature of the subject	Sessional Marks	Semester End Exam. Marks
Theory subjects	40	60
Practical's	40	60
Seminar / Internship / Mini Project / Professional Certification / Dissertation (Phase-I)	100	–
Dissertation (Phase-II)	40	60

7 LABORATORY / PRACTICAL COURSES

In any semester, a minimum of 10 experiments / exercises specified in the syllabus for laboratory course shall be completed by the student and get the record certified by the concerned Head of the Department, to be eligible to appear for the Semester End Examination in that Practical course.

8 ATTENDANCE

8.1 The student shall put up a minimum of 75% attendance in each subject.

8.2 Condonation for shortage in attendance up to 10% in any subject may be condoned by the Principal of the College for reasons of ill health and the application is submitted through proper channel at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.

8.3 If the student does not satisfy the attendance requirement in any subject, he or she shall not be permitted to appear for the Semester End examination in that subject and has to repeat that subject when next offered.

9 CONDITION(S) FOR PROMOTION

A student is eligible for promotion to next semester, if he / she satisfies the minimum requirements of attendance and sessional marks in 50% of the Theory Subjects, as stipulated in Clauses 6 and 8.

10 CONDITIONS FOR PASS

A student is declared to have passed in individual subject if he / she secures a minimum of 40% marks in theory and 50% marks in Laboratory / Project Work in Semester End Examination and a minimum of 50% marks in both Sessional & Semester End Examination put together.

11 AWARD OF CREDITS

Credits are awarded for each Theory / Practical / Internship / Professional Certification / Seminar / Dissertation / MOOCS. Each theory subject is awarded 3 credits and each practical / Internship / Professional Certification Seminar / MOOCS subjects are awarded 2 credits. Dissertation (Phase-I) in II Year I Semester is awarded 6 credits and Dissertation (Phase-II) at the end of II Year II Semester is awarded 14 credits.

11.1 AWARD OF GRADES

S.No.	Range of marks	Grade	Grade Points
1.	≥90%	A+	10.0
2.	> 80% -< 90%	A	9.0
3.	> 70% -< 80%	B+	8.0
4.	> 60% -< 70%	B	7.0
5.	> 55% -< 60%	C	6.0
6.	> 50% -< 55%	D	5.0
7.	≤49%	F	0.0
8.	The grade 'W' represents withdrawal /absent (subsequently changed into pass or C to O or F grade in the same semester)	W	0.0

11.2 A candidate securing 'F' grade in any course there by securing zero grade points has to reap- pear and secure at least 'C' grade in the subsequent examinations for that course.

11.3 After each semester, Grade sheet will be issued which will contain the following details:

- The list of courses for each semester and corresponding credits and grades obtained
- The Semester Grade Point Average (SGPA) for each Semester and
- The Cumulative Grade Point Average (CGPA) of all courses put together up to that semester. SGPA is calculated based on the following formula:

$$\frac{\sum[No.of credits \times Gradepoints]}{\sum No.of credits}$$

CGPA will be calculated in a similar manner, considering all the courses up to that semester.

11.4 A consolidated Grade Sheet shall be issued to the candidate, after completing all, indicating the CGPA of all the Two years put together.

11.5 Conversion of CGPA into equivalent Percentage of marks:

Percentage of Marks = (CGPA-0.50) x 10.

12 ELIGIBILITY FOR AWARD OF M.TECH. DEGREE

The M.Tech. Degree shall be conferred on a student who satisfies the following requirements:

12.1 The student who satisfies the conditions for pass in all the subjects including labs of all the years as stipulated in Clauses 10.

12.2 Maximum Time Limit for completion of M.Tech Degree: A candidate, who fails to fulfil
all the academic requirements for the award of the degree within four academic years from the year of admission, shall forefeit his/her seat in M.Tech. Degree.

13 AWARD OF CLASS

A student who becomes eligible for the award of M.Tech. Degree as stipulated in Clause 11shall be placed in one of the following Classes.

S.No	Class	CGPA
1	First Class With Distinction	7.5 or more
2	First Class	6.5 or more but less than 7.5
2	Second Class	5.5 or more but less than 6.5
3	Pass Class	5.0 or more but less than 5.5

14 AWARD OF RANK

The rank shall be awarded based on the following:

14.1 Ranks shall be awarded in each branch of study for the top ten percent of the students appearing for the Regular Semester End Examinations or the top two students whichever is minimum.

14.2 The Rank shall be awarded only to those students who completes their degree within two academic years.

14.3 For the purpose of awarding rank in each branch, only such students who passed all subjects in the first attempt shall be considered.

15 TRANSITORY REGULATIONS

15.1 A student, studied under R-17 regulations of RVR & JCCE (Autonomous) curriculum and discontinued the I Year I Semester course, shall join in I Year I Semester of R-21 regulations.

15.2 A student, studied under R-17 regulations of RVR & JCCE (Autonomous) curriculum and discontinued the I year II Semester course and also at the subsequent semesters will follow the same R-17 regulations/ curriculum and he / she has to complete the subject by appearing the examinations conducted by the college under R-17 curriculum.

16 CONDUCT AND DISCIPLINE

16.1 Candidates shall conduct themselves within and outside the premises of the institute in a manner befitting the candidates of our institution.

16.2 As per the order of Hon'ble Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

16.3 The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

a) Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.

b) Willful damage of college / individual property.

c) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallu-cinogenic drugs.

d) Mutilation or unauthorized possession of library books.

e) Noisy and unseemly behavior, disturbing studies of fellow candidates.

f) Hacking of computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber- crime etc.)

g) Usage of camera / cell phone in the campus

h) Plagiarism of any nature

i) Any other acts of gross indiscipline as decided by the academic council from time to time.

16.4 Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary.

16.5 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.

16.6 Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.

16.7 All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.

16.8 The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

16.9 The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the programmes committee in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

16.10 "Grievance and Redressal Committee" (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

17 MALPRACTICES

17.1 The Principal shall refer the cases of malpractices in internal assessment tests and semester- end examinations to a malpractice enquiry committee constituted by him / her for the purpose. Such committee shall follow the approved scales of punishment. The principal shall take necessary action, against the erring candidates basing on the recommendations of the committee.

17.2 Any action on the part of a candidate during an examination trying to get undue advantage or trying to help another, or drive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the staff, who are in-charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading in- formation) that infringe upon the course of natural justice to one and all concerned in the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

18 AMENDMENTS TO REGULATIONS

The College may, from time to time, revise, amend, or change the Regulations, Schemes of Examinations, and / or Syllabus.

Department of Information Technology

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

(w.e.f. the batch of students admitted from the academic year 2024-2025)

Scheme(R21)

I YEAR I Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD511	Advanced Data Structures and Algorithms	3		40	60	3	100
2	AD512	Principles of Artificial Intelligence	3		40	60	3	100
3	AD513	Introduction to data Science	3		40	60	3	100
4	AD514	Professional Elective-I	3		40	60	3	100
5	AD515	Professional Elective-II	3		40	60	3	100
6	AD516	Professional Elective-III	3		40	60	3	100
7	AD551	Advanced Data Structures and Algorithms Lab		4	40	60	2	100
8	AD552	Artificial Intelligence and Machine Learning Lab		4	40	60	2	100
		Total	**18**	**8**	**320**	**480**	**22**	**800**

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

I YEAR II Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD521	Advanced Java Programming	3		40	60	3	100
2	AD522	Generative AI	3		40	60	3	100
3	AD523	Data Visualization and Interpretation	3		40	60	3	100
4	AD524	Professional Elective-IV	3		40	60	3	100
5	AD525	Professional Elective-V	3		40	60	3	100
6	AD526	Professional Elective-VI	3		40	60	3	100
7	AD561	Advanced Java Programming Lab		4	40	60	2	100
8	AD562	Data Visualization Lab		4	40	60	2	100
9	MC01	Research Methodology and IPR	3		100	-	-	100
		Total	**21**	**8**	**420**	**480**	**22**	**900**

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

II YEAR III Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD611	MOOCS	-	-	-	100	2	100
2	AD651	Internship	-	-	100	-	2	100
3	AD652	Dissertation Phase-I	-	-	100	-	6	100
		Total	-	**-**	**200**	**100**	**10**	**300**

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

II YEAR IV Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD661	Dissertation Phase-II	-	-	40	60	14	100
		Total	-	**-**	**40**	**60**	**14**	**100**

M.Tech (Artificial Intelligence & Data Science)
List of Electives

Professional Electives List	
Course Code	**Courses**
ADEL01	Statistics with R
ADEL02	Statistical Foundations For Data Science
ADEL03	Artificial Neural Networks
ADEL04	Machine Learning
ADEL05	Natural Language Processing
ADEL06	Computer Vision
ADEL07	Soft Computing
ADEL08	Reinforcement Learning
ADEL09	Big Data Analytics
ADEL10	Deep Learning
ADEL11	Optimization Techniques for Data Analysis
ADEL12	Data Science Applications of NLP
ADEL13	Generative AI Tools & Techniques
ADEL14	Virtual and Augmented Reality
ADEL15	Scalable Algorithms for Data Analysis
ADEL16	Web Mining and Social Network Analysis
ADEL17	Quantum Computing

ADEL18	Visual Recognition
ADEL19	Edge AI
ADEL20	Responsible AI
ADEL21	Optimization Techniques in Machine Learning
ADEL22	Information Retrieval
ADEL23	Image and Video Analytics
ADEL24	Industry Recommended Elective

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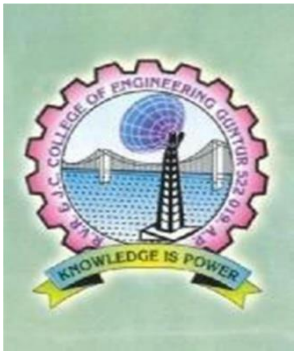

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M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

I YEAR II Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD521	Advanced Java Programming	3		40	60	3	100
2	AD522	Generative AI	3		40	60	3	100
3	AD523	Data Visualization and Interpretation	3		40	60	3	100
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M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

II YEAR III Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD611	MOOCS	-	-	-	100	2	100
2	AD651	Internship	-	-	100	-	2	100
3	AD652	Dissertation Phase-I	-	-	100	-	6	100
		Total	-	**-**	**200**	**100**	**10**	**300**

M.Tech.(ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

II YEAR IV Semester

S.No	Code	SUBJECT	Scheme of Instruction periods per week		Scheme of Examination			Total
			Theory	Lab	Internal Marks	Semester End Exam Marks	Credits	
1	AD661	Dissertation Phase-II	-	-	40	60	14	100
		Total	-	**-**	**40**	**60**	**14**	**100**

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ADEL13	Generative AI Tools & Techniques
ADEL14	Virtual and Augmented Reality
ADEL15	Scalable Algorithms for Data Analysis

ADEL16	Web Mining and Social Network Analysis
ADEL17	Quantum Computing
ADEL18	Visual Recognition
ADEL19	Edge AI
ADEL20	Responsible AI
ADEL21	Optimization Techniques in Machine Learning
ADEL22	Information Retrieval
ADEL23	Image and Video Analytics
ADEL24	Industry Recommended Elective

AD 511	Advanced Data Structures and Algorithms	L	T	P	C	Int	Ext
	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. Fundamentals of analysis of algorithm at depth.
2. Study of advanced data structures and its uses.
3. Analysis of problems from different domains

Course Outcomes: After successful completion of this course, students are able to
1. Identify and use suitable data structures for given problem from different domains
2. Appreciate the role of Linked List algorithms in solving variety of problems
3. Appreciate the role of Optimization by using linear programming
4. Analyze the various algorithms from different domains.
5. Understand the importance of advanced algorithms and techniques.

UNIT- I [CO 1] [10 Periods]
Data Structures: Introduction, Algorithm Analysis: Asymptotic Notations.
Linked List: Introduction, operations on linked lists, applications of linked lists
Stack and Queue: Introduction, Array Representation of Stack, Linked List Representation of stack, Application of stack, Queue, Array Representation of Queue, Linked List Representation of Queue.

UNIT- II [CO 2] [10 Periods]
Trees: Definitions and Concepts, Representations of Trees, Tree Traversal, Binary Search Tree(BST): Representation, Operations on BST.
Graphs: Representations and Traversal Techniques, Hashing: hash functions, Collision resolution techniques.

UNIT- III [CO 3] [10 Periods]
Divide and Conquer: General Method, Merge sort, Quick sort,
Greedy Method: Knapsack Problem, Spanning Trees, Single Source Shortest Path.

UNIT- IV [CO 4] [10 Periods]
Dynamic Programing: Multi stage Graph, All pair shortest paths algorithm, Single Source Shortest Problem, 0/1 Knapsack Problem, String editing, Travelling Sales Person Problem.

UNIT- V [CO 5] [10 Periods]
Backtracking: N-Queen Problem, Graph coloring, Knapsack problem
Branch and Bound: 15 puzzle problem, 0/1 Knapsack problem, Travelling sales person problem

Text Book(s)::
1. Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed. “Fundamentals of Data structures in C”, Second Edition, University Press, 2008(UNIT I & II).
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. “Fundamentals of computer algorithms”, Second Edition Galgotia Publications. (UNIT III, IV & V)

References Book(s)::
1. Robert Sedgewick Philippe Flajolet, “An Introduction to the Analysis of Algorithms”, First Edition,
2. G.A.V. Pai, “Data Structures and Algorithms”, TMH, 2009

AD 512	Principles of Artificial Intelligence	L	T	P	C	Int	Ext
	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the course the students will understand
1.To present fundamental concepts and problem solving methodologies of artificial intelligence.
2.To learn various search strategies and game playing methods
3.To describe logical representation of natural language sentences.
4.To present various knowledge representation strategies.

Course Outcomes: After successful completion of this course, students are able to
1. Explain the fundamental concepts of artificial intelligence and state space representation of aproblem.
2.Apply heuristic search techniques for solving simple AI problems and game playing strategies.
3. Inferring new knowledge using forward/ backward reasoning for the given natural language sentences .
4. Expain various knowledge representation techniques.

UNIT- I [CO 1] [10 Periods]
Introduction to Artificial Intelligence: Introduction, Brief History, Intelligent Systems, Foundations of AI, Sub-areas of AI, Applications, Tic-Tac-Toe Game Playing, Development of AI Languages, Current Trends in AI.
Problem Solving: State Space Search and Control Strategies: Introduction, General Problem Solving, Characteristics of Problem.

UNIT- II [CO 2] [12 Periods]
Search Techniques: Exhaustive Searches, Heuristic Search Techniques, Iterative Deepening A*, Constraint Satisfaction.
Problem Reduction and Game Playing: Introduction, Problem Reduction, Game Playing, Bounded Look-Ahead Strategy and Use of, Alpha- Beta Pruning, Two-Player Perfect Information Games.

UNIT- III [CO 3] [12 Periods]
Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Proportional Logic, Predicate Logic, Logic Programming..

UNIT- IV [CO 4] [10 Periods]
Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT- V [CO 4] [10 Periods]
Advanced Knowledge Representation Techniques: Introduction, Conceptual Dependency theory, Script Structure, CYC Theory, Case Grammars, and Semantic Web

Text Book(s):
1. Saroj Kaushik, Artificial Intelligence, CENGAGE Learning.

Reference Book(s):
1. Stuart Russel and Peter Norvig, Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education/ PHI.
2. Elaine Rich & Kevin Knight, Artificial Intelligence, Pearson Education.

AD 513	Introduction to Data Science	L	T	P	C	Int	Ext
	I Year I Semester	3	-	-	3	40	60

Course Objectives: At the end of the course the students will understand
1. Fundamental concepts and architectures of database system
2. To impart features and design of conceptual and relational data models
3. The data science fundamentals and process.
4. The importance of choosing correct algorithms and data structures for handling large amounts of data
5. To analyze text mining techniques for handling large volumes of data and visualize the data.

Course Outcomes: After successful completion of this course, students are able to
1. Discuss the fundamental concepts and architecture of database systems and data models
2. Use relational query languages and SQL for querying the database.
3. Illustrate and explain the various stages of data science.
4. Implement distributing data storage and processing frameworks and identifying the differences between NoSQL and relational databases
5. Apply the data and text mining models to solve problems by extracting knowledge from data

UNIT- I [CO 1] [10 Periods]

Introduction to Databases: Introduction - An Example - Characteristics of the Database Approach - Actors on the Scene - Workers behind the Scene - Advantages of Using the DBMS Approach - A Brief History of Database Applications.

Overview of Database Languages and Architecture: Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence - Database Languages and Interfaces - The Database System Environment - Centralized and Client/Server Architectures for DBMSs - Classification of Database Management Systems.

UNIT- II [CO 2] [10 Periods]

Conceptual Data Modeling Using Entities and Relationships: Using High-Level Conceptual Data Models for Database Design – A Sample Database Application - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types - Refining the ER Design for the COMPANY Database - ER Diagrams, Naming Conventions, and Design Issues.

SQL: SQL Data Definition and Data Types - Specifying Constraints in SQL – Basic Retrieval Queries in SQL-INSERT, DELETE, and UPDATE Statements in SQL-More Complex SQL Retrieval Queries- Views (Virtual Tables) in SQL-Schema Change Statements in SQL.

UNIT- III [CO 3] [12 Periods]

Data science in a big data world -Benefits and uses of data science and big data, Facets of data, The data science process, The big data ecosystem and data science, An introductory working example of Hadoop.

The data science process- Overview of the data science process, Step 1: Defining research goals and creating a project charter, Step 2: Retrieving data, Step 3: Cleansing, integrating, and transforming data, Step 4: Exploratory data analysis, Step 5: Build the models, Step 6: Presenting findings and building applications on top of them.

Machine learning - What is machine learning and why should you care about it? , The modeling process, Types of machine learning, Semi-supervised learning.

UNIT- IV [CO 4] [10 Periods]

Handling large data on a single computer- The problems you face when handling large data , General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Case study 1: Predicting malicious URLs, Case study 2: Building a recommender system inside a database.

First steps in big data- Distributing data storage and processing with frameworks, Case study: Assessing risk when loaning money.

Join the NoSQL movement- Introduction to NoSQL, Case study: What disease is that?

UNIT- V [CO 5] [10 Periods]

The rise of graph databases- Introducing connected data and graph databases, Introducing Neo4j: a graph database, Connected data example: a recipe recommendation engine.

Data visualization to the end user- Data visualization options , Crossfilter, the JavaScript MapReduce lib, Creating an interactive dashboard with dc.js, Dashboard development tools.

Text mining and text analytics- Text mining in the real world , Text mining techniques: Bag of words, Stemming and lemmatization ,Decision tree classifier.

Text Book(s):

1.Database Systems, Ramez Elmasri and Shamkant B.Navathe, Pearson Education, 6th edition. (UNIT I, and UNIT II)

2. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, John Wiley & Sons. (UNIT III, UNIT IV, and UNIT V)

Reference Book(s):

1.Data Sciences & Analytics, V.K. Jain, Khanna Publishing House.

2.Business Analytics: The Science of Data - Driven Decision Making, U Dinesh Kumar, John Wiley & Sons.

3.Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher.

4.Jake VanderPlas, Python Data Science Handbook, Shroff Publisher/O'Reilly PublisherMedia.

5.Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher/O'Reilly Publisher Media.

AD 551	Advanced Data Structures and Algorithms Lab	L	T	P	C	Int	Ext
	I Year I Semester	-	-	4	2	40	60

Course Objectives: At the end of the Course Students will

1. Understand and Implement Core Data Structures.
2. Explore Advanced Data Structures and Algorithms.
3. Develop Problem-Solving Techniques with Algorithmic Strategies.
4. Enhance Computational Efficiency and Optimization.

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

1. Implement linear and non-linear ADTs.
2. Solve real world problems using searching, sorting and hashing algorithms.
3. Develop solutions for the given problems using appropriate data structures.
4. Implement complex problems using the design strategy.

List of Experiments to implement:

1. Single Linked List ADT.
2. Single Circular List ADT.
3. Doubly Linked List ADT.
4. Stack ADT.
5. Queue ADT.
6. BST ADT.
7. Graph traversal techniques.
8. Hashing Techniques.
9. Problems related to Divide and Conquer strategy.
10. Problems related to Greedy Strategy.
11. Graph Related Problems using Greedy Strategy.
12. Problems related to Dynamic Programming.
13. Graph Related Problems using Dynamic Programming.
14. Problems related to Backtracking Strategy.
15. Problems related to Branch and Bound.
16. String Matching Problems.

AD 552	Artificial Intelligence and Machine Learning Lab	L	T	P	C	Int	Ext
	I Year I Semester	-	-	4	2	40	60

Course Objectives: The main objectives of this course are:

- Introduce Basic Python concepts, Numpy and Pandas
- Discuss Artificial Intelligence search algorithms and constraint satisfaction problems.
- Introduce basic concepts and applications of machine learning.
- Demonstrate supervised and unsupervised learning and its applications

Course Outcomes: After successful completion of the course, the students are able to:

1. Use Python concepts in implementing AI & ML algorithms.
2. Implement search and constraint satisfaction problems.
3. Implement machine learning solutions to classification, regression, and clustering.
4. Use machine algorithms to solve complex problems.

LAB CYCLE 01 – Programs in Python

- Usage of control structures
- Python Functions
- Python Lists
- NumPy arrays
- Pandas DataFrames

LAB CYCLE 02 – Programs in Aritificial Intelligence

- Tic-tac-toe game playing.
- Water-jug problem (BFS)
- A* Search (8-puzzle).
- N-Queen Problem (Constraint Satisfaction Problem).
- Graph Coloring Problem (Constraint Satisfaction Problem).

LAB CYCLE 03 – Programs in Machine Learning

- Concept Learning
- Bayesian Learning
- Decision Tree learning
- Neural network learning
- Instance based learning
- Unsupervised learning – Clustering and regression
- Supervised learning methods performance evaluation using scikit-learn package

AD 521	Advanced Java Programming	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:

The main objectives of this course are
1. Introducing database applications.
2. Introducing network applications by using TCP/IP sockets.
3. Introducing Web Applications with servlets, JSP and Spring MVC.

Course Outcomes:

After successful completion of the course, the students will be able to:
- Create Database applications using JDBC.
- Develop socket applications.
- Design and develop server side applications using java Servlets and JSP.
- Design and develop Applications with Spring Framework.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Java Database Connectivity (JDBC): Introduction, JDBC Drivers, JDBC Architecture, JDBC Classes and Interfaces, Loading a Driver, Making a Connection, Execute SQL Statement, SQL Statements, Retrieving Result, Getting Database Information, Scrollable and Updatable Resultset, Result Set Metadata.

UNIT – II **[CO2]** **10 Hours**

Advance Networking : Networking Basics, Introduction of Socket, Types of Socket, Socket API, TCP-IP Client/Server Sockets, URL, URLConnection,UDP: Datagrams, java.net package classes: Socket, ServerSocket, InetAddress.

Java Remote Method Invocation : RMI Architecture, Client Server Application using RMI**.**

UNIT – III **[CO3]** **10 Hours**

Servlets: Introduction to Java Servlets, Servlet interface, GenericServlet, HttpServlet, Servlet life Cycle, Servlet Request and Response Model, Deploying a Servlet, Servlet State Transitions, Servlet Config and ServletContext, Servlet Redirection and Request Dispatch, Maintaining Client State: Cookies, URL rewriting, Hidden form fields, Session Tracking

UNIT – IV **[CO3]** **10 Hours**

JSP: Introduction to JSP, JSP & Servlet as Web Components, Servlets vs. JSP, JSP Lifecycle, JSP Page Lifecycle Phases, General Rules of Syntax, JSP syntactic elements, JSP element syntax, Template content.JSP elements directives, declarations, expressions, scriptlets, actions.
JSP Standard Actions: jsp:useBean, jsp:getPreoperty, jsp:setProperty, jsp:include, jsp:forward, jsp:plugin,jsp:param,java

[CO4] **10 Hours**

UNIT –V

Spring MVC : Springing into action : Unleashing the power of POJOs , Injecting dependencies , Applying aspects ,Working with an application context ,A bean's life , Spring modules.
Wiring beans : Exploring Spring's configuration options , Automatically wiring beans.
Wiring beans with Java ,Wiring beans with XML . Scoping beans.
Building Spring web applications -Getting started with Spring MVC , Writing a simple controller , Accepting request input , Processing forms.

Learning Resources:

Text Book:

1. Herbert Schildt , Java™:The Complete Reference, Seventh Edition(**UNIT – I, UNIT – II)**
2. Professional Java Server Programming by Subrahmanyam Allamaraju, Cedric Buest Apress Publication(**UNIT – III, UNIT – IV)**
3. Spring in Action 4th edition , Craig walls, Manning Publication (**UNIT – V)**

Reference Books:

1. Black Book "Java server programming" J2EE, 1st ed., Dream Tech Publishers, 2008.

2. Core Java, Volume II: Advanced Features by Cay Horstmann and Gary Cornell, Pearson Publication.

3. Complete Reference J2EE by James Keogh mcgraw publication.

4. Beginning JSP, JSF and Tomcat, Giulio Zambon, Apress

AD 522	GENERATIVE AI	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

COURSE OBJECTIVES:

At the end of the course the students will understand

- To understand what Generative AI is and why it matters.
- To know how it's shaping the future of business.
- To analyze different AI tools.
- To decide about the application of Generative AI in various domains.

COURSE OUTCOMES:

At the end of the course, the student will be able to

- Explain the technical terminology surrounding Generative AI.
- Analyse the significance of Generative AI in today's digital landscape.
- Gain hands-on experience with state-of-the-art AI tools.
- Use the concept of Prompt Engineering.
- Make informed decisions about the application of Generative AI in various domains.

UNIT-I [CO1] 10 Periods

Introduction to Deep Learning: Deep Feed forward Networks: Learning XOR, Gradient Based Learning, Hidden Units, Architecture Design, Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Data Types.
Applications: Computer Vision, Natural Language Processing.

UNIT-II [CO2] 10 Periods

Generative Modeling, What Is Generative Modeling? Generative Versus Discriminative Modeling, Probabilistic Generative Models, The Challenges of Generative Modeling.
Variational Auto encoders: Autoencoders, Building a Variational Auto encoder, Using VAEs to generate Faces.

Unit-III [CO3] 10 Periods

Generative Adversarial Networks: Introduction to GANs, The Discriminator, The Generator, Training the GAN, GAN Challenges, LSTM Network, Generating New Text, Encoder-Decoder Models, The Future of Generative Modeling: The Transformer- BERT,GPT-2.

Unit-IV [CO4] 10 Periods

Understanding Prompting and Prompt Techniques: Introducing LLM Prompts, Types of LLM prompts, Components of LLM Prompt, Challenges and limitations of using LLM prompts, LLMs for creative writing-using AI for creative writing, using AI to generate fiction.

Unit-V [CO5] 10 Periods

Unlocking Insights from Unstructured Text-AI Techniques for Text Analysis, Sentiment Analysis, Organizing unstructured data, Cleaning up dirty data, Making sense of unstructured data-pattern matching for information extraction.

Learning Resources:

TEXT BOOKS:

1. "Deep Learning" Good fellow,Yoshua Bengio, Aaron Courville, MIT Press.[Unit-1]
2. "Generative Deep Learning", David Foster 1st edition. [Unit-II & III]
3. "Unlocking the Secrets of Prompt Engineering", Gilbert Mizrahi,1st edition. [Unit-IV & V]

Reference Books:

1. "Generative AI on AWS" by Chris Fregly, Antje Barth, Shelbee Eigenbrode.
2. "Artificial Intelligence & Generative AI for Beginners" by David M.Patel.

AD 523	Data Visualization and Interpretation	L	T	P	C	Int	Ext
	I Year II Semester	3	-	-	3	40	60

Course Objectives:
The main objectives of this course are

1. This course introduces the visualization techniques of data.
2. To enable students to make more effective use of data.
3. To utilize various levels and types of summarization of data
4. Give an insight into the statistical methods of data analysis and prediction

Course Outcomes:
After successful completion of the course, the students will be able to:

CO1. Articulate objectives of Data Visualization and techniques
CO2. Analyze data to create a visualization for various real-time applications
CO3. Develop programs and map visual layouts & graphical properties.
CO4. Create and publish visualizations that enable clear interpretations of big, complex and real world data.

UNIT – I **[CO1] 10 Hours**

The Context of Data Visualization: Visualization as a discovery tool, The bedrock of visualization knowledge, Defining data visualization, Visualization skills for the masses, the data visualization methodology, visualization design objects.

Setting the Purpose and Identifying Key Factors: Establishing intent – the visualization's function, Establishing intent – the visualization's tone, Key factors surrounding a visualization project, The " eight hats" of data visualization design

UNIT – II **[CO2] 10 Hours**

Conceiving and Reasoning Visualization Design Options: Data visualization design is all about choices, The visualization anatomy – data representation, The visualization anatomy – data presentation

Taxonomy of Data Visualization Methods: Data visualization methods, Choosing the appropriate chart type, Assessing hierarchies and part-to-whole relationships.

UNIT – III **[CO3] 10 Hours**

Constructing and Evaluating Your Design Solution: For constructing visualizations, technology matters, The construction process, Approaching the finishing line Post-launch evaluation. Case Studies on real-time applications

UNIT – IV **[CO4] 10 Hours**

An Introduction to Connecting to Data: An Introduction to Connecting to Data in Tableau, Shaping Data for Use with Tableau, Getting a Lay of the Land: Tableau Terminology, View the Underlying Data, View the Number of Records, Dimension Versus Measure, What Is a Measure? What Is a Dimension? Discrete Versus Continuous Five Ways to Make a Bar Chart/An

UNIT –V **[CO4] 10 Hours**

Introduction to Aggregation: Five Ways to Create a Bar Chart in Tableau An Introduction to Aggregation in Tableau, Line Graphs, Independent Axes, and Date Hierarchies, How to Make a Line Graph in Tableau, Independent Axes in Tableau, Date Hierarchies in Tableau, Marks Cards, Encoding, and Level of Detail, An Explanation of Level of Detail, An Introduction to Encoding, Label and Tooltip Marks Cards..

Learning Resources:

Text Books:

1. Andy Kirk, ”Data Visualization: a successful design process”, Packt Publishing December 2012. (UNIT-1, UNIT-II, UNIT-III)

2. Ryan Sleeper, Practical Tableau, O’Reilly Media, Inc. April 2018. (UNIT-IV, UNIT-V)

Reference Books:

1. Chakrabarti, S,”Mining the web: Discovering knowledge from hypertext data “, Morgan Kaufman Publishers, 2003.
2. Ben Fry, Villisualizing data, Sebastopo, O‘Reily, 2007

AD 561	Advanced Java Programming Lab	L	T	P	C	Int	Ext
	I Year II Semester	-	-	4	2	40	60

Course Objectives:

The main objectives of this course are
Introducing database applications.
Introducing network applications by using TCP/IP sockets.
Introducing Web Applications with servlets, JSP and Spring MVC.

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1. Create Database applications using JDBC.
CO2. Develop socket applications.
CO3. Design and develop server side applications using java Servlets and JSP.
CO4. Design and develop Applications with Spring Framework.

List of Experiments to implement:

Develop an application using JDBC for select, insert, and update operations.
Develop an application to demonstrate Meta Data .
Develop Network application using TCP protocol
Develop Network application using UDP protocol
Develop an application using RMI
Develop server side application with Generic Servlet.
Develop server side application with Http Servlet
Develop a server side application to perform operations on data base by using JDBC
Develop a server side application using JSP.
Develop a server side application using JSP Action Tags.
Develop Spring MVC application.

AD 562	Data Visualization Lab	L	T	P	C	Int	Ext
	I Year II Semester	-	-	4	2	40	60

Course Objectives:

This course enables the students:

- To interpret data plots and understand core data visualization concepts such as correlation, linear relationships, and log scales.
- To explore the relationship between two continuous variables using scatter plots and line plots.
- To translate and present data and data correlations in a simple way.

Course Outcomes:

Upon successful completion of this course, Students will be able to:

1. Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer.
2. Find and select appropriate data that can be used in order to create a visualization that answers a particular research question.
3. Properly document and organize data and visualizations in order to prepare them for reuse.

List of Experiments to implement:

1. Loading and Distinguishing Dependent and Independent parameters
2. Exploring Data Visualization tools
3. Drawing Charts
4. Drawing Graphs
5. Data mapping
6. Creating Scatter Plot maps
7. Using BNF Notations
8. Working with REGEX
9. Visualize Network Data
10. Understanding Data Visualization frameworks

Professional Electives

ADEL01	STATISTICS WITH R	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:
At the end of the course, the students will understand:
- The Semantics, Data Handling And Control Statements In R.
- Data Manipulation Techniques
- Plots Using Data Visualizations In R

Course Outcomes:
After successful completion of the course, the students are able to:

- Demonstrate The Semantics, Data Handling And Control Statements In R.
- Apply Data Manipulation Techniques And Linear, Nonlinear Models On The Given Dataset.
- Analyze The Relationship Among Data Attributes With Appropriate Techniques.
- Construct Suitable Plots Using Data Visualizations In R For The Given Application.

UNIT I **10 Periods (CO1)**

The R Environment: Command Line Interface, R Studio, Installing R Packages.
Basics of R: Basic Math, Variable, Data Types, Vectors, Calling Function, Missing Data, Data.Frames, Lists, Matrices, Arrays.
Reading Data Into R: Reading Csvs, Excel Data,Reading From Databases And Extract Data From Websites.
Case Study: Loading Data From Mysql Into Rstudio.

UNIT II **10 Periods (CO2)**
Control Structures & Loops: If And Else, Switch, If Else, Compound Tests, For Loops, WhileLoops, Controlling Loops.
Group manipulation: Apply Family, aggregate, plyr, data.table.
Data Reshaping:cbind, rbind, joins reshape2.

UNIT III **10 Periods (CO2)**
Strings: paste, sprint, extracting text, regular expressions.
Math Functions: Cumulative sums and products, minima and maxima, sorting, set operations.
Probability Distributions: Normal Distribution, Binomial Distribution,Poisson Distribution.

UNIT IV **10 Periods (CO3)**
Basics Statistics: Summary statistics, correlation and covariance, t-tests.
Linear Models: Simple Linear Regression, Multiple Regression, Logistics Regression, Poisson Regression.
Nonlinear Models: Nonlinear Least Squares, Splines, Decision Trees, Random Forests.

UNIT V **10 Periods (CO4)**

Time Series: Autoregressive Moving Average, Var.
Clustering: K Means, Pam, Hierarchical Clustering
Plots: Base Graphics And Ggplot2.

Learning Resources:

Text Book:

1. Jared P. Lander, "R for Everyone, Addison Wesley Data & Analytics Series, Pearson", 2014.
2. Norman Matloff, "The Art of R Programming, No Strach Press", San Francisco, 2011.

Reference Books:

1) Jeffrey Stanton, "An Introduction To Data Science", 2012
2) G. Jay Kerns, Introduction to Probability and Statistics using R, First Edition, 2010

ADEL02	STATISTICAL FOUNDATIONS FOR DATA SCIENCE	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. To provide students with basic concepts of probability distributions.
2. To gain knowledge about random variables and its regression, correlations and curve fitting.
3. To decide whether to accept or reject a specific value of the parameters
4. To provide the most appropriate interval estimator of the parameters in statistical inferences
5. To avoid or at least minimize, the problems of estimating the effects of the independent variables by experimental designs.

Course Outcomes: After successful completion of this course, students are able to
1. Discrete and continuous random variables and various standard distributions and their properties.
2. Understand and apply the Curve fitting, regression and Correlation
3. Use statistical tests in testing the hypotheses on data
4. Interval estimation for population parameters such as mean and standard deviation.
5. List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.

UNIT- I [CO 1] [10 Periods]

PROBABILITY DISTRIBUTIONS

Random variables (Discrete and Continuous). Discrete distributions like Binomial and Poisson. Continuous distributions like Gamma and Normal distributions.

UNIT- II [CO 2] [10 Periods]

CURVE FITTING, REGRESSION AND CORRELATION

The method of least squares, Inferences based on the least squares estimators, Curve linear Regression, Multiple regression, checking the adequacy of the model, Correlation.

UNIT- III [CO 3] [10 Periods]

TESTING OF HYPOTHESIS

Sampling distributions-Type I and Type II errors-Tests basedon Normal, t, Chi square and F distributions for testing of mean, variance and proportions –Tests for independence of attributes and goodness of fit.

UNIT- IV [CO 4] [10 Periods]

ESTIMATION THEORY

Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT- V [CO 5] [10 Periods]

DESIGNOF EXPERIMENTS

Basic principles of design of experiments, Completely Randomized Design, Randomized Block Design, Latin Square Design

Text Book(s)::

1. Johnson,R.A.,Miller,I and Freund J.,"Miller and Freund' Probability and Statistics for Engineers", 9th Edition,Pearson Education,Asia,2016
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms", Second Edition Galgotia Publications. (UNIT III, IV & V)

References Book(s)::

1. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
2. Devore,J.L., "Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.
3. Rice, J.A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5thEdition, Elsevier, 2014.

ADEL03	ARTIFICIAL NEURAL NETWORKS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives: At the end of the Course Students will understand
1. Explain the principles and core components of these techniques.
2. Equip students with practical skills to learn various types of Artificial Neural Networks.
3. To investigate some common models and their applications

Course Outcomes: After successful completion of this course, students are able to
1. Understand the principles and concepts of neural networks and other related techniques.
2. Ability to select the Learning Networks in designing, training, and implementing neural networks real world systems
3. Ability to design, implement and evaluate associative memory networks, as well as their training methods and practical applications.
4. Implement common learning algorithms Adaptive resonance theory.
5. Describe back propagation neural networks to classification and recognition problems.

UNIT- I [CO 1] [10 Periods]

Artificial Neural Network - Definition, Advantages and Application scope of Neural Networks, Fundamental Concept, Evolution of Neural Networks , Basic Models of Artificial Neural Networks- Connections, Learning, Activation Functions, Important Terminologies of ANN's, McCulloch Pitt model, Linear separability

Simple Neural Networks for Pattern Classification: General Discussion, Hebb Net: Theory, Flowchart of Training Algorithm, Training Algorithm..

UNIT- II [CO 2] [10 Periods]

Supervised Learning Network- Introduction, perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons.
Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization.

UNIT- III [CO 3] [10 Periods]

Associative Memory Networks: Introduction, Training Algorithms for Pattern Association, Hetero associative Memory Neural Network, Auto associative Net, Iterative Auto associative Net, Bidirectional Associative Memory (BAM).

UNIT- IV [CO 4] [10 Periods]

Adaptive Resonance Theory Network: Fundamental Architecture, Fundamental Algorithm
ART1: Architecture, Flowchart of Training process, Training Algorithm.
ART2: Architecture, Flowchart of Training process, Training Algorithm.

UNIT- V [CO 5] [10 Periods]

BACKPROPAGATION NEURAL NET: Standard Back Propagation Neural Net
Fixed Weight Nets for Constrained Optimization: Boltzmann Machine, Gaussian Machine, Cauchy Machine, Boltzmann with Machine Learning, Simple Recurrent Net.

Text Book(s):

1. Fundamentals of Neural Networks–Laurence Fausett, Pearson Education.2004
2. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication

References Book(s)::

1) Introduction to Neural Networks Using Matlab6.0- S.N. Sivanandam, S.Sumathi,S.N.Deepa.
2) Neural Networks –James A.Freeman/ David A.Skapura, Pearson Education.
3) Neural Networks –Simon Haykin–2nd edition, Pearson Education.
4) Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
5) S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication (for practicals)

ADEL04	MACHINE LEARNING	L	T	P	C	Int	Ext
		3	-		3	40	60

Course Objectives: At the end of the Course Students will understand
1. Basic concepts and applications of machine learning.
2. Supervised learning and its applications.
3. Unsupervised learning and its applications.

Course Outcomes: After successful completion of this course, students are able to
1. apply the machine learning concepts in real life problems.
2. design solutions for supervised learning problems.
3. use rule sets and reinforcement learning to solve real world problems.
4. discuss the issues in dimensionality reduction and unsupervised learning algorithms.

UNIT- I [CO 1] [10 Periods]

Introduction: Well posed learning problems, Designing a Learning System, Perspectives and Issues in machine learning, Supervised learning, Unsupervised learning.

Concept Learning and general to specific ordering: concept learning Task , Concept learning as a search, Find-S: Finding a Maximally Specific Hypothesis , Version Spaces and Candidate Elimination Algorithm..

UNIT- II [CO 2] [10 Periods]

Decision Tree Learning : Decision Tree Representation, appropriate problems for decision tree, the basic decision tree Algorithm, Issues in decision tree learning.

Bayesian Learning: Bayes Theorem, Maximum Likelihood and Least Square Error Hypotheses, Bayes Optimal Classifier, Naïve-Bayes Classifier, Bayesian Belief Network.

UNIT- III [CO 2] [10 Periods]

Neural Networks: Introduction, Neural Network Representation, appropriate problems for neural network, Perceptrons , Multilayer Networks and the Back Propagation Algorithm

Instance Based Learning: Introduction, KNN Learning, Locally Weighted Regression , Radial Bias Functions, Case-Based Reasoning

UNIT- IV [CO 3] [10 Periods]

Learning Sets of Rules: Sequential Covering Algorithm , Learning Rule Sets: summary , Learning First Order Rules, Learning set of first order rules: FOIL.

Reinforcement Learning: Introduction, the Learning Task , Q Learning , Non Deterministic Rewards and Actions , Temporal Difference Learning , Generalizing from Examples , Relationship to Dynamic Programming.

UNIT- V [CO 4] [10 Periods]

Clustering: Introduction, Partitioning methods: K-Means Clustering, Hierarchical methods: DIANA and AGNES, Density-Based Methods : DBSCAN, Grid-based Method: STING.

Association Rules : Introduction, Apriori algorithm and FP growth algorithm

Dimensionality Reduction : Introduction, Feature Selection methods: subset selection, Feature extraction methods: Principal component analysis, Multidimensional Scaling, Linear Discriminant analysis..

Text Book(s):

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013. (UNIT I , UNIT II, UNIT III, and UNIT IV)
2. Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014. (UNIT V)

References Book(s)::

1) Data Mining Concepts & Techniques, Jiawei Han, Micheline Kamber, andJian Pei, 3/e, Morgan Kaufmann Publishers.
2) Stephen Marsland, —Machine learning: An Algorithmic Perspectivell, CRC Press, 2009
3) Machine Learning: a Probabilistic Perspective, Kevin P. Murphy, MIT Press, 2012.

ADEL05	Natural Language Processing	L	T	P	C	Int	Ext
		3	-	-	3	40	60

***Course Objectives**:*

The main objectives of this course are:

1. Understand the Representation and Layers of NLP.
2. Represent the sentences as parse trees.
3. Use and create sentiment lexicons.
4. Describe extractive Summarization in three generations and LLMs

Course Outcomes:

After successful completion of the course, the students are able to:

1. Describe the different generations of NLP.
2. Analyze the different parsing techniques.
3. Recognize the techniques to identify named entities for example sentences.
4. Analyze the sentiment analysis, question answering of natural language sentences.
5. Distinguish between extractive and abstractive summarization and LLMs.

UNIT I **[CO 1][10 Periods]**

Introduction: Language and Linguistics, Ambiguity and Layers of NLP, Generations of NLP.

Representation and NLP: Ambiguity and Representations, Generation 1: Belongingness via Grammars, Generation 2: Discrete Representational Semantics, Generation 3: Dense Representations.

UNIT II **[CO 2][10 Periods]**

Introduction to Natural Language Understanding: Applications of Natural Language Understanding, Evaluating Language Understanding Systems, The Different Levels of Language Analysis.

Grammars and Parsing: Grammars and Sentence Structure, A Top- Down parser, A Bottom- Up chart parser, Transition Network Grammars, Top-Down Chart Parsing, Finite State Models and Morphological Processing.

UNIT III **[CO 3] [10 Periods]**

Named Entity Recognition: Problem Formulation, Ambiguity in Named Entity Recognition, Datasets, First Generation: Rule-Based Approaches, Second Generation: Probabilistic Models, Third Generation: Sentence Representations and Position Wise Labelling.

Machine Translation: Introduction, Rule-Based Machine Translation, Indian Language Statistical Machine Translation, Phrase-Based Statistical Machine Translation, Factor-Based Statistical Machine Translation, Cooperative NLP: Pivot-Based Machine Translation, Neural Machine Translation.

UNIT IV **[CO 4][10 Periods]**

Sentiment Analysis: Problem Statement, Ambiguity for Sentiment Analysis, Lexicons for Sentiment Analysis, Rule-Based Sentiment Analysis, Statistical Sentiment Analysis, Neural approaches to Sentiment Analysis.

Question Answering: Problem Formulation, Ambiguity in Question Answering, Dataset Creation, Rule-based Q&A, Second Generation, Third Generation.

UNIT V **[CO 5][10 Periods]**

Summarization: Ambiguity in Text Summarization, Problem Definitions, Early Work, Summarization Using Machine Learning.

Large Language Models: Background, Ambiguity Resolution, Generative LLMs, Usage of LLMs

Text Book:

1. Natural Language Processing, Pushpak Bhattacharyya, Aditya Joshi, Wiley, 2023. (UNIT I, UNIT III, UNIT IV & UNIT V).
2. James Allen, Natural Language Understanding, Second Edition, Pearson Education.(UNIT II)..

Reference Books:

1. Daniel Jurafsky and James H Martin,"Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.
2. C. Manning and H. Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge, MA: 1999

ADEL06	COMPUTER VISION	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- To introduce students the fundamentals of image formation.
- To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition.
- To develop an appreciation for various issues in the design of computer vision and object recognition systems.
- To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes:

After successful completion of the course, the students will be able to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision.
2. Describe known principles of feature detection and matching.
3. Describe basic methods of computer vision related to image stitching, photography like high dynamic range imaging and blur removal.
4. Suggest a design of a computer vision system for a 3D Reconstruction, Albedos, image based rendering views and depths.

Course Content:

UNIT – I **[CO1, CO2]** **10 Hours**

Introduction: Image Formation: Geometric Primitives and Transformation, Photometric Image Formation, Digital Camera, Image Processing: Point Operators, Linear Filtering, More Neighborhood Operators, Fourier Transforms, Pyramids and Wavelets, Geometric Transformations, Global Optimization.

[CO1, CO3] **10 Hours**

UNIT – II

Feature Detection and Matching: Points and Patches, Edges, Lines, Segmentation: Active Contours, Split and Merge, Mean Shift and Mode Finding, Normalized Cuts, Feature-Based Alignment: 2D and 3D Feature-based Alignment, Pose Estimation, Geometric Intrinsic Calibration

[CO1, CO4] **10 Hours**

UNIT – III

Structure and Motion: Triangular, Two-frame Structure from Motion, Factorization, Bundle Adjustment, Constrained Structure and Motion, Dense Motion Estimation: Translation Alignment, Parametric Motion, Spline-based Motion, Optical Flow, Layered motion.

UNIT – IV **[CO1, CO5]** **10 Hours**

Image Stitching: Motion Models, Global Alignment, Composing, Computational Photography: Photometric Calibration, High Dynamic Range Imaging, Super Resolution and Blur Removal, image Matting and Compositing, Texture Analysis and Synthesis.

[CO1, CO5] **10 Hours**

UNIT –V

3D Reconstruction: Shape From X, Active Range Finding, Surface Representation, Point-based Representation, Volumetric Representation, Model-based Reconstruction, Recovering Texture Maps and Albedos Image- based Rendering: View Interpolation, Layered Depth Images, Light Fields and Lumigraphs, Environment Mattes, Video-based Rendering.

Learning Resources:

Text Book:

1**.** Richard Szeliski, Computer Vision: Algorithms and Applications, Springer Verlag London Limited, 2011.

2. Simon J.D Prince, Computer Vision: Models, Learning and Inference, 1st Edition, 2012..

Reference Books:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Haralick and Shapiro, “Computer and Robot Vision”, Vol II.
3. G_erard Medioni and Sing Bing Kang, “Emerging topics in Computer Vision”.

ADEL07	Soft Computing	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

1. explain the principles and core components of these techniques.
2.equip students with practical skills to apply soft computing techniques to real-world problems.
3.independently analyze, model, and solve complex problems using soft computing methods.
4.assess when and where soft computing approaches are most suitable and articulate their reasoning.

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1.define the principles and concepts of soft computing, including fuzzy sets, neural networks, genetic algorithms, and other related techniques.
CO2.apply fuzzy logic, Sets, relations in decision-making and control systems.
CO3.demonstrate fuzzy membership functions and defuzzification.
CO4.demonstrate fuzzy arithmetic and fuzzy measures, fuzzy rule based and approximate reasoning.
CO5.apply genetic algorithms to optimization and search problems.

Course Content:

UNIT – I **[CO1, CO2] 10 Hours**

Introduction: Neural Networks, Application Scope of Neural Networks, Fuzzy Logic, Genetic Algorithm, Hybrid Systems, Soft Computing.

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Introduction to Fuzzy Logic, Classical Sets, Fuzzy Sets.

Classical Relations and Fuzzy Relations: Introduction, Cartesian Product of Relation, Classical Relation, fuzzy Relations, Tolerance and Equivalence Relations, Non interactive Fuzzy Sets.

[CO1, CO3] 10 Hours

UNIT – II

Membership Functions: Introduction, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments

Defuzzification: Introduction, Lambda-Cuts for Fuzzy Sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relations, Defuzzification Methods

[CO1, CO4] 10 Hours

UNIT – III

Fuzzy Arithmetic and Fuzzy Measures : Introduction, Fuzzy Arithmetic, Extension Principle, Fuzzy Measures, Measures of Fuzziness, Fuzzy Integrals

Fuzzy Rule Base and Approximate Reasoning: Introduction, TruthValuesandTablesin Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Overview of Fuzzy Expert System.

UNIT – IV **[CO1, CO5] 10 Hours**

Genetic Algorithms: Introduction, Biological Background, Traditional Optimization and Search Techniques, Genetic Algorithm and Search Space, Generic Algorithm vs. Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm.

Operators in Generic Algorithm: Encoding, Selection, Crossover, Mutation.

[CO1, CO5] 10 Hours

UNIT –V

Constraints in Genetic Algorithm

Problem Solving Using Genetic Algorithm: Maximizing a Function

Classification of Generic Algorithm: Messy Genetic Algorithms, Adaptive Genetic Algorithms, Hybrid Genetic Algorithm, Parallel Genetic Algorithm, Independent Sampling Genetic Algorithm (ISGA), RealCoded Genetic Algorithms.

Learning Resources:

Text Book:

1**.** Principles of Soft Computing by S. N. Sivanandan and S. N. Deepa, 2nd edition, Wiley India 2007.

Reference Books:

1. NEURAL NETWORKS, FUZZY LOGIC, AND GENETIC ALGORITHMS: SYNTHESIS ANDAPPLICATIONS (WITH CD-ROMby S. Rajasekaran and G. A. VijayalakshmiPai, PHI, 2013.

2. Soft computing and Intelligent Systems: Theory and Applications, by Naresh K. Sinha, Madan N. Gupta, Academic Press 2000.

ADEL08	REINFORCEMENT LEARNING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:
The main objectives of this course are

- Formalize problems as Markov Decision Processes.
- Understand basic exploration methods and the exploration / exploitation tradeoff.
- Understand value functions, as a general-purpose tool for optimal decision-making.
- Know how to implement dynamic programming as an efficient solution approach to an industrial control problem.

Course Outcomes:
After successful completion of the course, the students will be able to:

- Describe the Markov Decision Process.
- Apply Random and Optimistic Exploration Strategies to make correct decision making.
- Apply different Prediction techniques.
- Illustrate function approximation in Reinforcement Learning.
- Demonstrate various policy based Reinforcement Learning Algorithms.

Course Content:

UNIT – I [CO1] 10 Hours

Introduction: Deep Reinforcement Learning, Suitability of RL, Components of Reinforcement Learning - Agent, Environment, Observations, Actions, Example-The Bandit Walk Environment, Agent-Environment interaction cycle, MDP (Markov Decision Process): The engine of the Environment-States, Actions, Transition Function, Reward Signal.

UNIT-II [CO2] 10 Hours

Planning: Objective of a decision making agent-environment, Plan, Optimal policy, Comparison of Policies, Bellman Equation/State-Value Function, Action-Value Function, Action-Advantage Function, Optimality.
Exploitation and Exploration of Reinforcement Learning: Bandits- Single-state decision problem(Multi-Armed Bandit(MAB) problem), The cost of exploration, Approaches to solve MAB environments, Greedy Strategy, Random Strategy, Epsilon-Greedy Strategy, Decaying Epsilon-Greedy Strategy, Optimistic Initialization strategy, Strategic exploration, Softmax exploration strategy, Upper confidence bound (UCB) equation strategy, Thompson sampling strategy.

UNIT-III [CO3] 10 Hours

Model Free Reinforcement Learning: Monte Carlo Prediction (MC), First-Visit MC (FVMC), Every-Visit MC (EVMC), Temporal Difference Learning (TD), Learning to estimate from multiple steps, N-step TD learning, Forward-view TD(λ), Backward-view TD(λ), Generalized policy iteration(GPI), Monte Carlo control, SARSA: On-Policy TD control, Q-learning: Off-Policy TD control, Double Q-learning, SARSA(λ), Watkins's Q(λ). Model Based Reinforcement Learning: Dyna-Q, Trajectory sampling.

UNIT-IV [CO4] 10 Hours

Value Based Reinforcement Learning: Deep reinforcement learning agents with sequential feedback, evaluative feedback, sampled feedback, Function Approximation for Reinforcement Learning- high-dimensional state and action spaces, continuous state and action spaces, state-value function and action-value function with and without function approximation, Neural Fitted Q (NFQ), Deep Q-Network (DQN), Double Deep-Q Networks(DDQN), Dueling DDQN, Prioritized Experience Replay (PER).

UNIT-V [CO5] 10 Hours

Policy Based Reinforcement Learning: Policy Gradient and Actor-Critic Methods—REINFORCE Algorithm and Stochastic Policy Search, Vanilla Policy Gradient(VPG), Asynchronous Advantage Actor-Critic (A3C), Generalized Advantage Estimation (GAE), Advantage Actor-Critic(A2C), Deep Deterministic Policy Gradient (DDPG), Twin-Delayed DDPG (TD3), Soft Actor-Critic (SAC),proximal policy optimization (PPO).

Learning Resources:

Text Book:

1.Miguel Morales, Grokking, “Deep Reinforcement Learning”, Manning Publications, 2020.

Reference Books:

1.Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An Introduction, Second Edition, MIT Press, 2019.
2.Marco Wiering, Martijn van Otterlo(Ed),Reinforcement Learning, State-of-the-Art, Adaptation, Learning, and Optimization book series, ALO, volume 12, Springer, 2012.
3.Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020.
4. Francois Chollet, Deep Learning with Python, Manning Publications, 2018.

ADEL09	Big Data Analytics	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data
- To learn about stream computing.
- To know about the research that requires the integration of large amounts of data.

Course outcomes:

Upon completion of the course, the student will be able to achieve the following outcomes:

- Recognize Big Data and its analytics in the real world.
- Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.
- Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.
- Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.
- Implement Big Data Activities using Hive.

UNIT – I **[CO1] [10 Hours]**

Overview of Big Data: What is Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics

Exploring the use of Big Data in Business Context: Use of Big Data in social Networking, use of Big Data in preventing Fraudulent Activities, use of Big Data in detecting Fraudulent Activities Insurance sector, use of Big Data in Retail Industry

Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop, In-Memory Computing Technology for Big Data

UNIT – II **[CO2] [10 Hours]**

Understanding hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, MapReduce, Hadoop YARN, HBase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie

Understanding MapReduce Fundamentals and HBase: MapReduce Framework, Techniques to Optimize MapReduce Jobs, Uses of MapReduce, Characteristics of HBase.

Understanding Big Data Technology Foundations: Exploring the Big Data Stack, Virtualization and Big Data, Virtualization approaches.

UNIT – III **[CO3] [10 Hours]**

Storing Data in Databases and Data Warehouses: RDMS and Big Data, Nom-Relational Database, Polyglot Persistence, Integrating Big Data with traditional Data Warehouses, Big Data Analysis and Data

Warehouses, Changing deployment in Big Data Era

Storing Data in Hadoop: Introducing HDFS, Introducing HBase, Combining HBase and HDFS, Selecting the suitable Hadoop Data organization for Applications.

UNIT – IV **[CO4] [10 Hours]**

NoSQL Data Management: Introduction to NoSQL, Aggregate Data Models, Key Value Data Models, Document Databases, Relationships, Graph Databases, Schema-Less Databases, Materialized Views, Distribution Models, Sharding, MapReduce Partioning and Combining, Composing MapReduce Calculations .

Understanding Analytics and Big Data: Comparing Reporting and Analysis, The Analytic Process, Types of Analytics .

UNIT – V **[CO5] [10 Hours]**

Analytical Approaches and Tools to Analyze Data: Analytical Approaches, History of Analytical Tools, Introducing Popular Analytical Tools, Comparing various Analytical Tools.

Social Media Analytics and Text Mining: Introducing Social Media, Introducing Key Elements of Social Media, Introducing Text Mining, Understanding Text Mining Process, Sentiment Analysis.

Text Book:

1. **BIG DATA Black Book , Dreamtech Press, 2016 First Edition**

Reference Books:

1. Bill Franks, Taming The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
2. Frank J. Ohlhorst, Big Data Analytics,1st Edition, Wiley, 2012.
3. Hadoop: The Definitive Guide, Tom White, 3rd Edition (2012), O'Reilly(SPD).

ADEL10	DEEP LEARNING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- Concepts of neural networks, back propagation, Attention mechanisms.
- ANN, CNN, Auto encoders and GANs on image processing
- RNN model for time series

Course Outcomes:

After successful completion of the course, the students are able to:

- summarize basic concepts of neural networks, back propagation, Attention mechanisms
- Apply ANN, CNN, Auto encoders and GANs on image processing applications.
- Design a suitable RNN model for time series applications.
- Create a suitable intelligent model for the given application.

Course Content

UNIT I **10 Periods (CO1)**

The Neural Network: Building Intelligent Machines , The Limits of Traditional Computer Programs , The Mechanics of Machine Learning , The Neuron , Expressing Linear Perceptrons as Neurons , Feed-Forward Neural Networks, Linear Neurons and Their Limitations , Sigmoid, Tanh, and ReLU, Softmax output layers.

UNIT II **10 Periods (CO2)**

Training Feed-Forward Neural Networks: Gradient Descent , The Delta Rule and Learning Rates , Gradient Descent with Sigmoidal Neurons, The Backpropagation Algorithm, Stochastic and Minibatch Gradient Descent , Test Sets, Validation Sets, and Overfitting, Preventing Overfitting in Deep Neural Networks

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UNIT III **10 Periods (CO2)**

Convolutional Neural Networks: Neurons in Human Vision ,The Shortcomings of Feature Selection, Vanilla Deep Neural Networks, Filters and Feature Maps, Full Description of the Convolutional Layer, Max Pooling, Full Architectural Description of Convolution Networks **Embedding and Representation Learning**: Learning Lower-Dimensional Representations,Principal Component Analysis, Motivating the Autoencoder Architecture, Denoising, Sparsity in Autoencoders.

UNIT IV **10 Periods (CO3)**

Sequence Modeling: Recurrent and Recursive nets: Unfolding Computational Graphs, Recurrent neural networks, Bidirectional RNNS,Encoder-Decoder sequence-to –sequence architectures, Deep Recurrent networks, Recursive neural networks.

The Challenge of Long-Term Dependencies: Echo State Networks, Leaky Units &Other strategies for multiple timescales, The Long Short-Term memory

UNIT V **10 Periods (CO4)**

Advanced Topics in Deep Learning:Introduction, Attention Mechanisms, Recurrent Models of Visual Attention, Attention Mechanisms for Machine Translation

Generative Adversarial Networks:Training a Generative Adversarial Network, Using GANs for Generating Image Data, Conditional Generative Adversarial Networks, Limitations of Neural Networks.

Learning Resources:

Text Book:

1. Nikhil Buduma, Nicholas Locascio, “Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, O'Reilly Media, 2017

2. Ian Goodfellow, YoshuaBengio, Aaron Courville, ”Deep Learning(Adaptive Computation and Machine Learning series”,MIT Press, 2017

.

Reference Books:

1). Li Deng and Dong Yu, “Deep learning Methods and Applications”, Now publishers, 2013

2). Michael Nielsen,“Neural Networks and Deep Learning”, Determination Press 2015

ADEL11	OPTIMIZATION TECHNIQUES FOR DATA ANALYSIS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- Optimization Techniques.
- Linear and non linear Programming
- Genetic Algorithms .

Course Outcomes:

After successful completion of the course, the students are able to:

- Summarize various techniques used for optimization problems arising from engineering areas.
- Analyze optimization algorithms for Linear Programming problems.
- Solve various constrained and unconstrained nonlinear programming problems.
- Apply modern and multi objective optimization techniques to provide optimal solution for real time problems

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UNIT I **10 Periods (CO1)**

Introduction to Optimization: Introduction, Historical Development, Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems.

Classical Optimization Techniques: Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints.

UNIT II **10 Periods (CO2)**

Linear Programming

Introduction, Applications of Linear Programming, Standard Form of a Linear Programming Problem, Geometry of Linear Programming Problems, Solution of a System of Linear Simultaneous Equations, Pivotal Reduction of a General System of Equations

Simplex Method:Motivation of the Simplex Method, Simplex Algorithm, Improving a Non-optimal Basic Feasible Solution, Two Phases of the Simplex Method and Applications of Simplex Algorithm.

UNIT III **10 Periods (CO2)**

Nonlinear Programming Algorithms: Applications of Unconstrained Algorithms – Direct Search Method, Gradient method, Applications of Constrained Algorithms - Separable Programming, Quadratic Programming, Chance- Constrained Programming, Linear Combinations method, Applications of SUMT Algorithm.

Case Study 1: Chance Constrained Problem

UNIT IV **10 Periods (CO3)**

Modern Methods of Optimization

Introduction, Applications of Genetic Algorithms, Applications of Simulated Annealing, Applications of Particle Swarm Optimization, Applications of Ant Colony Optimization, Optimization of Fuzzy Systems, Applications of Neural-Network-Based Optimization

UNIT V **10 Periods (CO4)**

Multi objective Optimization

Introduction, Pareto Solutions, Computing the Pareto Front, multi objective to single objective optimization.

Case Study 2: Travelling Salesperson Problem

Learning Resources:

Text Book:

1. Singiresu S Rao, “Engineering Optimization Theory and Practice", John Wiley and sons, 4th Edition, 2009

2. HamdyA.Taha, “OprationResearch : An Introduction”, 8th Edition, Pearson Prentice Hall, 2007.

Reference Books:

1). S.Rao, “Engineering optimization: Theory and practice”, 4th Edition, New Age International, 2009

2). An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.Andreas Antoniou. “Practical Optimization Algorithms and Engineering Applications”, Springer Series, 2007

ADEL12	Data Science Applications of NLP	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- To understand text processing for extracting information.
- To understand language specific tasks and learning models.
- To explore artificial intelligence in understanding the semantics of text data.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Understand the mechanics of language - the sound system, word structure, sentence structure, and meaning.
- Understand how to formulate NLP tasks as learning and inference tasks, and address the computational challenges involved.
- Apply text processing at syntactic, semantic, and pragmatic levels.
- Analyze text mining and manipulation techniques and analyze entity recognition and relationship between entities to retrieve information from text.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Introduction to Computational Linguistics - Word meaning - Distributional Semantics - Word Sense Disambiguation - Sequence Models - N-gram Language Models - Feedforward Neural Language Models - Word Embeddings.

UNIT – II **[CO2]** **10 Hours**

Recurrent Neural Language Models - POS tagging and Sequence Labeling - Structured Perceptron, Viterbi - Loss-augmented Structured Prediction - Neural text models and tasks.

UNIT – III **[CO3]** **10 Hours**

Information Extraction from Text - Sequential Labeling - Named Entity Recognition - Semantic Lexicon Induction. Relation Extraction-Para phrases Inference Rules-Event Extraction-Opinion Extraction

UNIT – IV **[CO3]** **10 Hours**

Temporal Information Extraction - Open Information Extraction - Knowledge Base Population - Narrative Event Chains and Script Learning - Knowledge graph augmented neural networks for Natural Language.

UNIT –V **[CO4]** **10 Hours**

Machine Translation - Encoder-decoder models, beam search - Attention Models - Multilingual Models-Syntax, Trees, Parsing-Transition-based Dependency Parsing-Graph-based Dependency Parsing - Deep Generative Models for Natural Language Data - Text Analytics - Information Extraction with AQL-Conversational AI.

Learning Resources:

Text Book:

1. Emily Bender, Linguistics Fundamentals for NLP, Morgan Claypool Publishers,2013
2. Jacob Eisenstein, Natural Language Processing, MITPress, 2019
3. Dan Jurafsky, James H. Martin, Speech and Language Processing, Third edition, Prentice Hall,2018.
4. Chris Manning, Hinrich Schuetze, Foundations of Statistical Natural Language Processing, MIT Press,1999.

ADEL13	Generative AI Tools & Techniques	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- Develop proficiency in Python and Tensor Flow2 for preprocessing and cleaning data in generative AI applications.
- Implement and optimize GANs and VAEs for image generation, including training, fine-tuning, and advanced techniques
- Master text generation techniques using LSTM and Transformer models, with a focus on fine-tuning language models for various applications.
- Explore music generation through different models like LSTM and Transformer, evaluating and fine-tuning compositions for diverse music applications

Course Outcomes:

After successful completion of the course, the students will be able to:

1. Understand generative AI principles and word embeddings for text representation.
2. Apply Large Language Models effectively, including pre training and transfer learning.
3. Evaluate Generative AI models using appropriate metrics.
4. Implement Generative Adversarial Networks (GANs) for image generation tasks using Tensor Flow.
5. Identify different types of generative AI models suitable for music generation and analyze ethical consideration for music composition using Gen AI.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Python and Tensor Flow2 in Generative AI: Overview of Python and Tensor Flow2, Preprocessing and cleaning data for Generative AI applications Visualizing data distributions and patterns in Generative AI datasets.
Introduction to Tensor Flow's computation graph and eager execution.

UNIT – II **[CO2]** **10 Hours**

Image Generation with Generative AI: Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs, Generating Images with VAEs, Advanced Techniques in Image Generation, and Image and Video Generation Applications..

UNIT – III **[CO3]** **10 Hours**

Text Generation with Generative AI:Introduction to Text Generation, LSTM-based Text Generation, Transformer-based Text Generation, Fine-Tuning Language Models, and Text Generation Applications.

UNIT – IV **[CO3]** **10 Hours**

Music Generation with Generative AI: Introduction to Music Generation, Music Representation, and LSTM-based Music Generation. Transformer-based Music Generation, Evaluation and Fine-Tuning, Music Composition Applications.
Muse GAN: Overview of Muse GAN architecture, Multi-track music generation using Muse GAN , Training Muse GAN on polyphonic music datasets, Generating complex music compositions with Muse GAN.

UNIT –V **[CO4]** **10 Hours**

Advanced Techniques and Applications: Transfer learning in music generation, Fine-tuning generative models for specific music genres or styles ,Ethical considerations in AI-generated music, Future directions and emerging trends in AI-driven music composition.

Learning Resources:

Text Book:

1. Generative AI with Python and Tensor Flow2:Create images, text, and music with VAEs, GANs, LSTMs, Transformer models" ,Joseph Babcock and Raghav Bali , 2024

2. Generative AI for everyone :Understanding the essentials and applications of this break through technology ".Altaf Rehmani

3. Deep Learning "by Ian Good fellow, Yoshua Bengio, and Aaron Courville

4. Neural Networks and Deep Learning: A Text book "by Charu C.Aggarwal.

Reference Books:

1. "Generative Deep Learning" by David Foster": A comprehensive guide that delves into the principles of generative models, covering topics from autoencoders to variational autoencoders and GANs.

2. "Generative Adversarial Networks Cookbook": Over 100 recipes to build generative models using Python, Tensor Flow, and Keras by Josh Kalin.

3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville: Often referred to as the "Bible of Deep Learning," this comprehensive book covers the fundamentals, making it indispensable for understanding generative models.

4. "Generative AI in Software Development: Beyond the Limitations of Traditional Coding" Jesse Sprinter, 2024

ADEL14	VIRTUAL AND AUGMENTED REALITY	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- Describe the concept of virtual reality and Communication Media.
- Understand current virtual reality hardware and software.
- Understand various modeling approaches.
- Illustrate the concepts of Human Factors and Applications of VR.
- Build a Virtual Reality Application.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Outline the history of Virtual Reality.
- Understand the navigation and manipulation.
- Understand the Model Management.
- Illustrate the challenges of Augmented Reality.
- Develop an application with VR experience.

Course Content:

UNIT – I **[CO1]** **10 Hours**

INTRODUCTION TO VIRTUAL REALITY (VR): Defining Virtual Reality, Key elements of virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace.

Bird's-Eye View: Hardware, Software, Human Physiology and Perception.

UNIT-II **[CO2]** **10 Hours**

Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.

Output Devices: Graphics displays, sound displays & haptic feedback.

UNIT-III **[CO3,CO4]** **10 Hours**

Modeling: Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.

UNIT-IV **[CO5]** **10 Hours**

Augmented Reality (AR): Taxonomy, Technology and Features of Augmented Reality, AR vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems.

AR software development : AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.

UNIT-V **[CO5]** **10 Hours**

Interaction & Audio: Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio - The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Learning Resources:

Text Book:

1. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc, 2017.
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.

Reference Books:

1. Rajesh K. Maurya, Computer Graphics with Virtual Reality System, 3rd Edition, Wiley Publication, 2018.
2. William R. Sherman and Alan B. Craig, Understanding Virtual Reality Interface, Application, and Design, 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2019.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, Wiley,2017.
4. K.S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd Edition, CRC Press, 2015.

ADEL15	SCALABLE ALGORITHMS FOR DATA ANALYSIS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- Data Scalability and its' applications.
- Networks and Data Clustering
- Geometric Techniques for Data analysis
- Face Recognition And Gesture Recognition

Course Outcomes:

After successful completion of the course, the students are able to:

- Formulate problems statements in terms of scalable algorithm
- Apply concepts of geometric techniques in real time problems.
- Integrate core theoretical knowledge of graph theory to solve problems.
- Analyze new networks using the main concepts of scalability.

UNIT I **10 Periods (CO1)**

INTRODUCTION

Challenges of Massive Data- Scalability of Algorithms-Complexity Class-Scalable Reduction and Algorithmic Primitives.

UNIT II **10 Periods (CO2)**

NETWORKS AND DATA

Weighted Graphs and Affinity Networks -Sources of Affinities- Basic Problems in Data and Network Analysis- Sparse Networks and Sparse Matrices

UNIT III **10 Periods (CO2)**

CLUSTERING

Local Algorithms for Network Analysis -Local Clustering and Random WalksPerformance Analysis of Local Clustering -Scalable Local Computation of Personalized Page Rank - Interplay Between Dynamic Processes and Networks - Cheeger's Inequality and its Parameterization.

UNIT IV **10 Periods (CO3)**

PARTITIONING: GEOMETRIC TECHNIQUES FOR DATAANALYSIS

Center points and Regression Depth – Scalable Algorithms for Center points -Geometric Separators-Dimension Reduction -Scalable Geometric Divide-andConquer -Graph Partitioning – Multiway Partition of Network and Geometric DataSpectral Graph Partitioning.

UNIT V **10 Periods (CO4)**

SPARSIFICATION : MAKING NETWORKS SIMPLER

Spectral Similarity of Graphs -Spectral Graph Sparsification -Graph Inequalities and Low-Stretch Spanning Trees Edge Centrality, Sampling and Spectral Approximation- Scalable Dense-Matrix Computation via Sparsification-PageRank Completion of Networks

Learning Resources:

Text Book:

1. Ping Zhang, Jay Yellen, Jonathan L. Gross," Handbook of Graph Theoryǁ, ", Chapman and Hall/CRC, 2nd Edition, ISBN: 9781439880197, 2015.

Reference Books:

1). Michel Rigo," Advanced Graph Theory and Combinatorics", Wiley & Sons, ISBN: 9781848216167, 2016.

2). Martin Charles, "Algorithmic Graph Theory and Perfect Graphs", North Holland, 2nd Edition, ISBN: 9780444515308, 2004

ADEL16	WEB MINING AND SOCIAL NETWORK ANALYSIS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- Graph basics to analyze the social media data.
- Edge detectors
- AlexNet and VGG Neural Networks
- Face Recognition And Gesture Recognition

Course Outcomes:

After successful completion of the course, the students are able to:

- Apply graph basics to analyze the social media data and measure the network measures
- Derive the similarities of people in the society and find the communities in the society.
- Generate recommendations, social recommendations and evaluate recommendations.
- Measuring influence and homophily, Analyze the individual behavior and collective behavior.

Course contents

UNIT I **10 Periods (CO1)**

Social media mining and its challenges. Graph Essentials: Graph basics: nodes, edges, degree, degree distribution. Graph representation, types of graphs. Connectivity in graphs. Special graphs
Network measures: centrality : degree centrality, eigenvector centrality, katz centrality, page rank, betweenness centrality

UNIT II **10 Periods (CO2)**

Community analysis: Community Detection, Node degree, Node Reachability, Social Communities, Community Detection Algorithms, Member Based Community Detection
Group Based Community Detection Algorithms: Balanced Communities, Robust Communities, Modular Communities, Dense Communities and Hierarchical communities.

UNIT III **10 Periods (CO2)**

Recommendation in Social Media: Recommendation System challenges, classical recommendation algorithms, Content-based methods, collaborative filtering, User-based collaborative filtering, item-based collaborative filtering,

UNIT IV **10 Periods (CO3)**

Recommendation using social context: Recommendation using social context alone, recommendation constrained by social context, Evaluating Recommendations.

UNIT V **10 Periods (CO4)**

Influence and Homophily: Measuring assortativity, Measuring Assortativity for Nominal Attributes and for ordinal attributes. Influence: Measuring influence and modeling influence. **Homophily**: Measuring Homophily, modeling Homophily, Distinguish Influence and Homophily. Behavior Analytics: Individual behavior, Individual behavior analysis, behaviour analysis methodology, individual behavior Modeling and prediction, link prediction

Learning Resources:

Text Book:

1. Reza Zafarani, Mohammad Ali Abbasi , Huan Liu Social Media Mining: An introduction

Reference Books:

1). Charu c. aggarwal "Social network data analytics" Springer

2). E M. E. J. Newman Hardback “Networks: An Introduction by M. E. J. Newman, a college-level textbook about the science of networks.”, Oxford University Press, 2010

ADEL17	QUANTUM COMPUTING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- To introduce the fundamentals of quantum computing.
- The problem-solving approach using finite dimensional mathematics.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Basics of complex vector spaces.
- Quantum mechanics as applied in Quantum computing.
- Architecture and algorithms.
- Fundamentals of Quantum computations.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Complex numbers and its geometrical representations, Complex vector spaces, inner products and Hilbert spaces, Hermitian and unitary matrices, Tensor products of vector spaces Deterministic Systems.

UNIT-II **[CO2]** **10 Hours**

Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits.

UNIT-III **[CO3]** **10 Hours**

Quantum Algorithm - I: Quantum parallelism, Quantum Evolution, Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Simon's periodicity algorithm.

UNIT-IV **[CO4]** **10 Hours**

Quantum Algorithm - II: Grover's search algorithm, Shor's Factoring algorithm. Application of entanglement, teleportation, superdence coding.

UNIT-V **[CO4]** **10 Hours**

Quantum programming languages, Probabilistic and Quantum computations, introduction to quantum cryptography and quantum information theory.

Learning Resources:

Text Book:

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, 2008

2. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008.

Reference Books:

1. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010.
2. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995.

ADEL18	VISUAL RECOGNITION	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- To Understand the fundamentals of computer vision and its applications.
- To Apply deep neural networks for intelligent image retrieval using CNNs, auto encoders, and GANs.
- To Explore advanced optimization techniques including gated CNNs, CTC, BiGRU, and encoder-decoder models.
- Design and evaluate real-time face mask detection systems on edge IoT devices and Apply deep learning techniques for sentiment analysis, focusing on hybrid models and neural architectures

Course Outcomes:

After successful completion of the course, the students are able to:

- Understand the fundamentals of computer vision and its applications in various automated systems
- Analyze and compare different deep learning accelerator architectures.
- Apply dictionary learning and deep neural network techniques to recognize handwritten digits and optimize handwriting recognition.
- Design and evaluate real-time face mask detection systems on edge IoT devices using traditional and deep learning methods
- Examine the challenges and ethical implications of DeepFake technologies and develop sentiment analysis models.

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UNIT I **10 Periods (CO1)**

Computer vision and recognition-based safe automated systems: Introduction, Application of computer vision technology in automation-Using face ID in mobile devices, Automated automobiles,Computer vision in agriculture, health sector, e-commerce industry, Generating 3D maps, Classifying and detecting object, Low-light mode with computer vision.

UNIT II **10 Periods (CO2)**

DLA deep learning accelerator: ASIC-based design accelerator, FPGA-based design accelerator, NoC-based design accelerator.

Intelligent image retrieval system using deep neural networks: Introduction, Conventional content-based image retrieval system, Image retrieval using convolutional neural networks, Image retrieval using auto encoders, Image retrieval using generative adversarial networks.

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UNIT III **10 Periods (CO2)**

Handwritten digits recognition using dictionary learning: Introduction, DPL variants for HNR, Input data preparation.

Handwriting recognition using CNN and its optimization approach: CNN, Gated convolutional neural network, Connectionist temporal classification, Bi-directional gated recurrent unit, Encoder and decoder model.

UNIT IV **10 Periods (CO3)**

Real-time face mask detection on edge IoT devices: IoT devices and object detection, Traditional feature extraction techniques, Traditional detection methods, Traditional face detection techniques, Face mask detection, Deep learning for object detection, Internet and deep learning, Edge IoT architecture.

UNIT V **10 Periods (CO4, CO5)**

Current challenges and applications of DeepFake systems: Introduction to DeepFake, Various DeepFake detection methods available and their limitations, Applications used to forge the multimedia, Current challenges and future of the technology.

Sentiment analysis using deep learning: Sentiment analysis, Sentiment and opinions, Components of opinion, Hybrid learning approaches, Deep neural networks, Convolutional neural networks, Proposed model.

Learning Resources:

Text Book:

1. Computer Vision and Recognition Systems Using Machine and Deep Learning Approaches “Chiranji Lal Chowdhary, Mamoun Alazab, Ankit Chaudhary, Saqib Hakak and Thippa Reddy Gadekallu”.

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Reference Books:

1.“ Deep Learning” Good fellow,Yoshua Bengio, Aaron Courville, MIT Press.
2. Visual Object Recognition “ Kristen Grauman & Bastian Leibe”.

ADEL19	EDGE AI	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- To Learn the techniques and components of Edge Artificial Intelligence.
- To apply AI knowledge to develop Edge Artificial Intelligent Systems.
- To find optimized solutions for given problems.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Understand the relation of AI and Edge Computing.
- Understand the computing tools and technologies of Edge AI.
- Apply knowledge of AI for optimizing Edge application.
- Apply concepts of Mobile Edge AI and Design and Develop edge application.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Introduction to Edge Computing and AI

Fundamentals of Edge computing, Introduction, Need, Key Techniques, Benefits, Systems Paradigms of Edge computing, Edge Computing Frameworks, Value Scenarios for Edge Computing, Edge computing system architectures. Industrial Applications of Edge Computing, Intelligent Edge and Edge Intelligence, Challenges and opportunities in Edge Computing. Fundamentals of Artificial Intelligence: Artificial Intelligence and Deep Learning, Neural Networks in Deep Learning, Deep Reinforcement Learning, Distributed DL Training, Potential DL Libraries for Edge. Case Study: Home Edge Computing Architecture (HEC)

UNIT – II **[CO2]** **10 Hours**

Role in Edge Computing: A high-level hardware hierarchy of edge computing paradigm, Virtualization: Virtual Machine and Container, Network Virtualization, Introduction to DevOps: Understanding the history and evolution, Overview of the benefits and challenges, Introduction to DevOps tools and practices, CI/CD: tools such as Jenkins, Travis CI, and CircleCI and CircleCI, GitLab CI/CD Setup and Configuration, installing and setting up GitLab CI/CD, Configuring GitLab CI/CD pipelines, Creating a basic CI/CD configuration file (. gitlab-ci.yml),

Case Study: Edge device toolkit providers-Google's Distributed Cloud Edge / NVIDIA Jetson platform.

UNIT – III **[CO3]** **10 Hours**

Artificial Intelligence for Optimizing Edge: AI for Adaptive Edge Caching: Use cases DNNs and DRL, Optimizing Edge Task Offloading, Edge Management and maintenance: Communication, security, joint Edge optimization. Case Study: Artificial Intelligence for edge service optimization in the Internet of Vehicles.

UNIT – IV **[CO4]** **10 Hours**

Mobile Edge AI: Overview, Edge inference: On -Device inference, Computation offloading, Server -based edge inference, Device-edge joint inference, Edge training: Data partition-based, Model partition-based, Coded computing. Case Study: Energy-Efficient Mobile Edge Computing Under Delay Constraints.

UNIT –V **[CO4]** **10 Hours**

Artificial Intelligence Applications On Edge: Real-time Video Analytic, Autonomous Internet of Vehicles (IoVs), Intelligent Manufacturing, Smart Home and City, Urban Healthcare, Urban Energy Management, Manufacturing, Transportation and traffic. Case study: Edge AI Solution for people's data privacy and security

Learning Resources:

Text Books:

- Wang,X.,Han,Y.,Leung,V.C.,Niyato,D.,Yan,X.,&Chen,X.,"EdgeAI:Conveceof edge computing and artificial intelligence",Singapore:Springer,2020,ISBN978-981-15-6185-6
- Jie Cao, Quan Zhang,Weisong Shi "Edge Computing:A Primer", Springer International Publishing
- MobileEdge Artificial Intelligence Opportunities and Challenges By Yuanming Shi,Kai Yang, Zhanpeng Yang,Yong Zhou 2021,ISBN -9780128238172, 0128238178, Elsevier Science publication.

ADEL20	RESPONSIBLE AI	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- Understand the principles and challenges of Responsible AI.
- Learn to identify and mitigate bias in AI systems.
- Explore methods for explainability and interpretability in AI.
- Study AI safety, security, and privacy techniques.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Describe key principles and challenges of Responsible AI, including fairness and safety.
- Detect and mitigate bias using fairness metrics and tools.
- Implement Classification Techniques.
- Apply explainability and interpretability techniques in AI models.
- Analyze and address safety, security, and privacy in AI systems.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Inroduction To Responsible Ai: Overview of AI, Common misconception of AI, Introduction to Responsible AI, Characteristics of Responsible AI, Key principles of responsible AI, Challenges in implementing responsible AI, ELSI Framework and AI, Safety and Alignment, Fairness and Privacy.

UNIT – II **[CO2]** **10 Hours**

Fairness And Bias: Human Bias, Types of biases, Effects of biases on different demographics, Bias vs Fairness, Sources of Biases, Exploratory data analysis, Bias Mitigation Techniques, Pre processing techniques, In-processing techniques, post processing techniques, Bias detection tools, Overview of fairness in AI, Group fairness and Individual fairness, Counterfactual fairness, Fairness metrics, Bias and disparity mitigation with Fairlearn.

UNIT – III **[CO3]** **10 Hours**

Classification: Supervised learning, Sensitive characteristics, Formal non-discrimination criteria, Calibration and sufficiency, Relationships between criteria, Inherent limitations of observational criteria, Case study: Credit scoring.

UNIT – IV **[CO4]** **10 Hours**

Explainability & Interpretability: Importance of Explainability and Interpretability – Challenges, Interpretability through simplification and visualization, Intrinsic interpretable methods, Post Hoc interpretability, Interpretability Evaluation methods, Explainability through causality, Model agnostic Interpretation.

UNIT –V **[CO5]** **10 Hours**

Safety, Security, And Privacy: Overview of safety – security – privacy - resilience - Taxonomy of AI safety and Security - Adversarial attacks and mitigation - Model and data security - The ML life cycle - Adopting an ML life cycle MLOps and ModelOps - Model drift - Data drift, Concept drift, Privacy-preserving AI techniques, Differential privacy, Federated learning.

Learning Resources:

Text Books:

- M. Sridhar, Abhijeet Chavan, “Responsible AI: Implementing AI with Trustworthiness and Fairness”, Wiley, 2023. – Covers fairness, accountability, transparency, safety, and real-world applications.
- Sandra Wachter, Brent Mittelstadt, “The Ethics of Artificial Intelligence”, Oxford University Press (Forthcoming), Preprint articles available online. – Deep dive into ELSI, legal frameworks, and AI governance.
- Suresh Venkatasubramanian & Solon Barocas, “Fairness and Machine Learning: Limitations and Opportunities” (2023, online). https://fairmlbook.org – Comprehensive resource on bias, fairness metrics, and mitigation techniques.

ADEL21	OPTIMIZATION TECHNIQUES IN MACHINE LEARNING	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are:

- Optimization techniques
- Large -Scale Cone Programming and Gradient Methods
- Cutting-plane Methods and Dual Decomposition

Course Outcomes:

After successful completion of the course, the students will be able to:

- Summarize various techniques used for optimization problems .
- Able to implement machine learning techniques by using Cone Programming and Gradient Methods.
- Understand various first order methods.
- Implement various machine learning algorithms

Course Content:

UNIT – I **[CO1]** **10 Hours**

Introduction: Optimization and Machine Learning, Support Vector Machines, Regularized Optimization.

Convex Optimization with Sparsity-Inducing Norms: Introduction, Generic Methods, Proximal Methods, (Block) Coordinate Descent Algorithms, Reweighted - 2 Algorithms, Working-Set Methods, Quantitative Evaluation.

UNIT – II **[CO2]** **10 Hours**

Interior-Point Methods for Large-Scale Cone Programming: Introduction, Primal-Dual Interior-Point Methods, Linear and Quadratic Programming, Second-Order Cone Programming, Semidefinite Programming.

Incremental Gradient, Subgradient, and Proximal Methods for Convex Optimization: Introduction, Incremental Subgradient - Proximal Methods, Convergence for Methods with Cyclic Order, Convergence for Methods with Randomized Order.

UNIT – III **[CO3]** **10 Hours**

First-Order Methods for Nonsmooth Convex Large-Scale Optimization, I: General Purpose Methods: Introduction, Mirror Descent Algorithm: Minimizing over a Simple Set, Problems with Functional Constraints, Minimizing Strongly Convex Functions, Mirror Descent Stochastic Approximation, Mirror Descent for Convex-Concave Saddle-Point Problems, Setting up a Mirror Descent Method

UNIT – IV **[CO4]** **10 Hours**

Introduction to Cutting-plane Methods: Introduction to Cutting-plane Methods, Regularized Risk Minimization, Multiple Kernel Learning, MAP Inference in Graphical Models.

Introduction to Dual Decomposition for Inference: Introduction, Motivating Applications, Dual Decomposition and Lagrangian Relaxation, Subgradient Algorithms, Block Coordinate Descent Algorithms, Relations to Linear Programming Relaxations, Decoding: Finding the MAP Assignment.

UNIT –V **[CO4]** **10 Hours**

Augmented Lagrangian Methods for Learning, Selecting, and Combining Features: Introduction, Proximal Minimization Algorithm, Dual Augmented Lagrangian (DAL) Algorithm, Connections, Application.

The Convex Optimization Approach to Regret Minimization: Introduction, The RFTL Algorithm and Its Analysis, The "Primal-Dual" Approach, Convexity of Loss Functions, Recent Applications.

Learning Resources:

Text Books:

1. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, "Optimization for Machine Learning", 2012 Massachusetts Institute of Technology.

References:

1. Tseng, P. (2001). Convergence of a block coordinate descent method for nondifferentiable minimization. Journal of Optimization Theory and Applications, 109(3):475–494.

2. VASILIKI KALAVRI , "Performance Optimization Techniques and Tools for Distributed Graph Processing" October 2016.Tryck: Universitetsservice US AB

ADEL22	INFORMATION RETRIEVAL	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

The main objectives of this course are

- Study fundamentals of DBMS, Data warehouse and Digital libraries.
- Learn various preprocessing techniques and indexing approaches in text mining.
- Know various clustering approaches and study different similarity measures.
- Study various search techniques in information retrieval systems.
- Know different cognitive approaches used in text retrieval systems and evaluation approaches.

Course Outcomes:

After successful completion of the course, the students will be able to:

- Recognize the Boolean Model, Vector Space Model, and Probabilistic Model.
- Understand retrieval utilities.
- Understand different formatting tags
- Understand cross-language information retrieval
- Understand the clustering techniques.

Course Content:

UNIT – I **[CO1]** **10 Hours**

Introduction: Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses.

Information Retrieval System Capabilities: Search, Browse, Miscellaneous.

UNIT-II **[CO2]** **10 Hours**

Cataloging and Indexing: Objectives, Indexing Process, Automatic Indexing, Information Extraction.

Data Structures: Introduction, Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure, Signature file structure, Hypertext data structure.

UNIT-III **[CO3,CO4]** **10 Hours**

Automatic Indexing: Classes of automatic indexing, Statistical indexing, Natural language, Concept indexing, Hypertext linkages.

Document and Term Clustering: Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters.

UNIT-IV **[CO5]** **10 Hours**

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, weighted searches of Boolean systems, Searching the Internet and hypertext.

Information Visualization: Introduction, Cognition and perception, Information visualization technologies.

UNIT-V **[CO5]** **10 Hours**

Text Search Algorithms: Introduction, Software text search algorithms, Hardware text search systems.

Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

Learning Resources:

Text Book:

1. Information Storage and Retrieval Systems: Theory and Implementation by Gerald J. Kowalski, Mark T. Maybury , Second Edition, Kluwer Academic Publishers

Reference Books:

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
2. Modern Information Retrival By Yates Pearson Education.
3. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons.

ADEL23	IMAGE AND VIDEO ANALYTICS	L	T	P	C	Int	Ext
		3	-	-	3	40	60

Course Objectives:

At the end of the course, the students will understand:

- principles and techniques of digital image.
- various image preprocessing techniques
- deep learning networks
- digital video processing

Course Outcomes:

After successful completion of the course, the students are able to:

- Illustrate the principles and techniques of digital image in applications related to digital imaging system
- Understand various image preprocessing techniques and their significance.
- Analyze various standard deep learning networks for real time applications.
- Understand the fundamentals of digital video processing.

UNIT I **10 Periods (CO1)**

INTRODUCTION

Computer Vision – Image representation and image analysis tasks – Image representations -digitization – properties – color images – Data structures for Image Analysis – Levels of image data representation – Traditional and Hierarchical image data structures.

UNIT II **10 Periods (CO2)**

IMAGE PRE-PROCESSING

Local pre-processing – Image smoothing – Edge detectors – Zero-crossings of the second derivative – Scale in image processing – Canny edge detection – Parametric edge models – Edges in multi-spectral images – Local preprocessing in the frequency domain – Line detection by local pre-processing operators – Image restoration.

UNIT III **10 Periods (CO2)**

VGGNet and AlexNet Networks

Technical requirements , AlexNet and VGG Neural Networks, VGG16 architecture, Difference between VGG16 and VGG19, Developing solutions using AlexNet and VGG

UNIT IV **10 Periods (CO3)**

Face Recognition And Gesture Recognition

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.

UNIT V **10 Periods (CO4)**

VIDEO ANALYTICS

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet architecture-RestNet and skip connectionsInception Network-GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3**.**

Learning Resources:

Text Book:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013

2. VaibhavVerdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021.

Reference Books:

3) .Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011

2). E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press

		L	T	P	C	Int	Ext
ADEL24	**Industry Recommended Elective**	**3**	**-**	**-**	**3**	**40**	**60**