RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University, Chennai)
Choice Based Credit System (CBCS)
REGULATIONS – 2023
B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
CURRICULUM AND SYLLABUS

Vision

To promote highly Ethical and Innovative Computer Professionals through excellence in teaching, training and research.

Mission

- To produce globally competent professionals, motivated to learn the emerging technologies and to be innovative in solving real world problems.
- To promote research activities amongst the students and the members of faculty that could benefit the society.
- To impart moral and ethical values in their profession.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To equip students with essential background in computer science with emphasis on Artificial Intelligence, Machine Learning, basic electronics and applied mathematics.

PEO 2: To prepare students with fundamental knowledge in programming languages, and tools and enable them to develop applications using emerging technologies.

PEO 3: To encourage research and innovative project development in the field of Artificial Intelligence, Machine Learning, Deep Learning, Networking, Security, Web development, Data Science and also emerging technologies for social benefit.

PEO 4: To develop professionally ethical individuals enhanced with analytical skills, communication skills and organizing ability to meet industry requirements.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of Mathematics, Science, Engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

A graduate of the Artificial Intelligence and Machine Learning Program will demonstrate

PSO 1: Foundation Skills: Ability to understand, analyze and develop Intelligent systems based on Algorithms, Web design, Artificial Intelligence, Machine Learning, Deep Learning, and Data Science for efficient design of computer-based systems of varying complexity; familiarity and practical competence with a broad range of programming languages, tools and open source platforms.

PSO 2: Problem-Solving Skills: Ability to apply mathematical methods, model real world problem using appropriate Artificial Intelligence and Machine Learning algorithms and solve computational problems. To understand and apply standard practices and strategies in project development, using open-ended programming environments to deliver a quality product.

PSO 3: Successful Progression: Ability to apply knowledge in various domains to identify gaps and to provide solutions in the form of new ideas, inculcate passion towards higher studies, creating innovative career paths to be an entrepreneur and evolve as an ethically responsible Artificial Intelligence and Machine Learning professional with committed to society.

CURRICULUM

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
Regulation 2023 | Total Credits: 162

SEMESTER I

SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	HS23111	Technical Communication I	HS	2	2	0	0	2
2.	MA23116	Mathematical Foundations for AI	BS	4	3	1	0	4
3.	GE23117	தமிழர் மரபு / Heritage of Tamils	HS	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
4.	PH23132	Physics for Information Science	BS	5	3	0	2	4
5.	GE23131	Programming using C	ES	7	1	0	6	4
6.	EE23233	Basic Electrical and Electronics Engineering	ES	5	3	0	2	4
LABORATORY COURSE								
7.	GE23122	Engineering Practices-Electrical and Electronics	ES	2	0	0	2	1
NON CREDIT COURSES								
8.	MC23111	Indian Constitution and Freedom Movement	MC	3	3	0	0	0
			TOTAL	**29**	**16**	**1**	**12**	**20**

SEMESTER II

SI. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	MA23214	Probability and Inferential Statistics	BS	4	3	1	0	4
2.	GE23217	தமிழரும்தொழில்நுட்பமும்/Tamil andTechnology	HS	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
3.	GE23111	Engineering Graphics	ES	6	2	0	4	4
4.	IT23231	Digital Principles and Computer Architecture	PC	5	3	0	2	4
5.	AI23231	Principles of Artificial Intelligence	PC	5	3	0	2	4
6.	CS23231	Data Structures	PC	7	3	0	4	5
LABORATORY COURSE								
7.	HS23221/ HS23222	Technical Communication II / English for Professional Competence	HS	2	0	0	2	1
8.	GE23121	Engineering Practices-Civil and Mechanical	ES	2	0	0	2	1
9.	CS23221	Python Programming Lab	PC	4	0	0	4	2
			TOTAL	**36**	**15**	**1**	**20**	**26**

SEMESTER III								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	MA23313	Discrete Mathematics for AI	BS	4	3	1	0	4
LAB ORIENTED THEORY COURSES								
2.	AI23331	Fundamentals of Machine Learning	PC	5	3	0	2	4
3.	CS23331	Design and Analysis of Algorithms	PC	5	3	0	2	4
4.	CS23332	Database Management Systems	PC	7	3	0	4	5
5.	CS23333	Object Oriented Programming using Java	PC	7	1	0	6	4
NON CREDIT COURSE								
6.	MC23112	Environmental Science and Engineering	MC	3	3	0	0	0
			TOTAL	**31**	**16**	**1**	**14**	**21**

SEMESTER IV								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Open Elective-I	OE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
2.	MA23434	Optimization Techniques for AI	BS	5	3	0	2	4
3.	AI23431	Web Technology and Mobile Application	PC	5	1	0	4	3
4.	CS23431	Operating Systems	PC	7	3	0	4	5
5.	CS23432	Software Construction	PC	5	3	0	2	4
EMPLOYABILITY ENHANCEMENT COURSES								
6.	GE23421	Soft Skills - I	EEC	2	0	0	2	1
7.	AI23421	Internship	EEC					1
			TOTAL	**27**	**13**	**0**	**14**	**21**

SEMESTER V								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-I	PE	3	3	0	0	3
2.		Open Elective-II	OE	3	3	0	0	3
3.	AI23512	Data Engineering	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	AI23531	Deep Learning	PC	5	3	0	2	4
5.	AD23632	Framework for Data and Visual Analytics	PC	5	3	0	2	4
6.	CS23532	Computer Networks	PC	7	3	0	4	5
LABORATORY COURSE								
7.	AI23521	Build and Deploy Machine Learning Applications	PC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	GE23521	Soft Skills - II	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VI								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective – II	PE	3	3	0	0	3
2.	AI23611	Secure Systems Engineering	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3.	AI23631	Predictive and Prescriptive Analytics	PC	5	3	0	2	4
4.	AI23632	Natural Language Processing	PC	5	3	0	2	4
5.	CS23634	Fundamentals of Generative AI and Prompt Engineering	PC	4	2	0	2	3
6.	GE23627	Design Thinking and Innovation	EEC	3	1	0	2	2
EMPLOYABILITY ENHANCEMENT COURSES								
7.	GE23621	Problem Solving Techniques	EEC	2	0	0	2	1
			TOTAL	**25**	**15**	**0**	**10**	**20**

SEMESTER VII								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective – III	PE	3	3	0	0	3
2.		Professional Elective – IV	PE	3	3	0	0	3
3.	AI23711	Social and Ethical Issues in AI	PC	1	1	0	0	1
4.	AI23712	Reinforcement Learning	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
5.	IT23731	Cloud and Big data Architecture	PC	5	3	0	2	4
LABORATORY COURSE								
6.	AI23721	Project Phase-I*	EEC	8	0	0	8	4
			TOTAL	**23**	**13**	**0**	**10**	**18**

SEMESTER VIII								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-V	PE	3	3	0	0	3
2.		Professional Elective- VI	PE	3	3	0	0	3
LABORATORY COURSE								
3.	AI23821	Project Phase-II*	EEC	12	0	0	12	6
			TOTAL	**18**	**6**	**0**	**12**	**12**

'*'- Should have focus on Artificial Intelligence and Machine Learning

TOTALNO. OFCREDITS: 162

PROFESSIONALELECTIVES(PE)

Advance AI -I								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI23A31	Social Network Analysis	PE	4	2	0	2	3
2.	AI23A32	Large Language Models	PE	4	2	0	2	3
3.	AI23A33	AI for Game Programming	PE	4	2	0	2	3
4.	AI23A34	Text Mining	PE	4	2	0	2	3
5.	AI23A35	Recommendation Systems	PE	4	2	0	2	3
6.	AI23A36	Big Data Analytics	PE	4	2	0	2	3
7.	AI23A37	Computer Vision and Applications	PE	4	2	0	2	3

Advance AI -II								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI23B31	Knowledge Representation and Reasoning	PE	4	2	0	2	3
2.	AI23B32	Soft Computing	PE	4	2	0	2	3
3.	AI23B33	Introduction to AI Robotics	PE	4	2	0	2	3
4.	AI23B34	Human Computer Interaction	PE	4	2	0	2	3
5.	AI23B11	Information Visualization	PE	3	3	0	0	3
6.	AI23B12	Cognitive Science	PE	3	3	0	0	3

Full Stack Development								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	IT23B31	C# and .Net Programming	PE	4	2	0	2	3
2.	IT23B33	DevOps	PE	4	2	0	2	3
3.	IT23C12	Software Project Management	PE	3	3	0	0	3
4.	IT23C17	Ubiquitous Computing	PE	3	3	0	0	3
5.	IT23C31	Software Testing	PE	4	2	0	2	3
6.	CS23A35	Web Application Security	PE	4	2	0	2	3

Emerging Technologies								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	IT23A11	Internet of Things	PE	4	2	0	2	3
2.	CS23B32	Advanced Application Development with Oracle APEX	PE	6	0	0	6	3
3.	CS23A32	Robotic Process Automation	PE	4	1	0	4	3
4.	CB23G11	Quantum Computation and Quantum Information	PE	3	3	0	0	3
5.	CR23A33	Cryptocurrency and Blockchain Technologies	PE	4	2	0	2	3
6.	CS23A36	3D Printing and Design	PE	4	2	0	2	3
7.	CS23A33	Cyber Security and Forensics	PE	4	2	0	2	3

Cyber Security								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	CR23A11	Security Assessment and Risk Analysis	PE	3	3	0	0	3
2.	CS23A11	Malware Detection And Analysis	PE	3	3	0	0	3
3.	CR23A31	Ethical Hacking and Security	PE	4	2	0	2	3
4.	CR23A32	Digital and Mobile Forensics	PE	4	2	0	2	3
5.	CR23A33	Cryptocurrency and Blockchain Technologies	PE	4	2	0	2	3
6.	CR23A34	Security and Privacy in Cloud	PE	4	2	0	2	3
7.	CR23A35	Social Network Security	PE	4	2	0	2	3
8.	CS23A35	Web Application Security	PE	4	2	0	2	3
9.	CR23A36	Information Security And Management	PE	4	2	0	2	3

Virtual and Augmented Reality								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	CS23A37	Augmented Reality and Virtual Reality	PE	4	2	0	2	3
2.	CD23C22	Data Visualization	PE	6	0	0	6	3
3.	CS23A39	Game Development	PE	4	2	0	2	3
4.	CS23B31	Introduction to Metaverse	PE	4	2	0	2	3
5.	IT23E31	Graphics and Multimedia	PE	4	2	0	2	3
6.	CD23721	Visual Effects	PC	6	0	0	6	3
7.	CD23731	Film Making and Radio podcasting	PC	4	2	0	2	3

OPEN ELECTIVE COURSES OFFERED BY AIML

Open Electives-AI								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI23O11	Artificial Intelligence and Neural Network	OE	3	3	0	0	3
2.	AI23O31	Introduction to Machine Learning	OE	4	2	0	2	3
3.	AI23O21	Introduction to Robotic Process Automation	OE	6	0	0	6	3

SUMMARY OF ALL COURSES

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
S.NO	**Course Category**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HS	3	2	4						9
2	BS	8	4	4	4					20
3	ES	9	7							16
4	PC		13	16	12	14	14	8		77
5	PE					6	3	3	6	18
6	OE				3		3			6
7	EEC				2	1	3	4	6	16
8	MC									
	Total	**20**	**26**	**24**	**21**	**21**	**23**	**15**	**12**	**162**

AI APPLICATIONS as Minor degree for other branches

Total Credits: 18

AI Applications as Minor degree for other branches								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.		Principles of Artificial Intelligence	PE	5	3	0	2	4
2.		Fundamentals of Machine Learning	PE	5	3	0	2	4
3.		Computer vision and applications	PE	5	3	0	2	4
4.		Supply chain analytics	PE	4	2	0	2	3
5.		AI in Governance	PE	4	2	0	2	3
6.		AI in Health care	PE	4	2	0	2	3

AIML Hons – Choose

1 Course from Programme Specific Elective 1- 4 Credits
2 Courses from Programme Specific Elective 2- 3 Credits – 6 Credits
3 Courses from General Elective – 3 Credit – 9 Credits

Total Credits: 19

Students are permitted to do the following activates in their due course, after successful completion, students can drop any one professional /Open elective course (Max 3 credits)

Guidelines for Special Projects / Activities for AIML, AIDS and CSD

S.no	Description	Credits	To be Completed	Compulsory	Optional	Professional or Open Elective can be dropped in
1	**GE23527** Research Paper **L T P C: 0 0 2 1**	1	on or before VI Semester		AIML, AIDS & CSD	Additional credits or combine with other online courses eligible drop in VII or VIII Semester
2	**GE23427** Games/Short Film/ Animation Videos/ Animated Educational Content **L T P C : 0 0 6 3**	3	on or before VI Semester	CSD	AIML & AIDS	Not applicable for CSD, but for others in VII or VIII Sem (3 - credits Course only
3	**GE23428** Interdisciplinary Societal Project / Real World Web & Mobile Applications/ Innovative Product **L T P C : 0 0 6 3**	3	on or before VI Semester		AIML , AIDS &CSD	VII or VIII Sem (3 - credits Course only
4	**GE23429** Participation in National /International competitions **L T P C : 0 0 6 3**	3	on or before VI Semester		AIML , AIDS &CSD	VII or VIII Sem (3 - credits Course only

GE23527 Research Paper writing (Eligible to drop 1 credit course Professional / Open elective course (if any) or combined with other online courses, eligible to drop one Professional/Open Elective (Max 3 credits) in VII or VIII semester)	L T P C : 0 0 2 1

Research Paper –Guideline

Activities:

- Individual work
- Each student has to identify the domain area
- Select any 5 conferences/Journal papers to understand their work (published within 5 years)
- Write a research paper on comparative study on the following topics
  - Aim of the paper
  - Problem statement identified
  - Methodology to solve the problem
  - Tools used to solve the problem
  - Result of the problem
  - Identify the error or defect in the result
  - Identify the future work / enhancement of this result

Assessment:

- The **Research Paper writing** shall be evaluated for a maximum of 100 marks, as a Continuous Assessment
- A guide will be assigned to each student to monitor the progress and conduct the review meetings.
- Finally, student has to submit the research paper on comparative study
- The viva-voce examination will be conducted with external faculty member from other/same department(s)

Continuous Assessment 100 Marks		
Review I **Guide**	**Review II** **Guide**	**Viva-Voce** **External (from other department)**
30	30	40

Evaluation - To be given as a Rubric – some components

- Introduction/Topic - introduction grabs interest of reader and states topic. Thesis/topic clear, well-developed, and a definitive statement.
- Topic Focus –The topic is focused narrowly enough for the scope of this assignment. A thesis statement provides direction for the paper, either by statement of a position or hypothesis.
- Content - Balanced presentation of relevant and legitimate information that clearly supports a central purpose or argument and shows a thoughtful, in-depth analysis of a significant topic. Concepts are integrated into the writer's own insights.
- Depth of Discussion - In-depth discussion & elaboration in all sections of the paper. Sources support the thesis argument in a logical manner. References are correctly cited.
- Evaluation and Results – Appropriate evaluation Measure & Results Comparison with existing work
- Conclusion -Summary of thesis argument with concluding ideas that impact reader. Introduces no new information
- Review Presentations
- Writing - Writing is clear and relevant, with no grammatical and/or spelling errors – polished and professional. Reference, citations and images are properly formatted.
- Length - Paper is the not more than 10 pages specified in the assignment.

- References–(atleast 7) Quality -Sources include both general background sources and specialized sources. All web sites utilized are authoritative.

CATEGORY	**Obtained**	**9-10 points**	**7-8 points**	**4-6 points**	**0-3 points**
Introduction/Topic					
Topic Focus					
Content					
Depth of Discussion					
Evaluation and Results					
Conclusion					
Review Presentations					
Writing					
Length					
References					
Total:					

Passing Requirements:

- The student should secure 50% marks in Continuous Assessment to pass in the subject
- If a student fails in this course he/she has to redo this course in subsequent semesters.

GE23427 Games/Short Film/ Animation Videos / Animated Educational Content (Eligible to drop one Professional/Open Elective(Max 3-credits) in VII or VIII semester)	L T P C : 0 0 6 3

Activities:

- Team Size : Maximum 2 students
- Team has to identify the problem statement of game/ Educational video content / short film/ Animated video
- Committee (consist of Project coordinator, Faculty member and guide) has to approve the team proposal to proceed further
- Team has to develop GAME/Video
- Team has to submit the report

Assessment:

- The **Game/Short Film/ Animation Videos /Animated Educational Content** shall be evaluated for a maximum of 100 marks, as a Continuous Assessment
- A guide will be assigned to each team to monitor the progress and conduct the review meetings.
- Finally, each student in the team has to submit the project report
- The viva-voce examination will be conducted with external faculty members from other/same department
- Based on the quality of the project, committee can approve to publish in YouTube.

Continuous Assessment 100 Marks		
Review I Guide	**Review II Guide**	**Viva-Voce External (from other department)**
30	30	40

Passing Requirements:

- The student should secure 50% marks in Continuous Assessment to pass in the subject
- For CSD students, this course is compulsory, in such a case , If a student fails in this course he/she has to redo this course in subsequent semesters
- For branch students, on successful completion of this project work, students are eligible to drop one Professional o/Open Elective (Max. 3 credits) in VII or VIII Semesters

GE23428 Interdisciplinary Societal Project / Real World Web or Mobile Applications / Innovative Product (Eligible to drop one Professional/Open Elective(Max 3-Credits) in VII or VIII semester)	L T P C : 0 0 6 3

Activities:

- Team Size : Maximum 2 students
- Team has to identify the problem statement to solve
- Committee (consist of a Project coordinator, a Faculty member and a guide) has to approve the team proposal to proceed further
- Team has to develop a project
- Team has to submit the Project report

Assessment:

- The **Project work** shall be evaluated for a maximum of 100 marks, as a Continuous Assessment
- A guide will be assigned to each team to monitor the progress and conduct the review meetings.
- Finally, each student in the team has to submit the project report
- The viva-voce examination will be conducted with external faculty members from other/same department
- Based on the quality of the project, committee can approve to publish in YouTube.

Continuous Assessment 100 Marks		
Review I **Guide**	**Review II** **Guide**	**Viva-Voce** **External (from other department)**
30	30	40

Passing Requirements:

- The student should secure 50% marks in Continuous Assessment to pass in the subject
- on successful completion of the project work, students are eligible to drop one Professional or Open Electives (3 credits) in VII or VIII Semesters

GE23429 **Participation in National /International competitions** (Eligible to drop one Professional/Open Elective (Max 3-credits) in VII or VIII semester)	**L T P C 0 0 6 3**

Activities:

- Team Size : Maximum 3 students
- Team has to identify National / International level competition
- Based on the problem statement GUIDE will be assigned
- Committee (consist of Project coordinator, Faculty member and guide) has to approve the proposal of the team to proceed further
- Team has to prepare and participate in the competition
- Team has to submit the final report

Assessment:

- Committee (consist of Project coordinator, Faculty member and guide) has to evaluate the report and should conduct viva-voce examination

Viva-Voce
50 Marks

Passing Requirements:

- The student should secure 50% marks in the Viva-voce examination
- Eligible students can drop one Professional or Open Elective (Max. 3 credits) in VII or VIII Semesters

SEMESTER I						
Subject Code	**Subject Name (Theory course)**	**Category**	**L**	**T**	**P**	**C**
HS 23111	**TECHNICAL COMMUNICATION I**	**HS**	**2**	**0**	**0**	**2**
Common to all branches of B.E/B. Tech programmes – First Semester						

Objectives:
To facilitate students develop their comprehension skills
To enable students to improve their receptive skills
To equip learners with better vocabulary and enhance their writing skills
To aid students speak effectively in all kinds of communicative contexts.
To improve the learners' basic proficiency in workplace communication

UNIT-I	**DEVELOPING COMPREHENSION SKILLS**	6
Listening: Introduction to Informational listening – Listening to Podcasts, News **Reading**: Short Narratives and Skimming Passages. **Speaking:** Introducing Oneself, Narrating a Story / Incident. **Writing:** Sequential Writing (Jumbled Sentences), Process Description **Grammar:** Verbs – Main & Auxiliary: Simple Tenses – Form, Function and Meaning. **Vocabulary**: Word formation – Prefix, Suffix, Compound Words.		
UNIT-II	**LISTENING AND EXTENDED READING**	6
Listening: Deep Listening – Listening to Talk Shows and Debates **Reading**: In-depth Reading - Scanning Passages **Speaking**: Describing Current Issues, Happenings, etc.., **Writing**: Note Making, Note Taking – Paragraph Writing **Grammar**: Continuous Tenses, Prepositions, Articles **Vocabulary**: One Word Substitutes, Phrasal Verbs.		
UNIT-III	**FORMAL WRITING AND VERBAL ABILITY**	6
Listening: Listening to Lectures and Taking Notes **Reading:** Interpretation of Tables, Charts and Graphs **Speaking:** SWOT Analysis on Oneself **Writing:** Formal Letter Writing and Email Writing **Grammar:** Perfect Tenses, Phrases and Clauses, Discourse Markers **Vocabulary :** Verbal Analogy / Cloze Exercise		
UNIT-IV	**ENHANCING SPEAKING ABILITY**	6
Listening: Listening to eminent voices of one's interest (Martin Luther King, APJ Abdul Kalam, etc..)		

Reading: Timed Reading, Filling KWL Chart. **Speaking:** Just a Minute, Impromptu **Writing:** Check-list, Instructions. **Grammar:** 'Wh' Questions / 'Yes' or 'No' Questions, Imperatives **Vocabulary:** Synonyms, Antonyms, Different forms of the same words.		
UNIT-V	**LANGUAGE FOR WORKPLACE**	6
Listening: Extensive Listening (Audio books, rendering of poems, etc.) **Reading**: Extensive reading (Jigsaw Reading, Short Stories, Novels) **Speaking**: Short Presentations on Technical Topics **Writing:** Recommendations, Essay Writing **Grammar:** Impersonal Passive, Reported Speech, Concord **Vocabulary :** Informal Vocabulary and Formal Substitutes		
		Total Contact Hours: 30

Course Outcomes:
On completion of the course students will be able to
apply their comprehension skills and interpret different contents effortlessly
read and comprehend various texts and audio visual contents
infer data from graphs and charts and communicate it efficiently in varied contexts
participate effectively in diverse speaking situations
present, discuss and coordinate with their peers in workplace using their language skills

SUGGESTED ACTIVITIES

- Ice breaker
- Just A Minute
- Ship wreck
- Hot seat
- Vocabulary building
- Chinese whispers
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):
1. Effective Technical Communication by M. Ashraf Rizvi (Author) 2nd Edition Paperback 2017
2. Sylvan Barnet and Hugo Bedau, 'Critical Thinking Reading and Writing', Bedford/st. Martin's: Fifth Edition (June 28, 2004)
3. Meenakshi Upadhyay, Arun Sharma – Verbal Ability and Reading Comprehension.
4. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:
1. Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers 2nd Edition by Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor)
2. Reading Development and Difficulties By Kate Cain
3. The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK
4. Everybody Writes: Your Go-To Guide to Creating Ridiculously Good Content Hardcover by Ann Handley (Author)

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HS23111. 1	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 3	-	1	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23111. 4	-	-	-	2	-	-	-	-	1	3	-	-	-	-	-
HS23111. 5	-	-	-	1	-	-	-	-	1	3	-	-	-	-	-
Average	-	1	-	1.2	-	-	-	-	1	3	-	-	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
MA23116	MATHEMATICAL FOUNDATIONS FOR AI	BS	3	1	0	4
Common to	I Sem- B.Tech AI&DS and AIML					

Objectives:
• To gain knowledge in using matrix techniques and the concepts of rank and nature of the matrix.
• To gain knowledge in using matrix algebra techniques and the concepts of basis and dimension in vector spaces.
• To understand normalization finding ortho-normal vectors .
• To understand the concepts of source coding techniques
• To understand the techniques of calculus which are applied in the Engineering problems..

UNIT-I	MATRICES AND QUADRATIC FORMS	12
Matrices : Types - Symmetric and Skew – symmetric matrices, Hermitian matrix, Unitary matrix and Orthogonal matrices – Rank, Inverse and Trace of a matrix - Eigen values and eigenvectors- Diagonalization of matrices using orthogonal transformation - Quadratic forms - Reduction to canonical form using orthogonal transformation.		
UNIT-II	**VECTOR SPACES**	**12**
Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation - Null space, Range and dimension theorem.		
UNIT-III	**INNER PRODUCT SPACES**	**12**
Inner product and norms - Gram Schmidt orthonormalization process - Modified Gram Schmidt ortho-normalization process - QR Factorization-Singular value decomposition -Principal component analysis.		
UNIT-IV	**INFORMATION THEORY**	**12**
Measure of Information, Entropy, Source coding theorem - Shannon-Fano codes & Huffman codes, Discrete Memoryless channel, Mutual information, Channel Capacity, Shannon-Hartley theorem.		
UNIT-V	**FUNCTIONS OF SEVERAL VARIABLES**	**12**
Partial differentiation–Total derivative–Change of variables–Jacobians–Partial differentiation of implicit functions–Taylor's series for functions of two variables–Maxima and minima of functions of two variables–Lagrange's method of undetermined multipliers.		
Total Contact Hours: 60		

Course Outcomes: On completion of the course students will be able to:
• Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix for solving problems.
• Use concepts of basis and dimension in vector spaces in solving problems
• Use concepts of normalization in inner products solving problems and to construct orthonormal basis using inner products.
• Apply the various source coding techniques on communication systems
• Analyze, sketch and study the properties of different curves and to handle functions of several variables and problems of maxima and minima.

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic

- Problem solving sessions
- Activity Based Learning(Vector products using Scilab, Linear algebra using online calculator)
- Implementation of small module(https://www.wolframalpha.com/calculators/eigenvalue-calculator)

SUGGESTED EVALUATION METHODS

- Tutorial problems

- Assignment problems
- Quizzes
- Class Discussion

Text Book(s):

1. Grewal B.S., " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. T Veerarajan , Linear Algebra and Partial Differential Equations, Mc Graw Hill Education,2019. http://library.lol/main/3FE18B4BC738F2D3130E2FD17B3CBB3A
3. T Veerarajan, Engineering Mathematics –I , Mc Graw Hill Education, 2018. http://library.lol/main/D84CE246DE69AD78EFC9998B4045EB65
4. Simon Haykin, "Communication Systems", 3rd Edition John Wiley & sons, 2001.
5. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", 2nd Edition, Pearson Education, 2006.

Reference Books(s) / Web links:

Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt.Ltd, New Delhi, 2016. http://library.lol/main/507B45BE17BFBD29CDC32752A1AFCFB3

- Friedberg, A.H., Insel, A.J. and Spence, L., ―Linear Algebra‖, Prentice - Hall of India, New Delhi, 2004.
- Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

CO - PO – PSO matrices of course

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA23116.1	3	2	1	-	-	-	-	-	-	-	1	-	1	1	-
MA23116.2	3	3	-	-	-	-	-	-	-	-	-	-	1	1	-
MA23116.3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
MA23116.4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23116.5	2	2	-	-	-	-	-	-	-	-	1	1	-	1	-
Average	2.4	2.2	1	-	-	-	-	-	-	-	1	1	1	1	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

GE23117 **தமிழர் மரபு** **L T P C**

1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழிக் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Subject Code	Subject Name	Category	L	T	P	C
PH23132	PHYSICS FOR INFORMATION SCIENCE For Sem 1: Common to -B.E. CSD., B.Tech,- AIML, AI&DS For Sem 2: Common to – B. E. CSE, B.Tech.- IT	BS	3	0	2	4

Objectives:

- To understand the principles of laser and fibre optics in engineering and technology.
- To analyze the properties of magnetic and superconducting materials.
- To understand the advanced concept of quantum theory and applications.
- To become proficient in semiconductor applications
- To become proficient in optoelectronic devices

UNIT-I	LASERS AND FIBRE OPTICS	9

Lasers: Population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –Nd-YAG Laser, Semiconductor lasers: Homojunction and Heterojunction- Applications of Lasers and Holography. Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers -Fibre optic communication system - fiber optic sensors: pressure and displacement.

UNIT-II	MAGNETIC AND SUPERCONDUCTING MATERIALS	9

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility -Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage –Introduction of Superconductivity, Properties of Superconductors, BCS theory (Qualitative), Type-I and Type II Superconductors -Magnetic Levitation-SQUIDS-Cryotrons.

UNIT-III	QUANTUM PHYSICS	9

Introduction- Quantum free electron theory-De Broglie's concept-Schrodinger wave equation-Time independent and time dependent equations-Physical significance of wave function - Particle in a one dimensional box – electrons in metals -degenerate states – Fermi- Dirac statistics – Density of energy states -Size dependence of Fermi energy – Quantum confinement – Quantum structures –Quantum wells, Quantum wires, Quantum dots and Quantum clusters - Band gap of nanomaterials.

UNIT-IV	SEMICONDUCTOR PHYSICS	9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors –- Carrier concentration in intrinsic semiconductors – Band gap determination- extrinsic semiconductors (Qualitative)- Formation of P-N junction-Forward bias- Reverse bias-Hall effect -Ohmic contact-Schottky diode- Tunnel diode.

UNIT-V	OPTOELECTRONICS	9

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) – Photo electric effect-Photo current in a P-N diode – Photo transistor-solar cell - LED – Organic LED- Non Linear Optical materials-properties and applications.

	Contact Hours	:	45

List of Experiments

1	Determine the size of the microparticle using diode laser and wavelength of the laser using grating.
2	Determine the angle of divergence of laser beam and numerical aperture and acceptance
3	Study the permeability of the free space using Helmoltz coil.
4	Determine the hysteresis loss in the transformer core using B-H curve unit.
5	Determine the band gap of given semiconductor.

6	Determine the Hall coefficient of semiconducting material.			
7	Determine specific resistance of the material of given wires using metre bridge.			
8	Study the resonance frequency in series connected LCR circuits.			
9	Determine the V-I characteristics of the solar cell.			
10	Determine the thickness of the given specimen by using air wedge method.			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Course Outcomes:

On completion of the course, the students will be able to

- Use the concepts of Laser and Fiber optics in communication.
- Use the properties of magnetic and superconducting materials in data storage devices.
- Apply the concepts of electron transport in nanodevices.
-
- Analyze the properties of optical materials for optoelectronic applications.

Suggested Activities

- Problem solving sessions

Suggested Evaluation Methods

- Quizzes
- Class Presentation / Discussion

Text Book(s):

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley 2012.
3. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.

Reference Books(s) / Web links:

1. S. O. Pillai, Solid state physics, New Age International, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education, 2009.

List of Equipment Available

(Common to B.E. CSD and CSE & B.Tech. AI&DS, AI & ML, IT)

S. No	Name of the equipment	Quantity Required	Quantity Available	Deficiency
1	Wavelength of Laser and Characteristics -Laser source and grating plate	7	15	-
2	Laser - angle of divergence and NA acceptance angle	6	8	-
3	Determination of permeability of free space - Helmholtz coil setup	5	5	-
4	B-H curve Setup and CRO	6	7	-
5	Band gap of a semiconductor Setup	6	19	-
6	Hall coefficient of Semiconductor Setup	4	4	-
7	Determine specific resistance of the material of given wires-metre bridge	6	6	-
8	LCR circuit kit	6	7	-
9	Solar cell parameters setup	6	8	-
10	Thickness of thin wire-Air wedge method- Travelling Microscope, Glass Plate	8	13	-

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
PH23132. 1	3	3	2	2	2	1	-	-	-	-	-	2	1	1	1
PH23132.2	3	3	2	2	3	1	1	-	-	-	-	2	1	1	1
PH23132.3	3	3	2	2	3	1	1	-	-	-	-	2	2	1	1
PH23132. 4	3	3	2	2	3	1	1	-	-	-	-	2	2	1	1
PH23132.5	3	3	2	2	3	1	1	-	-	-	-	2	2	1	1
Average	3.00	3.00	2.00	2.00	2.80	1.00	1.00	0.00	0.00	0.00	0.00	2.00	1.80	1.00	1.00

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
GE23131	PROGRAMMING USING C	PC	1	0	6	4
Common to						

Objectives:
• To develop simple algorithms for arithmetic and logical problems.
• To develop C Programs using basic programming constructs
• To develop C programs using arrays and strings
• To develop applications in C using functions , pointers and structures
• To develop applications using structures and union

List of Experiments	
1.	Overview of C, Constants, Variables and Data Types
2.	Operators and Expressions, Managing Input and Output Operations
3.	Decision Making and Branching
4.	Decision Making and Looping
5.	Nested Loops - while and for, Jumps in Loops
6.	One-Dimensional Arrays
7.	Searching Algorithms - Linear and Binary
8.	Sorting Algorithms - Bubble and Selection
9.	Two-Dimensional and Multi-dimensional Arrays
10.	Character Arrays and Strings Handling Functions
11.	User-Defined Functions - Recursive Functions
12.	Passing Arrays and Strings to Functions
13.	Scope, Visibility and Lifetime of Variables
14.	Structures and Unions
15.	Pointers
16.	The Preprocessor
Platform Needed: GCC Compiler for Windows/Linux	
	Total Contact Hours: 90

Text Book(s):
1. Brian W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Second Edition, PHI
2. Byron Gottfried, “Programming in C”, Second Edition, Schaum Outline Series

Reference Books(s) / Web links:
• Herbert Schildt, “C: The Complete Reference”, Fourth Edition, McGraw Hill.
• YashavantKanetkar, “Let Us C”, BPB Publications
• E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
• NPTEL course , “Problem Solving Through Programming In C”, By Prof. Anupam Basu, IIT Kharagpur

Course Outcomes:
• To formulate simple algorithms for arithmetic and logical problems.
• To implement conditional branching, iteration.
• To decompose a problem into functions and synthesize a complete program.
• To use arrays, pointers and structures to formulate algorithms and programs.
• To apply programming to solve simple numerical method problems.

Suggested Activities
Practice small and tricky codes Practice problems in portals like Digital Café Debugging the codes Completing the function definitions etc

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19141.1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	-
GE19141.2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
GE19141.3	1	1	2	1	1	-	-	-	-	-	1	1	2	2	-
GE19141.4	2	2	3	2	1	-	-	-	1	-	2	1	2	2	2
GE19141.5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	2
Average	1.4	1.6	2.2	1.6	1.0	-	-	-	1.0	2.0	1.4	1.0	2.0	2.2	2.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
EE23233	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	ES	3	0	2	4

Objectives:

- To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
- To impart knowledge on the analysis of AC circuits
- To expose the principles of electrical machines and electronic devices.
- To teach the concepts of different types of electrical measuring instruments and transducers.
- To experimentally analyze the electrical circuits and machines, electronic devices and transducers.

UNIT-I	DC CIRCUITS	9

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff 's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.

UNIT-II	AC CIRCUITS	9

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations series resonance. Three phase balanced circuits, voltage and current relations in star and delta connections

UNIT-III	ELECTRICAL MACHINES	9

Construction, Principles of operation of DC machines, Single phase Transformers, Synchronous machines, Single phase induction motors.

UNIT-IV	ELECTRONIC DEVICES & CIRCUITS	9

Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction diode–Forward and Reverse Bias – Bipolar Junction Transistor – Common Emitter characteristics –Introduction to operational Amplifier – Inverting Amplifier –Non Inverting Amplifier.

UNIT-V	MEASUREMENTS & INSTRUMENTATION	9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Piezoelectric, - Classification of instruments - PMMC and MI Ammeters and Voltmeters – Digital Storage Oscilloscope.

Contact Hours	**:**	**45**

List of Experiments

1	Verification of Kirchhoff's Laws.
2	Load test on DC Shunt Motor.
3	Load test on Single phase Transformer.
4	Load test on Single phase Induction motor.
5	Characteristics of P-N junction Diode.
6	Characteristics of CE based NPN Transistor.
7	Characteristics of LVDT, RTD and Thermistor.

Contact Hours	**:**	**30**
Total Contact Hours	**:**	**75**

Course Outcomes:

On completion of the course, the students will be able to

- analyse DC circuits and apply circuit theorems.
- calculate the power and power factor in AC circuits
- understand the principles of electrical machines.
- comprehend the principles of different types of electronic devices, electrical measuring instruments and transducers.
- experimentally analyze the electric circuits and machines, electronic devices, and transducers.

Suggested Activities

- Problem solving sessions

Suggested Evaluation Methods

- Quizzes
- Class Presentation / Discussion

Text Book(s):

1	J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria& Sons Publications, 2002.
2	Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum Series and Systems", Schaum"s Outlines, Tata McGrawHill, Indian. 5th Edison , 2017
3	Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

Reference Books(s) / Web links:

1	Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2	John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3	Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4	Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5	A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill

	Education(India) Private Limited, 2009
6	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
7	https://nptel.ac.in/courses/108108076

Lab Equipment Required:

Sl. No.	Name of the Equipment	Quantity Required (For a batch of 30 students)
1.	**Verification of ohms and Kirchhoff's Laws** 1. DC Regulated Power supply (0 - 30 V variable) 2. Bread Board 3. Resistors 4. Multimeter 5. Connecting wires	 1 1 As per Circuit diagram1 As Required
2.	**Load test on DC Shunt Motor.** 1. Ammeter MC (0-20A) 2. Voltmeter MC (0-300)V 3. Tachometer 4. Field Rheostat 500 Ω, 1.5 A 5. Connecting wires	 1 1 1 1 As Required
3.	**Load Test on Induction Motor** 1. Ammeter MI (0-20A) 2. Voltmeter MI (0-300)V 3. Wattmeter – 300V, 30 A 4. Tachometer – Digital 5. Connecting Wires 6. Single phase Induction motor	 1 1 1 1 As Required1
4.	**Load test on Single phase Transformer** 1. Ammeter (0-30) A, (0-5) A 2. Voltmeter (0-150)V, (0-300)V 3. Wattmeter – 300V, 5A, UPF 4. Autotransformer 5. Single phase Transformer 6. Connecting Wires	 **1** **1** **1** **1** **1** As Required
5.	**Characteristics of PN and Zener Diodes** 1. PN Diode (IN4007), Zener diode (6.8V, 1A) 2. Resistor 1 KΩ, 100Ω 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	 1 1 1 1 1 As Required
6.	**Characteristics of BJT** 1. Transistor (BC107) 2. Resistors- 1kΩ, 470KΩ, 1MΩ 3. Bread Board 4. DC Regulated Power supply (0 - 30 V variable) 5. Multimeter 6. Connecting wires	 1 1 1 1 1 As Required
7.	**Measurement of displacement of LVDT, RTD and Thermistor** 1. LVDT Kit 2. RTD 3. Thermistor 4. Multimeter	 1 1 1 1 1

CO – PO – PSO matrices of course

COs/POs&PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	3		3	1	1	2	1	1	1			
CO 2	3	3	3	3		3	1	1	2	1	1	1			
CO 3	3	3	3	3		3	1	1	2	1	1	1			
CO 4	3	3	3	3		3	1	1	2	1	1	1			
CO 5	3	3	3	3		3	1	1	2	1	1	1			
Average	**3**	**3**	**3**	**3**		**3**	**1**	**1**	**2**	**1**	**1**	**1**			

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
GE23122	ENGINEERING PRACTICES - ELECTRICAL AND ELECTRONICS	ES	0	0	2	1

Objectives:

- To provide hands-on experience on various basic engineering practices in Electrical Engineering.
- To impart hands-on experience on various basic engineering practices in Electronics Engineering.

List of Experiments

A. ELECTRICAL ENGINEERING PRACTICE

1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of electrical quantities – voltage, current, power & power factor in RL circuit.
5	Measurement of resistance to earth of electrical equipment.
6	Study of Ceiling Fan and Iron Box

B. ELECTRONICS ENGINEERING PRACTICE

1	Study of electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2	(a) Study of Multimeter (b) Testing of electronic components.
3	Study of logic gates AND, OR, EXOR and NOT.
4	Generation of Clock Signals.
5	Soldering practice – Components Devices and Circuits – Using general purpose PCB.
6	Measurement of ripple factor of HWR and FWR.

Total Contact Hours	**:**	**30**

Course Outcomes:

On completion of the course, the students will be able to

- fabricate the electrical circuits
- construct the house wiring circuits
- fabricate the electronic circuits
- verify the truth table of logic gates
- design the AC-DC converter using diodes and passive components

SUGGESTED EVALUATION METHODS

- Experiment based Viva

REFERENCE

1	Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
2	Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.

3	Jeyapoovan T., Saravanapandian M. &Pranitha S., "Engineering Practices Lab Manual",Vikas Publishing House Pvt.Ltd, 2006.
4	Rajendra Prasad A. &Sarma P.M.M.S., "Workshop Practice", SreeSai Publication, 2002.

Lab Equipment Required:

S.	Name of the Equipment	Quantity Required
1	Residential house wiring using switches, fuse, indicator, lamp and energy	3 Nos
2	Fluorescent lamp wiring.	3 Nos
3	Stair case wiring	3 Nos
4	Measurement of electrical quantities – voltage, current, power & power	2 Nos
5	Study purpose items: Iron box, Ceiling fan.	2 each
6	Megger (250V/500V)	2 Nos.
7	Soldering guns	10 Nos.
8	Assorted electronic components for making circuits	50 Nos.
9	Small PCBs	10 Nos.
10	Multimeters	10 Nos.
11	Digital trainer kit	5 Nos.
12	CRO	8 Nos.
13	Transformer	8 Nos.
14	Function Generator	8 Nos.

CO-PO-PSO-Mapping

COs/POs&PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	-	-	2	-	3	2	-	3			
CO 2	3	3	2	2	-	-	2	-	3	2	-	3			
CO 3	3	3	3	2	-	-	2	-	3	2	-	3			
CO 4	3	3	3	2	-	-		-	3	2	-	3			
CO 5	3	3	3	2	-	-		-	3	2	-	3			
Average	**3**	**3**	**2.67**	**2**	**-**	**-**	**2**	**-**	**3**	**2**	**-**	**3**			

Correlation levels 1, 2 or 3 are as defined below: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC23111	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	3	0	0	0
	Common to all branches of B.E/B. Tech Programmes – First / Second/third Semester					

Objectives:
• To apprehend the sacrifices made by the freedom fighters.
• To inculcate the values enshrined in the Indian constitution.
• To instill a sense of responsibility as the citizens of India.
• To familiarize about the functions of the various levels of Government.
• To be informed about Constitutional and Non- Constitutional bodies.

UNIT-I	**INDIAN FREEDOM MOVEMENT**	9
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
UNIT-II	**CONSTITUTION OF INDIA**	9
Historical Background – Indian Constitution: Constitution' meaning of the term, Sources and constitutional history, Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.		
UNIT-III	**STRUCTURE AND FUNCTIONS OF CENTRAL GOVERNMENT**	9
Union Government – Structure of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-IV	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCAL BODY**	9
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati Raj: Introduction, Elected officials and their roles, Village level: Role of Elected and Appointed officials.		
UNIT-V	**CONSTITUTIONAL FUNCTIONS AND BODIES**	9
Indian Federal System – Centre – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.		
Total Contact Hours: 45		

Course Outcomes: Upon completion of the course, students will be able to:
• appreciate the sacrifices made by freedom fighters during freedom movement.
• be responsible citizens and abide by the rules of the Indian constitution.
• be aware of the functions of the Indian government.
• be knowledgeable about the functions of the state Government and the Local bodies.
• apply the knowledge on constitutional functions and role of constitutional bodies and non-constitutional bodies.

SUGGESTED ACTIVITIES

- Famous speeches from around the world relating to independence
- Case study
- Quiz on Portfolio and Cabinet
- Discussions on International Associations like the UN, BRICS, QUAD
- Presentation on issues around the world

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes

- Class Presentation/Discussion
- Continuous assessments (CAT)

Text Book(s):
1. M. Laxmikanth , “Indian Polity:, McGraw-Hill, New Delhi.
2. Durga Das Basu, “Introduction to the Constitution of India “, Lexis Nexis, New Delhi. 21st ed 2013.
3. P K Agarwal and K N Chaturvedi ,PrabhatPrakashan, New Delhi, 1st ed , 2017.

Reference Books(s) / Web links:
1. Sharma, Brij Kishore, “Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, “Indian Political System “, New Academic Publishing House, Jalaendhar
3. Bipan Chandra, India’s Struggle for Independence, Penguin Books, 2016.
4. Maciver and Page, “Society: An Introduction Analysis “, Mac Milan India Ltd., New Delhi.2nd ed, 2014.
5. Bipan Chandra, History of Modern India, Orient Black Swan, 2009.

CO-PO-PSO-Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: “-”

SEMESTER II

Subject Code	Subject Name	Category	L	T	P	C
MA23214	PROBABILITY AND INFERENTIAL STATISTICS	BS	3	1	0	4
Common to	II Sem B.E., CSD, B.Tech. AIDS and AIML					

Objectives:
• To provide the required mathematical support in real life problems.
• To equip the students in using Statistical techniques to solve problems.
• To use the concept of non parametric testing for Non-Normal population
• To develop probabilistic models which can be used in several areas of Science and Engineering.
• To understand the use of statistical modelling for forecasting

UNIT-I	PROBABILITY - BAYES THEOREM	12
Probability models and axioms- Conditioning and Bayes' rule – Discrete random variables: Binomial and Poisson distributions - Multiple discrete random variables: joint PMFs, expectations, conditioning - Continuous random variables: Uniform and Gaussian distributions - Multiple continuous random variables- Continuous Bayes rule.		
UNIT-II	**STATISTICAL TESTING**	**12**
Bayesian statistical inference- Maximal Likelihood estimation : Parameters of Binomial and Poisson distribution- Test of hypotheses: tests of significance – Z, Chi square, F test.		
UNIT-III	**NON PARAMETRIC TESTS**	**12**
Sign test -Wilcoxon signed rank test - Mann Whitney test - Run test - Kolmogorov Smirnov test - Spearmann and Kendall's test - Tolerance region.		
UNIT-IV	**LINEAR STATISTICAL MODELS**	**12**
Scatter diagram- Linear Regression and Correlation- Least squares method- Rank correlation- Multiple regression and multiple correlation- Analysis of variance (one way, two way).		
UNIT-V	**BASICS OF TIME SERIES**	**12**
Stationary Time Series - ARIMA models: Identification, Estimation and Forecasting		
		Total Contact Hours: 60

Course Outcomes:
On completion of the course students will be able to
• Apply the basic concepts of probability and random variables.
• Obtain statistical data from experiments and to analyze the same using statistical test.
• Use the concept of non parametric testing for Non-Normal population
• Apply the concept of correlation, regression and analysis of variance in real life situation.
• Apply the concept of Time series Analysis in real life situation

SUGGESTED ACTIVITIES

- Problem solving sessions
- MATLAB and GeoGebra https://www.geogebra.org/?lang=en https://login.mathworks.com/embedded-login/landing.html?cid=getmatlab&s_tid=gn_getml
- Time series forecasting using R program

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1. T. Veerarajan, 'Probability, Statistics and Random Processes with Queueing Theory and QueueingNetworks' ,McGraw Hill, 2016. https://dokumen.pub/qdownload/probability-statistics-and-random-processes-with-queueing-theory-and-queueing-networks-4nbsped-9339218558-9789339218553.html
2. Goon, M. Gupta and B. Dasgupta, "Fundamentals of Statistics", Vol. I & II, A., World Press. http://125.22.75.155:8080/view/web/viewer.html?file=/bitstream/123456789/13979/3/Fundamentals%20of%20Statistics%20Vol%20one%20Sixth%20Revised%20Edition.pdf https://ia804709.us.archive.org/32/items/in.ernet.dli.2015.462524/2015.462524.Fundamentals-Of-Statistics-Vol-2.pdf
3. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi. https://ia801706.us.archive.org/20/items/higher-engineering-mathematics-bs-grewal/Higher%20Engineering%20Mathematics%20BS%20Grewal.pdf
4. John F. Shortle, James M. Thompson, Donald Gross, Carl M. Harris, "Fundamentals of Queueing Theory", Wiley series in Probability and Statistics, 5thedition, 2018. http://library.lol/main/CB08696D9B4FE8289B5BE19FD5783E1F
5. Chris Chattfield, "The analysis of Time series: An Introduction" http://library.lol/main/251E2917F932D6CAE441AD5305971C11

Reference Books(s) / Web links:
• S.M. Ross, "A first course in Probability",Prentice Hall,8th edition, 2010. http://julio.staff.ipb.ac.id/files/2015/02/Ross_8th_ed_English.pdf
• R. Johnson, "Miller &Freund's Probability and Statistics for Engineers", (9th Edition), PHI. http://library.lol/main/5B975EF87B5E4F3500CCB5A8621B76C3
• Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2016. http://library.lol/main/FBCC848A75832ED38DA5736E798B87E8

CO-PO-PSO-Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
MA23214.1	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
MA23214.2	3	2	1	1	-	-	-	-	-	-	-	1	-	1	-
MA23214.3	3	2	2	2	-	-	-	-	-	-	-	1	-	1	-
MA23214.4	2	2	1	1	-	-	-	-	-	-	-	1	-	1	-
MA23214.5	3	2	2	1	-	-	-	-	-	-	-	1	-	1	-
Average	2.8	2	1.5	1.25	-	-	-	-	-	-	-	1	1	1	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial(High) No correlation: "-"

Course Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
GE23111	ENGINEERING GRAPHICS	ES	2	0	4	4

Objectives:
● To understand the importance of the drawing in engineering applications
● To develop graphic skills for communication of concepts, ideas and design of engineering products
● To expose them to existing national standards related to technical drawings.
● To improve their visualization skills so that they can apply this skill in developing new products.
● To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination)		1
Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications– Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.		
UNIT-I	**PLANE CURVES AND PROJECTION OF POINTS**	**5+12**
Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method – Cycloidal Curves–Construction of cycloid, epicycloid and hypocycloid – Construction of involutes of square andcircle– Drawing of tangents and normal to the above curves.Principles of Projection and Projection of points.		
UNIT-II	**PROJECTION OF LINES AND PLANE SURFACES**	**6+12**
Projection of straight lines (First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
UNIT-III	**PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principalplanes by rotating object method. Sectioning of solids in simple vertical position when the cutting plane is inclined to HP and perpendicular to VP –obtaining true shape of the section. Practicing three-dimensional modeling of simple objects by CAD software (Not for examination)		
UNIT-IV	**DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS**	**12**
Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders and cones .Model making of isometric projection of combination of solids as assignment (Not for End semester)		
UNIT-V	**FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS**	**12**
Free Hand sketching: Freehand sketching of multiple views from pictorial views of objects - Freehand sketching of pictorial views of object from multiple views .Perspective projection of simple solids-Prisms, pyramids, cylinder and cone by visual ray method.		
Total Contact Hours: (L=30; P=60) 90 Periods		

Course Outcomes: After learning the course, the students should be able
● To construct different plane curves and to comprehend the theory of projection
● To draw the basic views related to projection of lines and planes
● To draw the projection of simple solids and to draw the projection of development of surfaces of Sectioned solids in simple vertical position
● To draw the orthographic projection from pictorial objects and Isometric projections of simple solids
● To visualize Perspective view of simple solids

Text Book(s):	
1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2	Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017.
3	Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
Reference Books(s) :	
1	Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt.Ltd., 2013.
2	V.B Sikka "Civil Engineering Drawing", S.K Kataria & Sons, New Delhi.
3	Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International (P)Limited, 2008.
4	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2017.

5	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill Publishing Company Limited, New Delhi, 2018.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
GE23111.1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
GE23111.5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
Average	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

Correlation levels 1, 2 or 3 are as defined below: 1: Slight (Low)
2: Moderate (Medium) 3: Substantial
(High) No correlation: "-"

GE23217 **தமிழரும் தொழில்நுட்பமும்** **L T P C**

1 0 0 1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கல்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் : 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr. S. Singaravelu)(Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr. S. V. Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies).
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
IT23231	DIGITAL LOGIC AND COMPUTER ARCHITECTURE	PC	3	0	2	4
Common to	AIML & AIDS					

Objectives:
To introduce basic postulates of Boolean algebra and the methods for simplifying Boolean expressions. To introduce Logic Gates and implementation of logic function using logic gates
To outline the formal procedures for the analysis and design of combinational and sequential circuits
To learn the basic structure and operation of digital computer.
To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations
To expose and make the students to learn about the memory system design and different ways of communicating with I/O devices and standard I/O interfaces.

UNIT-I	MINIMIZATION TECHNIQUES	9
Number System and Complements. **Fundamentals** : Boolean postulates and Laws – De-Morgan's Theorem – Principle of Duality – Boolean Expression – Minimization ofBoolean expressions -Sum of Products (SOP) – Product of Sums (POS). **Minimization Techniques:** Minimization of Boolean expressions using Boolean laws, Karnaugh map, Quine McCluskey method of minimization, don"t care conditions. **Logic Gates :** Basic Logic Gates, Universal Gates,		
UNIT-II	**COMBINATIONAL AND SEQUENTIAL CIRCUITS**	9
Combinational Circuits : Adder - Subtractor –Multiplexer- De multiplexer – Decoder – Encoder. **Sequential Circuits:** Latches – Flip Flops – Shift Registers.		
UNIT-III	**INTRODUCTION TO COMPUTER ARCHITECTURE & INSTRUCTIONS**	9
Introduction –RISC – CISC, Eight ideas – Components of a computer system – Technology – Performance – Power wall –Instructions – Operations & Operands, Representing instructions, Logical operations – Instructions for decision making- Addressing Modes. Case Study: Evolution of Intel x86 architecture.		
UNIT-IV	**ARITHMETIC AND LOGIC UNIT**	9
Design of ALU, Integer Arithmetic: Addition, Subtraction, Multiplication and Division – Floating Point Arithmetic: Representation, Addition, subtraction, Multiplication.		
UNIT-V	**MEMORY AND I/O SYSTEMS**	9
Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory – TLBs, Input/output system, programmed I/O, DMA and interrupts, I/O processors. Case Study: RAID		
	Total Contact Hours: 45	

Course Outcomes: On completion of the course, the students will be able to
• Simplify the Boolean expressions using basic postulates of Boolean algebra with suitable minimization techniques. Understand the use of electronic circuits involved in the design of logic gates.
• Apply the procedure to design and implement combinational and sequential circuits.
• Understand the impact of instruction set architecture on cost-performance of computer design.
• Perform computer arithmetic operations.
• Evaluate the performance of memory systems.

SUGGESTED ACTIVITIES
• Problem Based Learning • Flipped classroom

- Circuit Design using Software
- Students Seminar to improve technical presentation
- Quiz to check conceptual understanding

SUGGESTED EVALUATION METHODS

- Continuous Assessment Test
- Online Quiz Assignment
- Offline Assignments
- Circuit Design
- Practical Evaluation

Text Book(s):

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. David A. Patterson and John L. Hennessey, "Computer organization and design", 5th edition, Elsevier, 2014.

Reference Books(s) / Web links:

- Charles H.Roth, "Fundamentals of Logic Design", 7th Edition, Thomson Learning, 2014.
- Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
- Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
- Donald D.Givone, "Digital Principles and Design", TMH, 2003.
- Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", 2nd Edition, Pearson Education,2005.
- Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", 1st edition, Tata McGraw Hill, New Delhi, 2005.
- John P Hayes, "Computer Architecture and Organization",3rd edition, McGraw Hill, 2002.
- V.CarlHamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 6th edition, Mc Graw-Hill Inc, 2012.
- William Stallings, "Computer Organization and Architecture Designing for performance", 10th Edition, PHI Pvt. Ltd., Eastern Economy Edition 2016

Description of the Experiments	
1. Design and Implementation basic logic gates	
2. Design and Implementation universal gates	
3. Design and Implementation of adder using logic gate	
4. Design and Implementation of subtractor using logic gate	
5. Design and Implementation of Multiplexer using logic gates.	
6. Design and Implementation of De-multiplexer using logic gates.	
7. Design of Registers	
8. Design of ALU	
9. Design of Central Processing Unit	
10. Design of Memory	
Total Contact Hours: 15	

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic

- Experiment based viva
- Quizzes
- Mini Project

Web Links for Virtual Lab (If any)
http://vlabs.iitkgp.ernet.in/coa/
https://www.vlab.co.in/broad-area-computer-science-and-engineering
https://cse11-iiith.vlabs.ac.in/

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EC19243.1	2	2	1	2	2	-	-	-	-	-	-	1	1	2	-
EC19243.2	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.3	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
Average	1.2	1.2	1.8	1.2	1.2	-	-	-	-	-	-	1.6	1.6	2.0	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23231	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	PC	3	0	2	4

Objectives:	
●	To Understand the various characteristics of a problem solving agent
●	To Learn about the different strategies involved in problem solving
●	To Learn about solving problems with various constraints.
●	To Learn about various knowledge representation
●	To Understand the different models of reasoning and decision making

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT	9
AI-Introduction. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.		
UNIT-II	**SEARCH TECHNIQUES**	9
Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.		
UNIT-III	**CONSTRAINT SATISFACTION PROBLEMS AND GAME THEORY**	9
Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the min max search procedure, alpha-beta pruning.		
UNIT-IV	**KNOWLEDGE REPRESENTATION**	9
AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning.		
UNIT-V	**REASONING & DECISION MAKING**	9
Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. Decision networks, Markov Decision Process. Expert System		
	Contact Hours : 45	

List of Experiments		
1	Programs on Problem Solving	
	a.	Write a program to solve 8 Queens problem
	b.	Solve any problem using depth first search
	c.	Implement MINIMAX algorithm
	d.	Implement A* algorithm
2	Programs on Decision Making and Knowledge Representation	

	a.	Introduction to PROLOG i) Find minimum maximum of two numbers ii) Here are some simple clauses. likes(mary,food). likes(mary,wine). likes(john,wine). likes(john,mary). The following queries yield the specified answers. | ?- likes(mary,food). yes. | ?- likes(john,wine). yes. | ?- likes(john,food). no. How do you add the following facts? 1. John likes anything that Mary likes 2. John likes anyone who likes wine 3. John likes anyone who likes themselves
	b.	Implementation of Unification and Resolution Algorithm
	c.	Implementation of Backward Chaining
	d.	Implementation of Forward Chaining
3	Programs on Planning and Learning	
	a.	Implementation of Blocks World program
	b.	Implementing a fuzzy inference system

Contact Hours	**:**	**60**
Total Contact Hours	**:**	**105**

Lab Specifications:

- The lab can be implemented using Python or C.
- Knowledge representation experiments can be performed using a PROLOG TOOL.

Course Outcomes: On completion of the course, the students will be able to	
●	Basic knowledge representation, problem solving, and learning methods of artificial intelligence.
●	Provide the apt agent strategy to solve a given problem
●	Represent a problem using first order and predicate logic
●	Design applications like expert systems and chat-bot.
●	Suggest the different models of reasoning and decision making for any given problem

Text Books:	
1	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2022.
2	Denis Rothman, Artificial Intelligence By Example: Acquire advanced AI, machine learning, and deep learning design skills, Packt Publishing; 2nd edition, 2020
3	Deepak Khemani, A First Course in Artificial Intelligence , McGraw Hill Education, 2017

Reference Books:	
1	Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed.,2017.
2	Introduction to Artificial Intelligence & Expert Systems, Patterson, Pearson, 1st ed. 2015

WEB LINKS

- https://sites.cs.ucsb.edu/~yuxiangw/classes/AICourse-2022Spring/
- https://web.stanford.edu/class/archive/cs/cs221/cs221.1196/
- https://redirect.cs.umbc.edu/~ypeng/AICourseOld/471-671.html
- http://ai.berkeley.edu/lecture_slides.html
- https://www.cs.utexas.edu/~mooney/cs343/
- https://courses.cs.washington.edu/courses/csep573/22wi/
- https://www.cse.iitd.ac.in/~rohanpaul/teaching/2022-col333.html
- https://courses.grainger.illinois.edu/ece448/sp2022/

SUGGESTED ACTIVITIES

- Case study Discussion
- Flipped classroom – Comparing of Different Algorithms
- Activity Based Learning

SUGGESTED EVALUATION METHODS

- Mini Projects
- Assignment problems
- Quizzes

CO-PO-PSO-Mappings

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23231.1	3	3	1	-	2	1	1	1	1	-	2.2	1	2	1	1
AI23231.2	2	2	1	-	2	1	2	-	-	-	2	2	1	1	1
AI23231.3	3	3	1	-	3	-	1	-	-	-	3	1	2	3	2
AI23231.4	2	2	2	2	3	-	1	2	-	-	2	2	2	2	2
AI23231.5	2	3	-	-	2	1	1	1	-	-	2	2	2	2	2
Average	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	-	2.0	1.8	1.8	1.8	1.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
CS23231	DATA STRUCTURES Common To	PC	3	0	4	5

Objectives:	
●	To apply the concepts of Linked List in the applications of various linear data structures.
●	To demonstrate the understanding of stacks, queues and their applications.
●	To apply the concepts of Linked List in the applications of various nonlinear data structures.
●	To understand the implementation of graphs and their applications.
●	To be able to incorporate various sorting and hashing techniques in real time scenarios

UNIT-I	LINEAR DATA STRUCTURE -LIST	9
Self-Referential Structures, Dynamic Memory Allocation, Linked list implementation - Singly Linked List, Doubly Linked List, Circular Linked List, Applications of List.		
UNIT-II	**LINEAR DATA STRUCTURE –STACK AND QUEUE**	**8**
Stack – Operations, Array and Linked list implementation, Applications – Evaluation of Arithmetic Expressions, Queues-Operations, Array and Linked list Implementation.		
UNIT-III	**NONLINEAR DATA STRUCTURE -TREES**	**10**
Tree Terminologies, Binary Tree Representation, Tree Traversals, Binary Search Trees, Binary Heap, Height Balance Trees – AVL Trees.		
UNIT-IV	**NONLINEAR DATA STRUCTURE -GRAPH**	**9**
Representation of Graphs, Topological Sort, Depth First Search and Breadth-First Search , Minimum Spanning Tree – Prim's Algorithm, Shortest path algorithm – Dijikstra's Algorithm.		
UNIT-V	**SORTING AND HASHING**	**9**
Sorting Techniques –Insertion Sort, Quick Sort, Merge Sort, Hashing- Hashing functions – Mid square, Division, Folding, Collision Resolution Techniques – Separate Chaining – Open Addressing – Rehashing.		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Understand and apply the various concepts of Linear data Structures
●	Understand and apply the various concepts of Non Linear data Structures.
●	Understand and apply the various sorting and Hashing concepts.
●	Analyse and apply the suitable data structure for their research.
●	Choose efficient data structures and apply them to solve real world problems.

SUGGESTED ACTIVITIES

- **Role play-** Linked List **(Unit 1).**
- **Mind Map, Poster Design -** Stack and Queue **(Unit 2).**
- **Flipped Classroom -** Binary Heap **(Unit 3).**
- **Poster Design -** Graph **(Unit4).**
- **Implementation of small module-** Hashing **(Unit5).**

SUGGESTED EVALUATION METHODS

- **Assignment problems -** Linked List **(Unit 1).**
- **Tutorial problems -** Applications – Evaluation of Arithmetic Expressions **(Unit 2).**
- **Quizzes -** BST and Binary Heap **(Unit 3).**
- **Tutorial problems-** Graph traversal **(Unit 4).**
- **Quizzes - Hashing and Sorting(Unit5) .**

Text Books(s):	
1	"Data Structures and Algorithm Analysis in C", Mark Allen Weiss, 2nd Edition, Pearson Education, 2005
2	"Data Structures and Algorithm Analysis in C++ - Anna University, Mark Allen Weiss, Pearson Education, 2017.

Reference Books:	
1	"Data Structures Using C and C++", Langsam, Augenstein and Tanenbaum, 2nd Edition, Pearson Education, 2015.
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.

Description of Experiments (If applicable)		**Total Contact Hours: 60**
1	Implementation of Single Linked List (Insertion , Deletion and Display).	
2	Implementation of Doubly Linked List (Insertion , Deletion and Display).	
3	Implementation of Stack using Array and Linked List implementation.	
4	Implementation of Queue using Array and Linked List implementation.	
5	Implementation of Binary Search Tree and perform Tree Traversal Techniques.	
6	Program to perform Quick Sort	
7	Program to perform Merge Sort	
8	Program to perform Linear Probing.	
9	Program to perform Rehashing.	
10	**Mini Project:** • Contact book application using Linked List. • Dictionary using Binary search trees. • Snake Game. • Chess Game.	

	• Travel Planner (Shortest Path Algorithm). • Tic-Tac-Toe Game. • Library Management System. • Project Management System. • other projects .

Web links for Theory & Lab	
1	Data Structures - GeeksforGeeks
2	Data Structures | DS Tutorial - javatpoint
3	Data Structure and Types (programiz.com)

CO-PO-PSO-Mappings

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS19241.1	1	2	1	2	1	-	-	-	-	-	-	1	1	2	-
CS19241.2	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.3	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
Average	1.0	1.2	1.8	1.2	1.0	-	-	-	-	-	-	1.6	1.6	2.0	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS 23221	TECHNICAL COMMUNICATION II	HS	0	0	2	1
	Common to all branches of B.E/B. Tech programmes –Second Semester					

Objectives:
• To facilitate students to improve their vocabulary for a better communication
• To enable learners to understand and reproduce language
• To aid students to write technical reports in a convincing manner
• To expose students to different sentence structures
• To equip learners to present their ideas in an efficient manner

UNIT-I	VOCABULARY FOR BETTER COMMUNICATION	6

Listening: Telephonic Conversations and TV News

Reading: Newspapers and Magazines

Speaking: Conversational Practice: Speaking in a given situation, Asking permission and requesting etc..,

Writing: Job Application Letter and Resume

Grammar: Reference words: pronouns and determiners

Vocabulary: Guessing meanings of words in different contexts.

UNIT-II	FUNCTIONAL LANGUAGE ASPECTS	6

Listening: Motivational listening – listening to real life challenges

Reading: Articles and Technical reports

Speaking: Using Polite Expressions, Indirect Questions

Writing: Paraphrasing a Text, Poem

Grammar: Purpose Statements, Cause and Effect Expressions

Vocabulary: Neologisms.

UNIT-III	TECHNICAL REPORTWRITING	6

Listening: Empathetic Listening – Giving Solutions to Problems

Reading: Inferential Reading

Speaking: Dialogues – Interviewing Celebrities / Leaders / Sportspersons, etc..,

Writing: Report Writing

Grammar: Functional Usage of Expressions – used to, gone / been, etc..,

Vocabulary: Words Often Confused

UNIT-IV	STRUCTURAL GRAMMAR	6

Listening: Comprehension (IELTS practice tests)

Reading: Intensive Reading for specific information

Speaking: Pick and Talk

Writing: Proposals

Grammar: Sentence Structures – Simple, Compound, Complex Sentences **Vocabulary:** Replacing dull words with vivid ones		
UNIT-V	**PRESENTATION SKILLS**	6
Listening: Discriminative listening – sarcasm, irony, pun, etc.., **Reading:** Practice of chunking – breaking up reading materials **Speaking:** Mini presentation on some topic **Writing:** Minutes of the meeting **Grammar:** Correction of Errors **Vocabulary:** Advanced vocabulary – fixing appropriate words in the given context.		
Total Contact Hours: 30		

Course Outcomes:
On completion of the course students will be able to
• communicate effectively using appropriate vocabulary
• use the acquired language skills to comprehend various types of language contents
• evaluate different texts and write effective technical content
• use appropriate sentence structures to convey their thoughts in varied contexts
• present their concepts and ideas in an effective manner

SUGGESTED ACTIVITIES

- Story Lines
- One truth and two lies
- Hang Man
- Pictionary
- Word Scramble
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Text Book(s):

5. Raymond Murphy, “Intermediate English Grammar,” Second Edition , Cambridge University Press, 2018
6. Meenakshi Raman & Sangeeta Sharma, “Technical Communication” Third Edition, Oxford University Press, 2015
7. Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine ChuenMeng Goh, Cambridge University Press

Reference Books(s) / Web links:
1. Michael McCarthy (Author), Felicity O'Dell (Author), John D. Bunting (Contributor), "Basic Vocabulary in Use: 60 Units of Vocabulary Practice in North American English With Answers" 2nd Edition
2. Dale Carnegie, "The Art of Public Speaking," Insight Press
3. Jack C. Richards & Theodore S. Rodgers, " Approaches and Methods in Language Teaching, Second Edition, Cambridge University Press

CO-PO-PSO Mappings

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23221.1	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-
HS23221.2	-	-	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221.3	-	2	-	1	-	-	-	-	-	3	-	-	-	-	-
HS23221.4	-	-	-	1	-	-	-	-	2	3	-	-	-	-	-
HS23221.5	-	-	-	1	-	-	-	-	2	2	-	-	-	-	-
Average	-	2	-	1	0	0	0	0	2	2.6	-	-	-	-	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
HS 23222	ENGLISH FOR PROFESSIONAL COMPETENCE Common to all branches of B.E/B. Tech programmes –Second Semester	HS	0	0	2	1

Objectives:

●	To facilitate the learners in acquiring listening and reading competence
●	To enable the learners to communicate effectively through written and oral medium
●	To assist the learners in preparing for competitive examinations
●	To train the students in acquiring corporate skills
●	To inculcate professional standards among the students and make them realize their responsibility in addressing the challenges

UNIT-I	**RECEPTIVE SKILLS**	6

Listening – Comprehensive Listening – Watching the news – Listening to a peer giving presentation, etc. – Critical Listening – Watching a televised debate, Listening to poems – **Reading** – Extensive Reading – Short stories and One-act Plays – Intensive Reading – Articles or Editorials in Magazines, Blog posts on topics like science and technology, arts, etc.

UNIT-II	**PRODUCTIVE SKILLS**	6

Speaking – Demonstrative Speaking – Process description through visual aids – Persuasive Speaking – Convincing the listener with the speaker's view – **Writing** – Descriptive Writing - Describing a place, person, process – Subjective Writing – Autobiography, Writing based on personal opinions and interpretations

UNIT-III	**ENGLISH FOR COMPETITIVE EXAMS**	6

An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defence Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT-IV	**CORPORATE SKILLS**	6

Critical Thinking and Problem Solving – Case Study, Brainstorming, Q & A Discussion – **Team work and Collaboration** – Activities like Office Debates, Perfect Square, Blind Retriever, etc. – **Professionalism and Strong Work Ethics** – Integrity, Resilience, Accountability, Adaptability, Growth Mind set

UNIT-V	**PROJECT WORK**	6

Case Study based on the challenges faced by the employers and the employees – Devise Plan, Provide Solution

	Total Contact Hours		30

Course Outcomes:

On completion of the course, students will be able to

- interpret and respond appropriately in the listening and reading contexts.
- express themselves effectively in spoken and written communication
- apply their acquired language skills in writing the competitive examinations

• exhibit their professional skills in their work place
• identify the challenges in the work place and suggest strategies solutions

SUGGESTED ACTIVITIES

- Online Quizzes on Vocabulary
- Online Quizzes on grammar
- Communication Gap Exercises
- Presentations
- Word Building Games
- Case study

SUGGESTED EVALUATION METHODS

- Assignment topics
- Quizzes
- Class Presentation/Discussion
- Continuous Assessment Tests

Reference Books	
1	How to Read Better & Faster, Norman Lewis, Goyal Publishers
2	Teaching Speaking: A Holistic Approach, Book by Anne Burns and Christine Chuen Meng Goh, Cambridge University Press
3	The Official Cambridge Guide To IELTS by Pauline Cullen, Cambridge University Press
4	The 7 Habits of Highly Effective People by Stephen Covey, Simon and Schuster, UK

Reference Books(s) / Web links:

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.
2. Hartley, Mary. "The Power of Listening," JaicoPublishing House; First Edition (2015).
3. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.

CO-PO-PSO Mappings

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS23222. 1	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 2	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
HS23222. 4	-	-	-	-	-	-	2	2	-	3	-	-	-	-	-
HS23222. 5	-	-	1	-	-	-	2	-	-	3	-	-	-	-	-
Average	0	1	1	0	0	0	2	2	0	3	0	0	-	-	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

Course Code	Subject Name (Lab oriented Courses)	Category	L	T	P	C
GE23121	ENGINEERING PRACTICES – CIVIL AND MECHANICAL	ES	0	0	2	1

Objectives:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments				
CIVIL ENGINEERING PRACTICE				
1	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, andelbows in household fittings.			
2	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.			
3	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.			
Carpentry Works:				
4	Study of joints in roofs, doors, windows and furniture.			
5	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.			
MECHANICAL ENGINEERING PRACTICE				
6	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.			
7	Gas welding practice.			
Basic Machining:				
8	Simple Turning and Taper turning			
9	Drilling Practice			
Sheet Metal Work:				
10	Forming & Bending:			
11	Model making – Trays and funnels			
12	Different type of joints.			
Machine Assembly Practice:				
13	Study of centrifugal pump			
14	Study of air conditioner			
		Total Contact Hours	**:**	**30**

Course Outcomes: On completion of the course, the students will be able to
• Able to perform plumbing activities for residential and industrial buildings considering safety aspects while gainingclear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
• Able to perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
• Able to produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process whileacquiring in depth knowledge in the principle of operation of welding and other accessories
• Able to perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operationin drilling machine
• Able to perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays,funnels, etc.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
GE23121.1	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.2	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.3	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.4	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
GE23121.5	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1
Average	1	1	1	-	-	2	1	-	2	-	-	2	-	2	1

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Course Code	Course Title (Laboratory Course)	Category	L	T	P	C
CS23221	Python Programming Lab	PC	0	0	4	2

Objectives:	
•	Learn the basics of Python Programming and Control statements
•	Demonstrate various Python data structures like Lists, Tuples, Sets and dictionaries
•	Understand about Strings, Functions, Modules and Regular Expressions in Python Programming
•	Understand the concepts of file handling using Python
•	Understand the concepts of Numpy, Pandas, sciPy modules

Description of the Experiments	Total Contact Hours:60
1. Experiments based on Variables, Datatypes and Operators in Python.	
2. Implement various control statements in python.	
3. Implement various String & List operations.	
4. Implement Inbuilt functions, User-defined functions and Lambda functions.	
5. Implementation of Tuples, sets, Dictionary and its operations.	
6. Implementation of Exception Handling and I/O files.	
7. Experiments based on Packages : math, datetime, platform, re	
8. Experiments based on Packages : NumPy, pandas, matplotlib	
9. Experiments based on Packages : collections	
10. Experiments based on Packages :sciPy	
11. Mini Project	

Course Outcomes:	
On completion of the course students will be able to:	
●	Use the basics of Python Programming in problem solving and conditionals and loops.
●	Use of Python Data structures such as List, Sets, Tuples, Dictionary for Compound Data
●	Use Strings, Functions, Modules and Regular Expressions in Python Programming
●	Implement the concepts of file handling and Exceptional handling.
●	Apply Numpy, Pandas and SciPy for numerical and statistical data

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic
• Experiment based viva • Quizzes • Mind map • Logical thinking – solving case study problems problems • Implementation of small Systems

Web links for virtual lab (if any)
• https://www.python.org/shell/
• https://python-iitk.vlabs.ac.in/
• https://www.hackerrank.com/domains/python

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS19241.1	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS19241.2	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS19241.3	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS19241.4	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
CS19241.5	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-
Average	3	2	2	1	-	1	-	2	2	2	-	2	-	-	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)No correlation: "-"

SEMESTER III

Course Code	Subject Name (Theory course)	Category	L	T	P	C
MA23313	DISCRETE MATHEMATICS FOR AI	BS	3	1	0	4
Common to Artificial Intelligence & Data Science and Artificial Intelligence & Machine Learning						

Objectives:
● To extend student's Logical and Mathematical maturity and ability to deal with abstraction.
● To provide discrete structures of many levels and to know the principle of counting.
● To provide the basic principles of sets and operations in sets and to Prove basic set equalities.
● To introduce the concept of Number Theory using axioms, definitions, examples, theorems and their proofs.
● To model problems in Computer Science and Engineering using graphs and trees.

UNIT-I	**MATHEMATICAL LOGIC**	**12**
Propositional calculus: Propositions and Connectives- Syntax: Semantics –truth tables – validity and satisfiability- Tautology–Connectives: Functionally complete set –Equivalence and normal forms –Formal reducibility–Predicates and quantifiers-Nested Quantifiers-Rules of inference – Temporal logic – Three valued logic.		
UNIT-II	**COMBINATORICS**	**12**
Basic counting sum and product- Balls and bins problems – Generating functions – Recurrence relations- Proof Techniques – Principle of Mathematical Induction - Pigeon hole principle.		
UNIT-III	**STRUCTUREDSETS**	**12**
Set- Relation: Equivalence relations, Poset, Hasse diagram, Lattices –Boolean algebra–Algebraic System: Groups, Semi groups, monoid, homomorphism -Cosets and Lagrange's theorem-Rings and Fields(definition).		
UNIT-IV	**NUMBER THEORY**	**12**
Introduction - Divisibility - Primes - The binomial theorem-Congruences - Solutions of congruences - The Chinese - Remainder theorem - Techniques of numerical calculation.		
UNIT-V	**GRAPHS AND TREES**	**12**
Graph theory: Introduction to graphs- Graph isomorphism – Connectivity - Euler and Hamilton paths - Planar graphs - Trees –Properties- Distance and Centres – Types – Rooted Tree— Spanning Tree – Fundamental Circuits- Cut Sets – Properties –Connectivity - Separability -Graph coloring – Four color Theorem.		
Total Contact Hours: 60		

Course Outcomes: On completion of the course, students will be able to
● Demonstrate the ability to write and evaluate a proof or outline the basic structure and give examples of each proof technique described.
● Apply counting principles to determine probabilities in engineering problems.
● Analyse the concepts and properties of algebraic structures in the solving complex engineering problems.
● Work effectively as part of a group to solve challenging problems in Number Theory.
● Use different traversal methods for trees and graphs arising in the field of engineering and technology.

SUGGESTED ACTIVITIES
● Problem solving sessions
● Visio for drawing graphs

• Online Calculators for PDNF and PCNF, recurrence relations and sets • Online calculators for Logic gates • GeoGebra for Hasse diagrams and graphs
SUGGESTED EVALUATION METHODS • Problem solving in Tutorial sessions • Assignment problems • Quizzes and class test • Discussion in classroom

Text Books:	
1	Elements of Discrete Mathematics, (Second Edition) C. L. LiuMcGraw Hill, New Delhi.
2	Digital Logic & Computer Design, M. Morris Mano, Pearson.
3	Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
4	Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.
5	Bressoud D., Wagon S., "A Course in Computational Number Theory", Key College Publishing, New York, 2000.

Reference Books(s) / Web links:	
1	Introduction to linear algebra. Gilbert Strang.
2	Introductory Combinatorics, R. A. Brualdi, North-Holland, New York.
3	Graph Theory with Applications to Engineering and Computer Science, N. Deo, Prentice Hall, Englewood Cliffs.
4	Introduction to Mathematical Logic,(Second Edition), E. Mendelsohn, Van-Nostrand, London.
5	Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
6	Mathematical Logic for Computer Science,L. Zhongwan, World Scientific, Singapore.
7	Topics in Algebra, I. N. Herstein, John Wiley and Sons.

CO - PO – PSO matrices of course

COs/POs&PSOs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
MA23313.1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
MA23313.2	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
MA23313.3	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
MA23313.4	3	3	3	3	2	-	-	-	-	-	-	2	1		1
MA23313.5	3	3	3	3	2	-	-	-	-	-	-	2	1	1	2
Average	2	1	2	3	2	-	-	-	-	-	-	2	1	1	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23331	FUNDAMENTALS OF MACHINE LEARNING	PC	3	0	2	4
Common to AIML & AIDS						

Objectives:	
●	To know the fundamentals of machine learning.
●	Be exposed to linear models.
●	Be familiar with basic machine learning algorithms with classification.
●	To understand machine learning algorithms with clustering.
●	To learn and apply reinforcement learning techniques.

UNIT-I	FOUNDATIONS OF LEARNING	8
Components of learning – learning models – geometric models – probabilistic models – logical models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve.		
UNIT-II	**LINEAR MODELS**	**9**
Linear classification – univariate linear regression - bivariate regression – multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's – Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models – Bayesian Logistic Regression.		
UNIT-III	**SUPERVISED LEARNING**	**10**
Perceptron: – multilayer neural networks – back propagation - learning neural networks structures – **support vector machines:** – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation. **Decision trees**: Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy - **Ensemble methods:** Bagging- Boosting- Boosting AdaBoost - Gradient Boosting – Xg boost.		
UNIT-IV	**UNSUPERVISED LEARNING**	**10**
Clustering: Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees. **Dimensionality Reduction:** – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.		
UNIT-V	**REINFORCEMENT LEARNING**	**8**
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control.		
	Contact Hours : 45	

List of Experiments				
1	A python program to implement univariate regression, bivariate regression and multivariate regression.			
2	A python program to implement Simple linear regression using Least Square Method			
3	A python program to implement logistic model.			
4	A python program to implement single layer perceptron.			
5	A python program to implement multi layer perceptron with back propagation.			
6	A python program to do face recognition using SVM classifier.			
7	A python program to implement decision tree.			
8	A python program to implement boosting.			
9	A python program to implement KNN and K-means.			
10	A python program to implement dimensionality reduction – PCA.			
11	Mini project – develop a simple application using tensorflow / keras.			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Understand fundamentals of machine learning.
●	Apply the linear models for tuning parameters.
●	Understand and explore the machine learning algorithms with classification.
●	Apply machine learning algorithms with clustering and feature extraction.
●	Apply reinforcement learning techniques for various applications.

Text Books:	
1	Aurélien Géron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. September 21019, Reilly Media, Inc., ISBN: 9781492032649.
2	Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3	Shai Shalev-Shwartz and Shai Ben-David," Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press 2014.

Reference Books:	
1	Alex Smola and S.V.N. Vishwanathan," Introduction to Machine Learning", Cambridge University Press 2011.
2	Andreas C. Müller and Sarah Guido," Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, Inc,2016.
3	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.
4	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

Web links for virtual lab:	
1	https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So
2	https://nptel.ac.in/courses/106/106/106106139/

CO - PO – PSO matrices of course

COs/POs& PSOs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
AI23331.1	3	3	2	-	-	-	-	-	1	-	-	-	3	1	-
AI23331.2	3	3	3	2	-	2	-	-	-	-	-	2	2	3	-
AI23331.3	3	3	3	2	3	-	-	2	2	-	-	-	-	3	-
AI23331.4	3	3	3	-	3	1	-	-	-	-	1	2	2	-	-
AI23331.5	3	3	2	3	2	-	-	1	3	-	3	3	3	3	1
Average	3	3	2.6	1.4	1.4	0.6	-	0.6	0.8	-	0.6	1.4	2	2	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23331	**Design and Analysis of Algorithms** **Common to CSE, AIML, & AIDS**	PC	3	0	2	4

Objectives:	
•	Learn and understand the algorithm analysis techniques and complexity notations
•	Become familiar with the different algorithm design techniques for effective problem solving in computing.
•	Learn to apply the design techniques in solving various kinds of problems in an efficient way.
•	Understand the limitations of Algorithm power.
•	Solve variety of problems using different design techniques

UNIT I	INTRODUCTION TO ANALYSIS OF ALGORITHMS AND EXHAUSTIVE SEARCH	9
Introduction- Algorithm–Fundamentals of Algorithmic Problem Solving-Analysis: Space Complexity - Time Complexity: Counter method, Mathematical Analysis of non-recursive algorithms- Asymptotic Notations - Using Limits for Comparing Orders of Growth – Basic Efficiency Classes-Brute Force Technique-Exhaustive Search-Travelling Salesperson Problem-Knapsack Problem		
UNIT II	**RECURRENCE RELATION AND GREEDY TECHNIQUE**	10
Mathematical Analysis of Recursive algorithms -Recurrence Relation-Solving Recurrence Relations: Substitution methods and Master Theorem Method. Greedy Method – Minimum Spanning Trees: Kruskal's Algorithm– Fractional Knapsack - Huffman Codes-Activity Selection Problem.		
UNIT-III	**DIVIDE AND CONQUER TECHNIQUE**	7
Divide and Conquer Method-Introduction-Binary Search-Finding Min Max-Maximum Subarray Problem-Towers of Hanoi Problem-Finding the kth element-Analysis of Quick and Merge Sort.		
UNIT IV	**DYNAMIC PROGRAMMING TECHNIQUE**	9
Dynamic Programming-Rod Cutting-Longest Common Subsequence-Traveling Sales Person Problem-String Editing- Longest Common Substring-Longest non-decreasing subsequence-Stair Case Problem.		
UNIT-V	**BACKTRACKING BRANCH AND BOUND AND NP COMPLETE & NP HARD**	10
Backtracking-Graph Coloring-n Queen's Problem-Branch and Bound-Knapsack Problem-- NP Complete and NP Hard Problems: Basic Concepts - Non-Deterministic Algorithms - Class of NP Complete and NP Hard Problems-Approximation Algorithm- TSP.		
	Total Contact Hours : 45	

List of Experiments	
1	Finding Time Complexity of algorithms
2	Design and implement algorithms using Divide and Conquer Technique
3	Design and implement algorithms using Greedy Technique
4	Design and implement algorithms using Dynamic Programming
5	Competitive Programming-Certain Techniques

Contact Hours :	30

Course Outcomes:	
On completion of course you will be able to	
●	Analyze the time and space complexity of various algorithms and compare algorithms with respect to complexities.
●	Decide and apply Divide and Conquer design strategy to Synthesize algorithms for appropriate computing problems.
●	Decide and Apply Greedy technique to Synthesize algorithms for appropriate computing problems.
●	Decide and Apply Dynamic Programming technique to Synthesize algorithms for appropriate computing problems.
●	Decide and Apply Backtracking and Branch and Bound techniques to Synthesize algorithms for appropriate computing problems.

Suggested Activities:	
●	Complexity Analysis Exercises: Assign exercises where students practice calculating the space and time complexity of given algorithms using the counter method and mathematical analysis
●	Asymptotic Notations Quiz: Organize quizzes focusing on understanding and applying asymptotic notations to compare algorithm efficiency.
●	Greedy technique and Divide and Conquer Technique-Problem-Solving Contests-Host contests where students solve problems like the activity selection problem using greedy techniques, encouraging competitive learning.
●	Dynamic Programming-Case Studies on Optimization Problems-Discuss in-depth various optimization problems solved using dynamic programming, highlighting the strategy and solution steps.
●	Approximation Algorithm Projects: Assign projects where students explore and implement approximation algorithms for problems

Textbooks:	
●	Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012.
●	Ellis Horowitz, Shani, Sanguthevar Rajasekaran, "Computer Algorithms" Universities Press, Second Edition 2008.
●	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.

Reference Books (s)/Web links:	
1.	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
2.	Donald E. Knuth, “The Art of Computer Programming”, Volumes 1& 3 Pearson Education, 2009.
3.	Sara Baase Allen Van Gelder, "Computer Algorithms - Introduction to Analysis" Pearson Education Asia, 2010

4.	https://www.geeksforgeeks.org/fundamentals-of-algorithms/
5.	https://www.hackerrank.com/domains/algorithms

CO - PO – PSO matrices of course

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CS23331.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**2**
CS23331.2	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**1**
CS23331.3	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**1**
CS23331.4	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**1**
CS23331.5	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**1**
Average	**2.0**	**2.8**	**2.0**	**2.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1.0**	**3.0**	**2.8**	**1.2**

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23332	**Database Management Systems** **Common to CSE, AIML, & AIDS**	PC	3	0	4	5

Objectives:	
•	Understand the role of a database management system and construct simple and moderately advanced database queries using Structured Query Language (SQL).
•	Apply logical database design principles, including E-R diagrams, Relational Algebra, Tuple Relational calculus Representation and Query Processing
•	Know the importance of functional dependency and normalization, and what role it plays in the database design process and File Organization.
•	Understand the concept of a database transaction including concurrency control, backup and recovery, and data object locking and handling deadlocks.
•	Work with the foundation for No SQL technologies and web page designing

UNIT I	**DATABASE SYSTEMS AND SQL QUERY**	**9**
Introduction – Purpose of Database Systems - View of Data –Database Architecture -Database Schema – Keys – Codd's Rule –RDBMS- SQL: Data Definition – Domain types – Structure of SQL Queries - Modifications of the database – Set Operations – Aggregate Functions – Null Values- SQL Nested Subqueries – Complex Queries – Views – Joined relations – Complex Queries.		
UNIT II	**PL/SQL, DATA MODEL AND QUERY PROCESSING**	**9**
PL/SQL: Functions, Procedures, Triggers, Cursors –Dynamic SQL–Relational Algebra-Tuple Relational calculus-Domain Relational Calculus– Entity Relationship Model – Constraints -Entity Relationship Diagram - Design Issues of ER Model – Extended ER Features – Mapping ER Model to Relational Model– Query Processing – Heuristics for Query Optimization.		
UNIT-III	**NORMAL FORMS AND INDEXING**	**9**
Motivation for Normal Forms – Functional dependencies – Armstrong's Axioms for Functional Dependencies – Closure for a set of Functional Dependencies – Definitions of 1NF-2NF-3NF and BCNF – Multivalued Dependency 4NF - Joint Dependency- 5NF-File Organization-Indexing B+ tree ,B-Tree		
UNIT IV	**TRANSACTIONS**	**9**
Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency – Concurrency control –Two Phase Locking- Timestamp – Multiversion – Validation and Snapshot isolation– Multiple Granularity locking – Deadlock Handling – Recovery Concepts – Recovery based on deferred and immediate update – Shadow paging – ARIES Algorithm.		
UNIT-V	**NOSQL DATABASE**	**9**
NoSQL Database vs.SQL Databases – CAP Theorem –Migrating from RDBMS to NoSQL – MongoDB – CRUD Operations– MongoDB Sharding – MongoDB Replication – Web Application Development using MongoDB with Python and Java.		

	Total Contact Hours	**:**	**45**

List of Experiments		
1	Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.	
2	Data extraction from call logs using Sleuth Kit.	
3	Data extraction from SMS and contacts using Sleuth Kit.	
4	Extract installed applications from Android devices.	
5	Extract diagnostic information from Android devices through the adb protocol.	
6	Generate a unified chronological timeline of extracted records,	
7	Implement the sql query database and to handle sqlite in browser	
8	Hide Invisible Secrets in the initial screen using Steganography	
	Contact Hours:	**30**
	Total Contact Hours:	**75**

Course Outcomes:	
On completion of course you will be able to	
•	Understand the use of the Relational model and apply SQL Queries
•	Apply Pl/SQL, Dynamic SQL, understand the representation of Relational Algebra, Calculus and Query Processing
•	Understand the concept of normalization, Indexing and apply as a case study
•	Understand concurrency control and recovery mechanisms.
•	Use MongoDB NoSQL Database to Maintain Data of an Enterprise

Textbooks:	
•	Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, Seventh Edition, Mc Graw Hill, March 2019.
•	P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2013.

Reference Books (s)/Web links:	
1.	Ramez Elmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2016.
2.	C.J.Date, A.Kannan and S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
3.	Atul Kahate, “Introduction to Database Management Systems”, Pearson Education, New Delhi, 2006.
4.	Steven Feuerstein with Bill Pribyl,”Oracle PL/SQL Programming”,sixth edition, Publisher: O'Reill 2014
5.	MongoDB: The Definitive Guide, 3rd Edition,by Kristina Chodorow, Shannon Bradshaw,Publisher: O'Reilly Media,2019
6.	ShashankTiwari,” Professional NoSQL”, Wiley, 2011.
7.	David Lane, Hugh.E.Williums, Web Database Applications with PHP and MySQL, O’Reilly Media; 2nd edition, 2004

CO - PO – PSO matrices of course

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CS23332.1	2	2	2	-	-	-	-	-	1	-	-	1	2	2	-
CS23332.2	2	2	3	3	3	-	-	-	2	1	2	1	2	1	-
CS23332.3	2	2	2	2	2	-	-	-	2	1	2	1	1	2	1
CS23332.4	2	2	2	2	2	-	-	-	1	1	-	-	1	2	1
CS23332.5	2	2	2	4	2	-	-	-	2	-	2	2	1	2	3
Average	2.0	2.0	2.2	2.8	2.3	-	-	-	1.6	1.0	2.0	1.3	1.4	1.8	1.7

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23333	Object Oriented Programming Using Java	PC	1	0	6	4

Objectives:	
•	To understand Object Oriented Programming concepts and characteristics of Java.
•	To know the principles of classes, abstraction and inheritance.
•	To create packages, define exceptions and use interface.
•	To use I/O streams and collections in applications.
•	To design and build simple programs using Streams, Lambda and JDBC

UNIT I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	3
Introduction to Object Oriented Programming – An overview of Java - Java Architecture - Data Types - Variables- Operators.		
UNIT II	**CLASSES AND INHERITANCE**	3
Classes – Class Fundamentals - A Simple Class - Declaring Objects - Methods – Constructors Inheritance - Inheritance Basics - Member Access - Method Overriding - Abstract Classes - Object Class		
UNIT-III	**PACKAGES, INTERFACE & EXCEPTION HANDLING**	3
Packages - Defining a Package - Access Protection - Imports - Interfaces - Implements - Nested Interfaces - Exception Handling - Types - try - catch - throw - throws – finally.		
UNIT IV	**I/O AND COLLECTIONS**	3
Input / Output Basics – Streams – Byte streams and Character streams – Collection Interfaces – Collection Classes.		
UNIT-V	**STREAMS API, LAMBDA AND JDBC**	3
Stream API – Reduction – Parallel – mapping – Collecting – Iterator - Lambda Expressions Functional Interfaces - Predefined Functional Interfaces - Accessing Databases with JDBC		
	Total Contact Hours :	15

List of Experiments	
1	Programs using control structures.
2	Programs using arrays.
3	Programs using strings and string buffer.
4	Programs using classes and objects.
5	Programs using inheritance.
6	Programs using default & static methods in interfaces.
7	Programs using functional interface.
8	Programs to create user defined exceptions.
9	Programs to implement Object Serialization.
10	Programs using collections-LIST.

11	Programs using collections-SET.	
12	Programs using collections-MAP.	
13	Programs using STREAMS.	
14	Programs using LAMBDA.	
15	Simple applications using JDBC.	
	Contact Hours :	60
	Total Contact Hours :	75

Course Outcomes:	
On completion of the course, the students will be able to	
●	Develop Java programs using OOP principles and Strings.
●	Develop Java programs with the concepts inheritance.
●	Build Java applications using exceptions and interfaces.
●	Develop Java applications using I/O and collections.
●	Develop interactive Java applications using Streams and JDBC.

Suggested Activities:	
●	**Quizzes –** basic concepts of JAVA & language basics **(Unit 1).**
●	**Tutorial –** Class & Inheritance **(Unit 2).**
●	**Flipped Classroom –** Packages & Interface **(Unit 3).**
●	**Mind Map, Poster Design –** IO & Collections **(Unit4).**
●	**Implementation of small Systems-** JDBC **(Unit5).**

Textbooks:	
●	Herbert Schildt, “Java The Complete Reference”, 9th Edition, McGraw Hill Education, 2014
●	Cay S. Horstmann, Gary Cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.

Reference Books (s)/Web links:	
1.	Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.
2.	Steven Holzner, “Java 2 Black book”, Dreamtech press, 2011.
3.	Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.
4.	SCJP Sun Certified Programmer for Java 6 Study Guide. 6th edition, McGrawHill.
5.	https://www.javatpoint.com/java-tutorial
6.	https://java-iitd.vlabs.ac.in/
7.	https://www.hackerrank.com/domains/java

CO - PO – PSO matrices of course

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CS23333.1	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CS23333.2	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CS23333.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CS23333.4	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
CS23333.5	3	3	3	3	3	-	2	-	2	2	3	3	3	3	3
Average	3	3	3	2.6	3	-	2	-	2	2	3	3	3	3	2.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
MC23112	ENVIRONMENTAL SCIENCE AND ENGINEERING	MC	3	0	0	0
Common to Artificial Intelligence & Machine Learning and Artificial Intelligence & Data Science.						

Objectives:
• To develop the understanding of environmental and associated issues
• To develop an attitude of concern for the environment
• To promote enthusiasm in participating environmental protection initiatives
• To nurture skills to solve environmental degradation issues
• To develop the knowledge about the environmental laws

UNIT-I	AIR AND NOISE POLLUTION	9
Definition –sources of air pollution –chemical and photochemical reactions in the atmosphere –formation of smog, PAN, acidrain, ozone depletion, particulate pollutants-Air quality standards-Air quality indices - control of particulate air pollutants-gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter),electro static precipitators(ESP)-catalytic converters. Noise pollution –sources -health effects - standards- measurement and control methods.		
UNIT-II	**WATER POLLUTION AND ITS MANAGEMENT**	9
Definition-causes-effects of water pollution-point and nonpoint sources of waste water-marine pollution – thermal pollution – Control of water pollution by physical, chemical and biological methods – waste water treatment-primary, secondary and tertiary treatment-sources and Characteristics of industrial effluents-zero liquid discharge.		
UNIT-III	**SOLID WASTE AND HAZARDOUS WASTE MANAGEMENT**	9
Solid waste – types- municipal solid waste management: sources, characteristics, collection, and transportation-sanitary landfill, recycling, composting, incineration, energy recovery options from waste – Hazardous waste–types ,characteristics, and health impact –hazardous waste management: neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal. E-waste-definition-sources-effects on human health and environment-E-waste management- steps involved - Role of E-waste management within the initiatives of the Govt. of India- Swachh Bharat Mission.		
UNIT-IV	**SUSTAINABLE DEVELOPMENT**	9
Sustainable development- concept-dimensions-sustainable development goals - value education-gender equality – food security - poverty – hunger - famine- Twelve principles of green chemistry –Green technology - definition, importance –Cleaner development mechanism - carboncredits,carbontrading,carbonsequestration,ecolabeling-International conventions and protocols-Disaster management.		
UNIT-V	**ENVIRONMENTAL MANAGEMENT AND LEGISLATION**	9
Environmental Management systems - ISO 14000 series- Environmental audit-Environmental Impact Assessment-life cycle assessment- human health risk assessment – Environmental Laws and Policy- Objectives - Polluter pays principle, Precautionary principle - The Environment (Protection) Act 1986 - Role of Information technology in environment and human health.		
Total Contact Hours:45		

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

- Associate air and noise quality standards with environment and human health.
- Illustrate the significance of water and devise control measures for water pollution.
- Analyze solid wastes and hazardous wastes.
- Outline the goals of sustainable development in an integrated perspective.
- Comprehend the significance of environmental laws.

SUGGESTED EVALUATION METHODS

- Continuous assessment tests
- Assignments
- Case studies, class room presentations (or) site visit

Text Book(s):

1. Benny Joseph, 'Environmental Science and Engineering',TataMcGraw-Hill,NewDelhi,2016
2. Anubha Kaushik and C.P.Kaushik's "Perspectives in Environmental Studies", 6thEdition, New Age International Publisher, 2018.
3. JohriR., E-waste: implications, regulations and management in India and current global best practices, TERIPress, New Delhi

Reference Books(s) / Web links:

- R.K.Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, EnviroMedia.38. Edition2010.
- Cunningham, W.P.Cooper, T.H.Gorhani,'Environmental Encyclopedia', JaicoPubl.,House,Mumbai,2001.
- FowlerB, Electronic Waste–1stEdition(Toxicology and Public Health Issues), 2017 Elsevier
- NPTEL course url
  https://onlinecourses.nptel.ac.in/noc19_ge22/
  NPTEL
  https://news.mit.edu/2013/ewaste-mit

1. For downloading text/reference books the weblink is given below can be used
   http://libgen.rs/

CO - PO – PSO matrices of course

COs/POs& PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
MC23112.1	1	2	3	1	-	2	2	2	1	1	1	2	-	1	-
MC23112.2	1	2	3	1	-	2	2	2	1	1	1	2	-	1	-
MC23112.3	-	-	3	1	-	2	3	2	1	-	1	2	-	1	-
MC23112.4	-	1	2	1	1	3	3	2	1	1	1	2	-	-	-
MC23112.5	-	1	2	-	-	2	2	2	1	2	2	2	-	-	-
Average	0.4	1.2	2.6	0.8	0.2	2.2	2.4	2	1	1	1.2	2	-	0.6	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

SEMESTER IV

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
BA23512	FUNDAMENTALS OF ACCOUNTING	HS	3	0	0	3
Common to Artificial Intelligence &Data Science and Artificial Intelligence & Machine Learning						

Objectives:	
•	To create an awareness about the importance and usefulness of the accounting concepts and their managerial implications.
•	To develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements.
•	To create awareness about cost accounting, different types of costing and cost management.
•	Understand how financial statement information can help solve business problems and increase the ability to read and understand financial statements and related information

UNIT-I	INTRODUCTION TO ACCOUNTING	9
Introduction to accounting : Meaning – Types of Accounting- Financial Accounting – Cost Accounting – Management Accounting – Users of accounting information -Accounting Cycle- Processing Accounting information.		
UNIT-II	**FINANCIAL ACCOUNTING**	**9**
Book Keeping and Record Maintenance, Fundamental Principles and Double Entry, Journal format - Ledger format- Trial Balance format (Elementary Problem) - Format of Final Accounts- Introduction to Capital Expenditure and Capital Revenue		
UNIT-III	**ANALYSIS OF FINANCIAL STATEMENTS**	**9**
Types of Financial Statements- Tools and techniques of Financial Statement analysis – Ratio analysis (Elementary Problems) – Trend Analysis and Trend Ratio (Problems)		
UNIT-IV	**MANAGEMENT ACCOUNTING**	**9**
Comparative and Common Size Financial Statements – Working Capital Estimation (Elementary Problem) – Introduction to Cash flow and Funds Flow statement – Difference between Cash flow and Funds Flow Statements		
UNIT-V	**COST ACCOUNTING**	**9**
Elements of Cost, Cost Behavior, Cost Sheet - Marginal Costing- Break Even Point Analysis (Elementary Problems) - Cost Volume Profit Analysis- Budgets- Types - Flexible Budget and Fixed Budget (Elementary Problems)		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
•	Understand the theories, concept, and evolution of management.
•	Demonstrate the ability to employ the management way of thinking.
•	Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc.
•	Understand the qualities of a leader in the managerial aspect in future terms.
•	Understand the managerial ethics and CSR and its importance.

Text Books:	
1	Robert N Anthony, David Hawkins, Kenneth Marchant, “Accounting: Texts and Cases”, Thirteenth Edition, McGraw-Hill, 2017.
2	M.Y.Khan&P.K.Jain, “Management Accounting”, Tata McGraw Hill, 2011.
3	R.Narayanaswamy, Financial Accounting – A managerial perspective, Fifth Edition, PHI Learning, New Delhi, 2011.

Reference Books:	
1	Jan Williams, “Financial and Managerial Accounting – The basis for business Decisions”, Fifteenth Edition, Tata McGraw Hill Publishers, 2010.
2	Horngren, Surdem, Stratton, Burgstahler, Schatzberg, “Introduction to Management Accounting”, Sixteenth Edition, PHI Learning, 2014.
3	Stice&Stice,” Financial Accounting Reporting and Analysis”,Eight Edition, Cengage Learning, 2010.
4	SinghviBodhanwala, “Management Accounting -Text and cases”, Third Edition, PHI Learning, 2018.
5	Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsevier, 2009.

CO - PO – PSO matrices of course

COs/POs&PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
BA23512.1	2	1	2	1	2	3	2	2	-	-	2	2	-	-	-
BA23512.2	2	1	2	2	2	3	3	3	-	-	2	2	-	-	-
BA23512.3	2	1	2	3	2	3	2	2	-	-	2	2	-	-	-
BA23512.4	2	1	2	3	2	3	1	1	-	-	2	2	-	-	-
BA23512.5	2	1	2	3	2	3	2	2	-	-	2	2	-	-	-
Average	2	1	2	2.4	2	3	2.2	2	-	-	2	2	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-“

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
MA23434	OPTIMIZATION TECHNIQUES FOR AI	BS	3	0	2	4
Common to Artificial Intelligence &Data Science and Artificial Intelligence &Machine Learning						

Objectives:
• To enumerate the fundamental knowledge of Linear Programming problems.
• To develop formulation skills in transportation and assignment models and finding solutions.
• To formulate and solve the pure integer, mixed integer or 0-1 integer linear programming models.
• To analyse the problems of unconstrained nonlinear programming and to know the necessary and sufficient conditions for the solution of unconstrained problems.
• To find the best ways to crash project schedule, shortening total project duration and the ways to save money by adjusting activity durations and optimizing resource requirements.

UNIT-I	INTRODUCTION TO OPTIMIZATION	9
Convex sets, Convex function-Linear Optimization: formulation, solution by graphical and simplex methods - Primal-Penalty- Two Phase –Principles of Duality.		
UNIT-II	**TRANSPORTATION AND ASSIGNMENT MODELS**	**9**
Transportation Models (Minimizing and Maximizing Problems) – Initial Basic feasible solution by Vogel's approximation methods- Check for optimality: Solution by MODI algorithm – Case of Degeneracy- Assignment Models -Solution by Hungarian method-Introduction to Bandit algorithm.		
UNIT-III	**INTEGER PROGRAMMING**	**9**
Cutting plane algorithm –Branch and bound methods -Multistage(Dynamic) programming.		
UNIT-IV	**NON –LINEAR OPTIMIZATION**	**9**
Unconstrained external problems -Newton–Raphson method–Equality constraints– Gradient Descent Method - Jacobianmethods–Lagrangianmethod–Kuhn–Tuckerconditions–Simpleproblems.		
UNIT-V	**PROJECT SCHEDULING**	**9**
Network diagram representation– Critical path method–Time charts and resource leveling–PERT.		
Total Contact Hours:45		

S.No	List of Experiment (using Python Programming)	Total Contact Hours: 30
1	*Linear programming Problem-Constraint Optimization*	
2	*Transportation Problem*	
3	Assignment Problem	
4	Integer Programming Problem- Branch and bound method	
5	Dynamic programming – Knapsack problem, Subset sum problem, longest common subsequence problem	
6	Gradient Descent Method- Stochastic Gradient Descent Algorithm	
7	*Unconstrained Optimization- Nonlinear Least squares*	
8	Kuhn-Tucker conditions -Lagrangian Multiplier method	
9	CPM -Analysis	
10	PERT -Analysis	

Course Outcomes:
On completion of the course, the students will be able to
• Solve Linear Programming problems using different methods.
• Formulate and solve transportation and assignment models arising in the field of engineering and technology.
• Set up and solve the pure integer, mixed integer or 0-1 integer linear programming problems in engineering and technology.
• Analyze the problems of unconstrained nonlinear programming and to know the necessary and sufficient

conditions for the solution of unconstrained problems.
• Find the best ways to crash project schedule, shortening total project duration and the ways to save money by adjusting activity durations and optimizing resource requirements in real life problems.

SUGGESTED ACTIVITIES

- Usage of MPSolver wrapper to solve LPP.
- Problem solving sessions
- Smart Class room sessions

SUGGESTED EVALUATION METHODS

- Problem solving in Tutorial sessions
- Assignment problems
- Quizzes and class test
- Discussion in classroom

Text Book(s):	
6.	Hamdy A Taha, Operations Research: An Introduction, Prentice Hall India, Tenth Edition, 2019.
7.	Hwei Hsu, "Schaums Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata Mcgraw Hill Edition, New Delhi, 1997.
8.	S.Boyd and L.Vandenberghe, Convex optimization, Cambridge University press,2004.
9.	John Myles White , Bandit algorithm for website Optimization, O' Riley Media, 2012.

Reference Books(s) / Web links:	
1.	Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print,2008.
2.	G. Srinivasan, Operations Research – Principles and Applications, 2nd edition, PHI, 2011.
3.	F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, McGraw-Hill, Year: 2001
4.	Katta G. Murty Linear Programming, John Wiley & Sons, 1983.

COs/POs &PSOs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
MA23434.1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
MA23434.2	2	2	-	-	-	-	-	-	-	-	1	-	-	-	-
MA23434. 3	2	1	2	-	2	-	-	-	-	-	-	-	-	-	-
MA23434. 4	2	2	-	-	-	-	-	-	-	-	2	-	-	-	-
MA23434.5	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
Average	2	1.6	2	-	2	-	-	-	-	-	1.3	-	-	-	-

Correlation level

1. slight (Low) 2.Moderate(Medium) 3.Substantial (High) 4.No correlation (-)

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23431	WEB TECHNOLOGY AND MOBILE APPLICATION	PC	1	0	4	3

Artificial Intelligence &Data Science and Artificial Intelligence &Machine Learning

Objectives:

- To provide foundational knowledge and practical skills in creating and structuring web pages using HTML, enabling students to build accessible and well-organized websites.
- To understand and practice Embedded Dynamic Scripting on Client-side Internet Programming.
- To implement Server Side Scripting.
- To facilitate students to understand android Application Design
- To help students to gain a basic understanding of Android application development

UNIT-I	WEB SITE BASIC, HTML 5.2, CSS 3.0	3

Internet Protocols – HTTP -Understand Internet-Difference between web site and application server-Internet technology overview-Understanding the difference between internet and intranet. HTML5.2 and CSS 3.0

UNIT-2	JAVASCRIPT	3

Introduction to Scripting - Core features - Data types and Variables -Operators, Expressions and Statements - Functions - Arrays - Objects - Document Object Model -Event Handling- JSON – Introduction to AJAX.

UNIT-3	SERVER SIDE PROGRAMMING	3

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session HandlingUnderstanding Cookies-DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP:Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-CreatingHTML forms by embedding JSP code.

UNIT-4	MOBILE APPLICATION DEVELOPMENT	3

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT-5	ANDROID USER INTERFACE DESIGN	3

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Testing Android applications, Publishing Android application.

Total Contact Hours	:	15

Course Outcomes: On completion of course students will be able to

- Upon completing the course, students will be able to design and develop basic web pages with proper structure and semantic elements, ensuring accessibility and functionality.
- Design and implement dynamic web page with validation using javascript objects and by applying different event handling mechanism.
- Design and implement simple webpage to learn JSP and Servlet.
- Design and implement simple Application Design.
- Identify various concepts of mobile programming that make it unique from programming for other platforms

LIST OF EXPERIMENTS	
1	HTML & CSS a) Create a web page to embed a map along with hot spot, frames & links. b) Create a web page using an embedded, external and inline CSS file.
2	Write JavaScript to validate the following fields of the Registration page.

	a) First Name (Name should contains alphabets and the length Should not be less than 6 characters). b) Password (Password should not be less than 6 characters length). c) E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) d) Mobile Number (Phone number should contain 10 digits only). e) Last Name and Address (should not be Empty).
3	Write a Servlet program that prints "Hello, World!" when accessed through a browser.
4	Create a web form that accepts a user's name and age. Write a Servlet to process the form data and display it back on the browser.
5	Write a Servlet to demonstrate the difference between HTTP GET and POST methods by creating a form and handling requests accordingly.
6	Write a Servlet to demonstrate session tracking using HttpSession. Implement a simple login system where the user's session is tracked.
7	Write a Servlet program to store a user's preferences (like theme or language) using cookies. Retrieve and display these preferences on subsequent visits.
8	Consider a Library Management System. Develop a JavaScript program that will validate the controls in the forms you have created for the application. State the assumptions you make (business logic you are taking into consideration). Note: Your application must access a database using Servlet/JSP.
9	Develop an Android application using controls like Button, TextView, EditText for designing a calculator having basic functionality like Addition, Subtraction, multiplication, and Division.
10	Develop an application to change the font and color of the text and display toast message when the user presses the button.
11	Implement an application that writes data to the SD card.
12	Develop a mobile application to send an email.
	Contact Hours : 60 **Total Contact Hours : 75**

Text Books:	
1	Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
2	Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”, Pearson Education, 2011.
3	T1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
Reference Books:	
1	Web Development with MongoDB and Node.js, Jason Krol, Packt Publishing, 2015.

2	Java Server Pages – Hans Bergsten, SPD O'Reilly.2011.
3	Beginning Web Programming-Jon Duckett WROX,2019
4	Programming world wide web, R.W. Sebesta. Fourth Edition, Pearson,2016
5	R1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd,2010
6	R2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd,2012

CO - PO – PSO matrices of course

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23431.01	3	3	3	3	3	3	2	2	3	2	1	3	3	3	2
AI23431.02	3	3	3	3	3	3	2	2	3	2	1	1	3	3	2
AI23431.03	3	3	3	3	3	3	2	2	3	2	2	2	3	3	3
AI23431.04	3	3	3	3	3	3	2	2	3	2	2	3	3	3	3
AI23431.05	3	3	3	3	3	3	2	2	3	2	3	3	3	3	3
Average	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1.8**	**2.1**	**3**	**3**	**2.4**

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23431	**Operating Systems** **Common to CSE, AIML, & AIDS**	PC	3	0	4	5

Objectives:	
•	To study the basic concepts and functions of operating systems.
•	To learn about Processes, Threads, Scheduling algorithms
•	To understand the process of synchronization and deadlock issues
•	To learn and understand the Memory management systems.
•	To learn I/O Management and File Systems.

UNIT I	OPERATING SYSTEMS OVERVIEW	9
Introduction – Computer System Organization – Computer System Architecture – Operations – Resource Management – Security and Protection – Virtualization – Computing Environments. Operating Systems Structures: Services – User and OS Interface – System Calls – Linkers and Loaders – Operating system Structure – Building and Booting OS.		
UNIT II	**PROCESS MANAGEMENT**	9
Process Concepts– Process Scheduling - Operations – Inter process Communication- Shared Memory and Message Passing Systems Threads: Overview- multithreading models-issues. CPU Scheduling: – FCFS – SJF – Priority – RR – Multilevel Queue Scheduling - Multilevel Feedback Queue.		
UNIT-III	**PROCESS SYNCHRONIZATION AND DEADLOCKS**	9
Process Synchronization – Critical Section Problem – Peterson's Solution – Hardware Synchronization – Semaphores- Monitors - Classic Problems of Synchronization, Deadlocks: Characterization-Prevention – Avoidance – Detection – Recovery.		
UNIT IV	**MEMORY MANAGEMENT**	9
Main Memory: Background - Contiguous Memory Allocation – Paging - Structure of a page table – Segmentation - Virtual Memory – Demand Paging - Page Replacement-FIFO-LRU-Optimal - Allocation of Frames – Thrashing - Mass Storage Management-Disk scheduling.		
UNIT-V	**FILE MANAGEMENT**	9
File System -Concepts - Access Methods- Directory Structure - Protection - Discretionary Access control and Mandatory Access Control - File System structure– Directory Implementation – Allocation Methods – Free-Space Management-Virtual File System. Case studies: Linux		
	Total Contact Hours :	45

List of Experiments	
1	Basic Unix/Linux commands
2	Study of Unix editors : sed,vi,emacs
3	Text processing using Awk script
4	System calls –fork(), exec(), getpid(),opendir(), readdir()
5	Scheduling algorithms – FCFS, SJF, Priority and RR
6	Inter-process Communication using Shared Memory
7	Producer Consumer Problem Solution using Semaphore

8	Bankers Deadlock Avoidance algorithm		
9	Contiguous Memory Allocation - First Fit and Best Fit		
10	Page Replacement Algorithms - FIFO & LRU		
11	File Organization Technique- single and Two level directory		
12	Installation and Configuration of Linux in a Virtual Machine		
13	Schedule Cron Tasks – scripts to run on boot, backup and shutdown at a particular time		
14	Building a Simple Loadable Kernel Module for basic operations		
15	Building Linux RPM package from source		
		Contact Hours	60
		Total Contact Hours	105

Course Outcomes:	
On completion of course, students will be able to	
•	Interpret the evaluation OS functionality, structure and layers.
•	Analyze the various Scheduling algorithms and design a model scheduling algorithm.
•	Apply and analyze Intercrosses communications, synchronization and Deadlock
•	Compare and contrast various memory management schemes.
•	Mount file systems and evaluate various disk scheduling techniques.

Suggested Activities:	
•	Compare the DOS and Linux Commands
•	Design and Analysis of various CPU scheduling algorithm
•	Implement an algorithm for synchronization
•	Analysis various page replacement algorithms
•	Study the various management algorithms used in Windows, Linux am Android OS

Textbooks:	
•	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 10th Edition, John Wiley and Sons Inc., 2018.

Reference Books (s)/Web links:	
1.	William Stallings, “Operating Systems – Internals and Design Principles”, 9thEdition, Pearson, 2018.
2.	Andrew S. Tanenbaum and Herbert Bos, “Modern Operating Systems”, 4th Edition, Pearson, 2016.
3.	Achyut Godbole and Atul Kahate, “Operating System”, 3rd Edition, Tata McGraw Hill, 2017.
4.	Pavel Y., Alex I., Mark E., David A., “Windows Internal Part I - System Architecture, Processes, Memory Management and More”, 7th Edition, Microsoft Press, 2017.

CO - PO – PSO matrices of course

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CS23431.1	2	-	-	-	3	-	1	-	1	2	2	2	3	-	1
CS23431.2	2	2	2	1	2	-	-	-	2	-	2	2	2	3	2
CS23431.3	2	2	2	1	2	-	-	-	1	-	2	2	2	3	2
CS23431.4	2	2	-	-	2	-	-	-	2	-	2	2	3	2	1
CS23431.5	2	-	1	-	2	-	-	1	1	-	2	2	3	-	2
Average	2.0	2.0	1.7	1.0	2.2	-	1.0	1.0	1.4	2.0	2.0	2.0	2.6	2.7	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23432	**Software Construction** **Common to CSE, AIML, & AIDS**	PC	3	0	2	4

Objectives:	
•	Students can gain a comprehensive understanding of Azure's infrastructure, including virtual machines, networking, storage, and security services, to effectively deploy and manage software applications.
•	Students can learn cloud-native development practices and principles, leveraging Azure services such as Azure App Service, Azure Functions for building scalable and resilient software solutions.
•	Students can explore CI/CD pipelines using Azure DevOps, GitHub Actions, or Azure Pipelines to automate the build, test, and deployment processes, ensuring rapid and reliable software delivery.
•	Students can develop skills in monitoring and diagnostics using Azure Monitor and Application Insights, enabling proactive identification and resolution of performance issues and errors in software applications.
•	**S**tudents can understand security best practices for software construction in Azure, including identity and access management (IAM), data encryption, network security to build secure and compliant software solutions.

UNIT I	INTRODUCTION TO SOFTWARE ENGINEERING	9
Software Process-Requirements to Maintenance-Perspective and Specialized Process Models-Projects on On-Prem/On Cloud (Azure, AWS, GCP)-Projects on cloud (cloud providers AWS, Azure)-Agile methods with associated metrics-Software metrices -AI and Data Science -Software Security- DevOps /DevSecOps.		
UNIT II	**SOFTWARE REQUIREMENTS**	9
How to do Requirements in Agile-Understand Themes, Epic, Features, User Stories and Tasks-How to identify Themes, Epics, Features, User Stories-How to document the same in Microsoft Azure Boards-How to use Poker Planning Estimation Technique -Non Functional Requirements - its purpose, different attributes of the same, and examples - Document the same in Microsoft Azure Boards.		
UNIT-III	**SYSTEM MODELING**	9
System Modeling-Context Model-Interaction Model-Interaction Model-Structural Model-Behavioral Model-Architectural patterns-Architectural patterns-continuation-Data Flow Diagrams-ER Diagram- Tools Practice (Azure) -Prototypes / MVP.		
UNIT IV	**TESTING**	9
Testing Using AZURE-AZURE Test Plan Preparation-Manual and Exploratory Testing-Automated Testing-Traceability-Reporting and Analysis.		
UNIT-V	**SOFTWARE CONFIGURATION MANAGEMENT**	9
Software Configuration Management-Introduction-Tools for SCM and Version Control-Visual Source Safe (VSS) – Introduction-Advanced Software Engineering Models-Case Study		
	Total Contact Hours :	45

List of Experiments	
1	Develop User Stories for the respective projects that has been assigned (both FR and NFR) in Azure Board
2	Develop the Business Architecture, Conceptual and Logical Model for the entities defined in the project
3	Develop the Class Diagram for these defined entities with all attributes and the associated methods
4	Develop the Sequence diagram for atleast 2 use stories for the respective project

5	Develop the Architecture diagram (using MVC) for the respective project (picking a template for Azure Architecture Center)		
6	Identify which SOLID design principles would be applicable and write the design document for the same		
7	Develop a view of the github repository in terms of code, design, test plans, test cases etc and showcase the same in Azure Repos		
8	Develop Test Plans, test cases for the user stories		
9	Develop a CI/CD pipeline using Azure DevOps to test the Architecture and Design		
10	Showcase the CI/CD pipeline using Azure DevOps for a single user story		
		Contact Hours	30
		Total Contact Hours	75

Course Outcomes:	
On completion of course, students will be able to	
•	**D**emonstrate proficiency in leveraging Azure services and tools for software construction, including virtual machines, containers, serverless computing, and databases, enabling them to design and deploy scalable and resilient applications on the Azure platform.
•	**I**mplement end-to-end CI/CD pipelines using Azure DevOps, GitHub Actions, or Azure Pipelines, automating the build, test, and deployment processes for software applications, resulting in increased efficiency and reliability of software delivery.
•	Optimizing software applications for performance and scalability on Azure, employing techniques such as auto-scaling, caching strategies, and performance tuning to ensure optimal performance under varying workloads.
•	Develop skills in monitoring and diagnostics using Azure Monitor and Application Insights, enabling them to proactively monitor the health, performance, and availability of software applications, and diagnose and troubleshoot issues efficiently.
•	Deeply understand security best practices for software construction in Azure, including identity and access management, data encryption, network security, and compliance standards, enabling them to build secure and compliant software solutions.Gain practical experience in designing, developing, and deploying software applications on Azure, preparing them for real-world scenarios and equipping them with the skills needed to succeed in software development roles in industry.

Suggested Activities:	
•	Assignment problems, Quiz.
•	Class presentation/Discussion

Textbooks:	
•	Design Patterns, Elements of Reusable Object Oriented Software (Gang of Four) (Erich Gamma, Richard Helm, Ralph Johnson etc.)
•	Patterns of Enterprise Application Architecture (Martin Fowler)
•	Beginning Software Engineering by Rod Stephens
•	Fowler, MartinBeck, Kent, Roberts, Refactoring Improving the Design of Existing Code
•	Clean Architecture by Robert C. Martin
•	Head First Design Patterns by Eric Freeman, Elisabeth Robson
•	Building Microservices Designing Fine-Grained Systems by Sam Newman
•	Vladimir Khorikov. Unit Testing Principles, Practices, and Patterns

Reference Books (s)/Web links:	
1.	Code Complete A Practical Handbook of Software Construction by Steve McConnell
2.	The Pragmatic Programmer Your Journey to Mastery by David Thomas, Andrew Hunt

CO-PO-PSO Mapping

COs/POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CS23432.1	2	2	3	2	2	2	2	2	2	2	3	2	1	3	-
CS23432.2	2	3	1	2	2	1	-	1	1	1	2	-	1	2	-
CS23432.3	2	2	1	1	1	1	1	1	1	1	1	1	2	2	1
CS23432.4	2	2	3	2	2	2	1	0	2	2	2	1	1	2	1
CS23432.5	2	2	2	1	1	1	1	0	2	1	1	1	2	1	-
Average	2.0	2.2	2.0	1.6	1,6	1.4	1.3	1.3	1.6	1.4	1.8	1.3	1.4	2.0	1.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	EMPLOYABILITY ENHANCEMENT COURSE	Category	L	T	P	C
GE23421	**Soft Skills - I**	PC	2	0	2	1

Objectives:	
•	To help students break out of shyness.
•	To build confidence.
•	To enhance English communication skills.
•	To encourage students' creative thinking to help them frame their own opinions.

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1.	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2.	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3.	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating	The aim of this activity is to make the students develop creative way of thinking.
4.	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.
5.	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6.	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for

			time so they only speak points that are relevant and important.
7.	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate.
8.	The art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9.	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10.	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11.	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12.	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
13.	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Outcomes:	
•	Students should be able to be more confident
•	Students should be able to speak in front of a large audience.
•	Students should be able to be better creative thinkers.
•	Students should be able to be spontaneous.
•	Students should be able to know the importance of communicating in English

CO – PO – PSO matrices of course

Cos/Pos&PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
CO2	1	-	-	-	-	-	1	-	1	3	1	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
Average	0.2	0	0	0	0	0	0.2	0	0.4	3	0.2	0.4	0	0	0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AI23511	Data Engineering	PE	3	0	0	3

Objectives: The student will be able to:	
□	Develop knowledge of foundation and building blocks for designing good data architecture.
□	Gain an in-depth understanding of data generation in source systems and its relation to data storage.
□	Understand the principles and processes involved in data ingestion.
□	Explore the lifecycle of queries, query optimization techniques, and strategies to improve query performance.
□	Understand the future of data engineering, including trends towards easier-to-use tools, cloud-scale data solutions, and the evolution of modern data architectures.

UNIT-I	**Foundation and Building Blocks**	**9**
Data Engineering Foundations – Data Engineering Life Cycle – Designing Good Architecture: Data Architecture – Enterprise Architecture - Principles of Good Data Architecture – Major Architecture Concepts – Types of Data Architecture – Choosing Technologies across the Data Engineering Lifecycle.		
UNIT-II	**Data Engineering Lifecycle Path**	**9**
Data Generation in Source Systems-Storage – Raw Ingredients of Data Storage – Data Storage Systems-Data Engineering Storage Abstractions – Trends in Storage		
UNIT-III	**Ingestion**	**9**
Data Ingestion – Key Engineering Considerations for the Ingestion Phase-Batch Ingestion Considerations-Message and Stream Ingestion Considerations- Ways to Ingest Data.		
UNIT-IV	**Queries, Data Modeling and Transformations**	**9**
Queries-Life of the query -The query optimizer- Improving Query Performance- Queries on Streaming Data-Data Modelling: Data Model-Conceptual, Logical and Physical Data Model-Normalization-Techniques for Modeling Batch Analytical Data- Modeling Streaming Data-Transformation: Batch Transformations-Materialized Views, Federation and Query Virtualization		
UNIT-V	**Security, Privacy and the Future of Data Engineering**	**9**
Ways to Serve Data for Analytics and ML- Reverse ETL- Security and Privacy: People – Processes-Technology-Future of Data Engineering: The Decline of Complexity and Easy to Use Data Tools-The Cloud Scale Data OS and Improved Interoperability-Enterprisey Data Engineering -Moving Beyond the Modern Data Stack, Toward the Live Data Stack		
	Total Contact Hours :	**45**

Course Outcomes: On completion of the course, the students will be able to	
●	Apply foundational principles of data architecture to design and implement scalable and efficient data systems across an enterprise.
●	Analyze and apply modern trends and abstraction techniques in data storage systems.
●	Develop strategies for scaling and optimizing data ingestion pipelines.
●	Apply query optimization and transformation techniques to enhance performance
●	Analyze emerging trends in data engineering, including cloud-scale solutions, reverse ETL, and live data stacks.

Textbooks:	
1.	Joe Reis, Matt Housley, “Fundamentals of Data Engineering: Plan and Build Robusr Sata Systems”, First Edition ,O’Reilly Media, Inc. Publishers, 2022.

Reference Books(s):	
1	Martin Kleppmann, “Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems”, O'Reilly Media, Inc. Publisher,2017
2	Ashish Agarwal, “ Ultimate Azure Data Engineering: Build Robust Data Engineering Systems on Azure with SQL, ETL, Data Modeling, and Power BI for Business Insights and Crack Azure Certifications”, Orange Education,2024

CO – PO – PSO matrices of course

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
AI23511.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI23511.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI23511.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI23511.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI23511.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AVERAGE	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: “-“

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23531	DEEP LEARNING	PC	3	0	2	4

Objectives:	
•	To introduce the foundational concepts of neural networks and enable students to implement a basic three-layer neural network for handwritten digit recognition.
•	To impart knowledge on various training techniques including optimization algorithms and hyperparameter tuning.
•	To familiarize students with convolutional neural networks (CNNs) and guide them through building and experimenting with CNN architectures.
•	To explore recurrent neural networks (RNNs) and their applications in natural language processing, image generation, and autoencoders.
•	To understand generative models, including variational autoencoders (VAE) and generative adversarial networks (GANs), and to discuss best practices for model optimization and scaling.

UNIT-I	INTRODUCTION TO DEEP LEARNING	9
Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – BackPropagation -Activation and Loss Functions – Implementing three layer Neural Network - Handwritten Digit Recognition		
UNIT-II	**TRAINING TECHNIQUES**	**9**
Numerical Differentiation – Gradient – Implementing a Training Algorithm - Stochastic Gradient Descent – Momentum – AdaGrad – Adam – Initial Weight Values – Regularization – Hyperparameter optimization - Validating Hyper parameters- - Model ensembling - Scaling up model training.		
UNIT-III	**CONVOLUTIONAL NEURAL NETWORKS**	**9**
Overall Architecture – The convolution layer – The pooling layer – Implementing a CNN- LeNet - ImageNet – AlexNet - VGG – GoogLeNet – ResNet		
UNIT-IV	**RECURRENT NEURAL NETWORKS**	**9**
Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Auto encoder -Complete Auto encoder, Regularized Autoencoder-LSTM		
UNIT-V	**GENERATIVE DEEP LEARNING**	**9**
Generative deep learning: Text generation – Deep dream – Neural style transfer – Generating images with variational autoencoders – Introduction to Generative Adversarial Networks.		
	Contact Hours : 45	

List of Experiments	
1.	Design and implement a three-layer neural network from scratch using Python. Train the network using the backpropagation algorithm with appropriate activation and loss functions. Apply the model to recognize handwritten digits. Suggested Dataset: MNIST Dataset
2.	Develop a multi-layer perceptron (MLP) for a simple classification task. Experiment with different numbers of hidden layers and activation functions, and evaluate the model's performance using accuracy and loss. Suggested Dataset: Iris Dataset

3.	Implement a training algorithm using stochastic gradient descent (SGD) with momentum and compare it with the Adam optimizer. Train both models on a dataset and compare their convergence rates and performance. Suggested Dataset: CIFAR-10 Dataset
4.	Implement a Convolutional Neural Network (CNN) from scratch to classify images. Train the network using a dataset of labeled images and evaluate its performance. Visualize the learned filters in the convolution layers. Suggested Dataset: CIFAR-10 Dataset
5.	Implement and compare the performance of three popular CNN architectures: VGG, ResNet, and GoogLeNet for classification using Dogs vs. Cats dataset. Suggested Dataset: Dogs vs. Cats dataset.
6.	Implement a bidirectional recurrent neural network (RNN) to predict sequences in time-series data. Train the RNN and compare its performance with a traditional feed-forward neural network for sequence-based tasks. Suggested Dataset: Airline Passenger Dataset
7.	Build a deep recurrent neural network (RNN) to generate image captions. Combine CNN for image feature extraction with RNN for sequence generation. Suggested Dataset: MS COCO Dataset
8.	Implement a variational autoencoder (VAE) to generate new images from a given dataset. Train the VAE to learn the latent representation of images and generate new samples from the learned distribution. Suggested Dataset: CelebA Dataset
9.	Build a text generation model using Long Short-Term Memory (LSTM) networks. Train the model on a text corpus to generate coherent sequences of text and evaluate the generated text for fluency and coherence. Suggested Dataset: Shakespeare Corpus
10.	Train a Generative Adversarial Network (GAN) to generate new images from a dataset. Evaluate the quality of the images generated using visual inspection and a quantitative metric like the Inception Score (IS) or Fréchet Inception Distance (FID). Suggested Dataset: LSUN Dataset
11.	Mini Project • **Choose a Topic**: Identify a deep learning problem of interest, such as image classification, text generation, or anomaly detection. Research related work using platforms like Google Scholar. • **Dataset Selection**: Find or collect a suitable dataset from sources like Kaggle or UCI. Ensure it is relevant, well-sized, and consider preprocessing requirements. • **Develop Methodology**: Start with baseline models, then experiment with advanced architectures (e.g., CNNs, Transformers). Use frameworks like TensorFlow or PyTorch. • **Implementation & Evaluation**: Train models and evaluate performance using appropriate metrics (e.g., accuracy, F1-score). Document findings systematically. • **Discuss & Present**: Analyze results, highlight challenges, and present your work with clear insights and future directions.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
•	Define the architecture of a neural network and implement a three-layer neural network
•	Analyze and apply various training techniques to optimize neural network performance
•	Design and evaluate convolutional neural networks (CNNs) by building models for image classification tasks
•	Illustrate the working of recurrent neural networks (RNNs) and apply autoencoders for various applications
•	Construct deep generative model for various applications.

Text Books:	
1	Koki Saitoh, "Deep Learning from the Basics - Python and Deep Learning: Theory and Implementation", 1st edition, Packt Publishing,2021.
2	Ian Goodfellow, Yoshua Bengio and Aaron Courville," Deep Learning ",1st edition ,MIT Press,2016.

Reference Books:	
1	Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2nd edition ,2007.
2	François Chollet, "Deep Learning with Python", Second Edition, Manning, 2021.
3	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", First Edition, Springer International Publishing AG ,2018.

Web link:

1. **https://www.manning.com/books/deep-learning-with-python-second-edition**

CO - PO – PSO Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23531.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI23531.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI23531.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI23531.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI23531.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AD23632	Framework for Data and Visual Analytics	PC	3	0	2	4

Objectives:	
•	To analyze the various data analysis frameworks (CRISP-DM, SEMMA, KDD) to determine their applications and effectiveness in different scenarios.
•	To evaluate the effectiveness of different exploratory data analysis (EDA) techniques in Python for handling and cleaning diverse datasets.
•	To Analyze the relationships and correlations within datasets by creating advanced visualizations using Python libraries like Matplotlib
•	To evaluate the functionalities and features of Power BI in designing and developing comprehensive data visualizations and interactive reports.
•	To analyze and compare various advanced visualization techniques in Tableau to create insightful dashboards and stories that effectively communicate data-driven insights.

UNIT-I	INTRODUCTION TO DATA ANALYTICS AND FRAMEWORK	9
Overview of Data Analytics-Importance and Applications-Data Types and Sources- Overview of Data Analysis Frameworks-CRISP-DM (Cross-Industry Standard Process for Data Mining)-SEMMA (Sample, Explore, Modify, Model, Assess)-KDD (Knowledge Discovery in Databases)		
UNIT-II	**EXPLORATORY DATA ANALYSIS USING PYTHON**	**9**
Introduction to Exploratory Data Analysis - Types of EDA - EDA Tools-EDA using Python : Data Frame Operations-Key Data Structures: Series and Data Frame-Creating and Loading Data Frames from Various Sources (e.g., CSV, Excel, SQL)- Viewing and Inspecting Data Frames-Filtering and Subsetting Data using Conditions-Data Cleaning with Pandas- Handling Missing Data-Detection, Filling, and Dropping-Removing Duplicates and Unnecessary Data-Data Type Conversion and Ensuring Consistency		
UNIT-III	**VISUALIZATION IN PYTHON**	**9**
Importance of data visualization in EDA- Types of data visualizations- Python Libraries for Data Visualization- Basic Plotting with Matplotlib - Visualization for Descriptive Statistics-Visualizing central tendency and dispersion-Box plots and whisker plots-Correlation and Relationship Analysis-Scatter plot matrix-Correlation heatmaps.		
UNIT-IV	**VISUALIZATION USING POWER BI**	**9**
What is Power BI? - Features of Power BI -Getting Started with Data Importing-Data Modelling- Report Design : Adding Visualization to the Report, Style Manipulations on a Report, Setting Colours and Background-,Exploring charts - Introduction to DAX Measures and Columns -Editing Interactions-Filters: Types of Filters-Visual Level, Page and Report Level, Include and Exclude,Using Slicer as a Filter-Adding Reports and Data Sets in Workspace -Converting Published Reports into Dashboards		
UNIT-V	**VISUALIZATION USING TABLEAU TOOL**	**9**
Introduction to Tableau-Overview of Tableau-Tableau Interface-Connecting to Data-Connecting to various data sources (Excel, CSV, SQL databases-Data Preparation-Data cleaning and transformation within Tableau-Basic Visualizations in Tableau -Bar charts, line charts, and pie charts-Tables and cross-tabs-Formatting and styling visualizations- Filters and Parameters-Adding filters to visualization-Calculated Fields and Analytics-Advanced Visualizations in Tableau-Heatmaps, tree maps, and bubble charts-Creating maps- Dashboards and Stories		
	Contact Hours : 45	

List of Experiments	
1	Setting up the Python environment and libraries-Juypter Notebook • Create a new notebook for Python • Write and execute Python code • Create new cells for code and Markdown

	• Demonstrate the application of Jupyter Widgets, Jupyter AI
2	EDA-Data Import and Export • Importing data from CSV, Excel, SQL databases, and web scraping • Handling different data formats • Export a DataFrame to an Excel file.
3	EDA-Data Cleaning • Handling missing values: detection, filling, and dropping • Removing duplicates and unnecessary data • Data type conversion and ensuring consistency • Normalize data (e.g., standardization, min-max scaling).
4	EDA-Data Inspection and Analysis • Viewing and inspecting DataFrames • Filtering and subsetting data using conditions • Descriptive statistics: measures of central tendency (mean, median, mode) and measures of dispersion (range, variance, standard deviation)
5	EDA-Data Visualization with Matplotlib • Basic plotting: line charts, bar charts, histograms
6	Data Visualization Using PowerBi • Learning the Power BI Interface • Connecting to various data sources (Excel, CSV, SQL databases) • Creating basic visualizations: bar charts, line charts, pie charts • Creating Calculated Columns and Measures • Building Dashboards
7	Data Visualization Using Tableau • Introduction to Tableau and its interface • Connecting to various data sources (Excel, CSV, SQL databases) • Creating basic visualizations: bar charts, line charts, pie charts • Creating calculated fields • Building dashboards and stories in Tableau
8	Mini Project • Healthcare Data Analytics • Financial Data Analytics • Social Media Data Analytics • Sports analytics • Tourism Analytics

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: At the end of the course the student will be able to:	
•	Critically analyze different data analysis frameworks (CRISP-DM, SEMMA, KDD) and determine their suitability for various data analytics projects and real-world applications.
•	Evaluate and apply appropriate exploratory data analysis (EDA) techniques in Python to clean, transform, and prepare datasets for further analysis, ensuring data quality and integrity.
•	Analyze complex datasets by creating advanced visualizations using Python libraries (Matplotlib) and interpret

	the visual representations to extract meaningful insights and identify patterns.
•	Evaluate the capabilities of Power BI and develop interactive and dynamic data visualizations and reports, effectively communicating data insights to stakeholders.
•	Analyze and compare advanced visualization techniques in Tableau, creating comprehensive dashboards and stories that effectively present data insights and support data-driven decision-making.

Text Book (s):	
1	Wes McKinney, "Python for Data Analysis", O'Reilly Media.2012
2	Wes McKinney, Python for Data Analysis - Data wrangling with pandas, Numpy, and ipython, Second edition, O'ReillyMedia Inc, 2017.
3	"Hands-On Data Analysis with Pandas: Efficiently perform data collection, wrangling, analysis, and visualization using Python" by Stefanie Molin
4	"Learning Tableau 2020: Create effective data visualizations, build interactive visual analytics, and transform your organization" by Joshua N. Milligan
5	"Microsoft Power BI - The Complete Masterclass [2023 EDITION]", Nokolai Schuler, 2023, Packt Publishing

Reference Books(s) / Web links:	
1	https://www.datacamp.com/courses/statistical-thinking-in-python-part-1

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AD23632.1	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**2**	**2**	**1**	**3**	**3**	**2**
AD23632.2	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**
AD23632.3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
AD23632.4	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
AD23632.5	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
Average	**2.4**	**2.8**	**2.8**	**2.8**	**2.6**	**1.8**	**1.6**	**2.4**	**3**	**2.6**	**2.8**	**1.8**	**3**	**3**	**2.8**

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23532	Computer Networks	PC	3	0	4	5
For B.E Programme CSE ,CSECS,CSD and B.Tech Programme in IT ,AIML & AIDS						

Objectives:
• Understand the concepts of computer networks and error detection-correction of data.
• Be exposed to various addressing schemes and routing protocols.
• Learn the Transport Layer, flow control and congestion control algorithms
• Be familiar with real time applications of networking devices and tools.
• To configure different devices and trace the flow of information between nodes in the network using various tools

UNIT I	FUNDAMENTALS AND DATA LINK LAYER	9
Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Application Programming Interface (sockets) – Performance – Link layer Services - Framing - Error Detection and Correction – Reliable Transmission		
UNIT II	**MEDIA ACCESS AND INTERNETWORKING**	**9**
Media Access Protocols – ALOHA - CSMA/CA/CD –Ethernet – Wireless LANs - 802.11- Bluetooth - Switching and Forwarding - Bridges and LAN Switches – Basic Internetworking- IP Service Model – IP Fragmentation - Global Addresses – ARP– DHCP – ICMP		
UNIT-III	**ROUTING**	**9**
Routing – Network as Graph - Distance Vector – Link State – Global Internet –Subnetting - Classless Routing (CIDR) – BGP– IPv6 – Multicast routing - DVMRP- PIM – Case Study-Software Defined Networking (SDN)		
UNIT IV	**TRANSPORT LAYER**	**9**
Overview of Transport layer – UDP – TCP - Segment Format - Connection Management – Adaptive Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements.		
UNIT-V	**APPLICATION LAYER**	**9**
E-Mail (SMTP, MIME, POP3, IMAP), HTTP – DNS - FTP - Telnet – Web Services – SNMP - MIB – RMON– SIP		
	Total Contact Hours :	**45**

List of Experiments	
1	Basic Networking Commands in Linux and Windows operating systems
2	Learning and Assignment of IP Address manually to computers
3	Study of different types of Network Cables and Crimping of cable with RJ45 connector
4	Implement packet sniffing using raw sockets in python
5	Develop a customized ping command to test the server connectivity
6	Building anonymous FTP Scanner using ftplib module
7	Develop a simple calculator using XMLRPC
8	Develop a program to create reverse shell using TCP sockets
9	Design a simple topology and configure with one router, two switches and PCs using Cisco Packet Tracer
10	Customize Switch with Network Modules using Cisco Packet Tracer
11	Examine Network Address Translation (NAT) using Cisco Packet Tracer
12	Nmap to discover live hosts using ARP scan, ICMP scan, and TCP/UDP ping scan in TryHackMe Platform.
13	Demonstrate network forensics using PcapXray tool
14	To capture, save, and analyze network traffic on TCP / UDP / IP / HTTP / ARP /DHCP /ICMP /DNS using Wireshark Tool
15	To Analyze the different types of servers using Webalizer tool
	Contact Hours : 60
	Total Contact Hours : 105

Course Outcomes: On completion of course you will be able to
● Choose the required functionality at each layer for given application
● Trace the flow of information from one node to another node in the network
● Apply the knowledge of addressing scheme and various routing protocols in data communication to select optimal path.
● Monitor the traffic within the network and analyze the transfer of packets.
● Develop real time applications of networks using different tools

Suggested Activities:

- Assignment problems based on GATE, Quiz.
- Class presentation/Discussion

Text Books(s):	
1	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Sixth Edition, Morgan Kaufmann Publishers Inc., 2021.
2	Behrouz A. Forouzan, "Data Communications and Networking", Fifth Edition, McGrawHill, 2017.

Reference Books (s)/Web links:	
1.	William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", Third Edition, Pearson Edition, 2009.
2.	James F. Kurose, Keith W. Ross," Computer Networking - A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2017.
3.	Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Prentice Hall publisher, 2010.
4.	William Stallings, "Data and Computer Communications", Eighth Edition, Pearson Education, 2011.
5.	Manuel Ortega, "Mastering Python for Networking and Security", Second Edition, Packt, 2021

CO - PO – PSO matrices of course

PO/PSO **CO**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CS23532.1		2	1	0	3	1	1	1	1	0	1	1	2	1	1
CS23532.2	2	2	1	0	2	1	1	0	0	0	2	2	1	1	1
CS23532.3	3	3	1	0	3	0	1	0	0	0	2	1	2	3	2
CS23532.4	2	3	0	0	3	1	1	1	0	0	2	2	1	2	3
CS23532.5	3	2	2	2	3	0	1	1	0	0	3	3	3	3	3
Average	**2.6**	**2.4**	**1.3**	**2.0**	**2.8**	**1.0**	**1.0**	**1.0**	**1.0**	**0.0**	**2.0**	**1.8**	**1.8**	**2.0**	**2.0**

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low 2: Moderate (Medium) 3:Substantial (High) No

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AI23521	BUILD AND DEPLOYMENT OF MACHINE LEARNING APPLICATIONS	PC	0	0	2	1

Objectives: Broad objective of this course is	
●	To know the components and structure of Machine Learning application development frameworks for windows OS-base web application.
●	To understand how to work with various Machine Learning application development frameworks.
●	To learn the basic and important design concepts and issues of development of Machine Learning applications.
●	To be familiar with API and Flask processing applications.
●	To be familiar with Docker processing applications.

List of Experiments				
1.	**Setting Up the Environment and Preprocessing Data for ML Applications** 1. Set up a fully functional machine learning development environment. 2. Collect, clean, and preprocess datasets to prepare them for building ML models.			
2.	**Supervised Learning Models** • Implement Support Vector Machines (SVM) for binary/multiclass classification. • Apply Random Forest models to enhance predictions.			
3.	**Classification with Decision Trees** 1. Implementing a decision tree classifier 2. Evaluating model performance with confusion matrix and accuracy score			
4.	**Advanced Supervised Learning Techniques** **Support Vector Machines (SVM)** Building a SVM model for classification tasks **Ensemble Methods - Random Forest** Implementing a random forest classifier and evaluating results			
5.	**Unsupervised Learning Models** **Clustering with K-Means** Applying K-Means clustering on a dataset Dimensionality Reduction with PCA **Dimensionality Reduction with PCA** Performing PCA for feature reduction and visualization			
6.	**Building a Simple Neural Network** Creating a feedforward neural network using a library (e.g., Tensor Flow/Keras) **Convolutional Neural Networks (CNN)** Implementing a CNN for image classification tasks			
7.	**Generative Models with GANs** Learn to create and train Generative Adversarial Networks (GANs). Train the GAN on datasets like MNIST or CIFAR-10 to generate new images.			
8.	**Model Evaluation and Improvement** **Hyperparameter Tuning with Grid Search:** Using Grid Search to optimize model hyperparameters **Cross-Validation Techniques**: Implementing k-fold cross-validation and evaluating model performance			
9.	**Creating REST API for Model Deployment:** Designing a RESTful API to serve machine learning models using Flask **Containerization with Docker:** Containerizing the model and API using Docker			
		Total Contact Hours	**:**	**30**

Mini Project:

Using the following datasets, create and deploy an application based on an ML model to achieve the specified objectives

1. **Data Set Preparation**:
   - Collect data containing attributes
   - Clean and preprocess the data by handling missing values and performing feature engineering.
2. **Model Building**:
   - Develop a model (e.g., Linear Regression, Random Forest, or Gradient Boosting)
   - Evaluate the model using metrics like Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE).
3. **Model Optimization**:
   - Tune hyper parameters using techniques like Grid Search or Random Search for better accuracy.
4. **Application Development**:
   - Deploy the trained model as a REST API using Flask or FastAPI to provide predictions based on user inputs.
5. **Frontend Integration**:
   - Create a simple web interface where users can input features (e.g., number of rooms, area, location) and get a price prediction.
6. **Dockerize**:
   - Containerize the application using Docker for easy deployment on different platforms.
7. **Documentation and Testing**:
   - Document the workflow, challenges, and results.
   - Test the application for accuracy and usability.

Course Outcomes:

On completion of the course, the students will be able to

- Learn the components of ML development.
- Gain the knowledge of how to work with various ML development frameworks.
- Acquire the basic and important design concepts and issues of development of ML applications.
- Deploy TensorFlow/Keras
- Develop simple REST processing web applications.

Text Books:	
1	Pramod Singh. Deploy Machine Learning Models to Production, " Apress ", 1st Edition , 2021.
2	Huyen, Chip. Designing machine learning systems. " O'Reilly Media, Inc.", 1st Edition, 2022.
3	Gift, Noah, and Alfredo Deza. Practical MLOps. " O'Reilly Media, Inc.",1st Edition, 2021.

Reference Books:	
1	Hapke H, Nelson C. Building machine learning pipelines. " O'Reilly Media , Inc" , 1st Edition, 2020.
2	Raj, Emmanuel. Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale. " Packt Publishing Ltd " , 1st Edition, 2021.
3	Hewage N, Meedeniya D. Machine learning operations: A survey on MLOps tool support. " arXiv ", preprint, 2022

CO-PO – PSO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
AI23521.1	3	3	3	3	3	3	2	2	-	-	1	3	3	3	2	3
AI23521.2	3	3	3	3	3	3	-	-	-	-	1	1	3	3	2	3
AI23521.3	3	3	3	3	3	-	-	2	2	-	2	2	3	2	3	3
AI23521.4	3	3	3	3	3	2	2	-	-	-	2	2	3	3	3	3
AI23521.5	3	3	3	3	3	2	2	-	-	-	2	2	3	3	3	3
Average	3	3	3	3	3	2	1.1	0.8	0.4	-	1.6	2	3	2.8	2.6	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial(High)

No correlation : "-"

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE23521	Soft Skills-II	EEC	0	0	2	1

Course Objectives:

The major course objectives are:

a. To help students break out of shyness.
b. To build confidence
c. To enhance English communication skills.
d. To encourage students' creative thinking to help them frame their own opinions,

Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out-of-the -box thinking to ensure a good debate and defense skills.
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.
4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move to the corner that they feel best explains their opinions	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.
5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd.	The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills.
7	Debate	Does violence on the TV and Video games influence children negatively?	This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on.
8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	The aim of this activity is to make the participants become spontaneous and have good presence of mind.

9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	FictionAD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Learning Outcome:

On successful completion of the course, students should be able to:

1. Be more confident
2. Speak in front of a large audience without hesitation
3. Think creatively
4. Speak impromptu

Communicate in English

SEMESTER VI

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AI23611	SECURE SYSTEMS ENGINEERING	PC	3	0	0	3

OBJECTIVES:	
•	To Able to know the fundamentals of secure systems.
•	To Understand the basic cryptography and key management techniques.
•	To Able to build and evaluate trusted system.
•	To Explore different auditing mechanisms and Network security.
•	To Learn the various security systems.

UNIT I	INTRODUCTION TO SECURE SYSTEMS	9
An overview of Computer Security – Access Control matrix – Foundational results Security Policies – Confidentiality policies – Hybrid policies.		
UNIT II	**BASIC CRYPTOGRAPHY AND KEY MANAGEMENT**	**9**
Classical Crypto systems: Transposition ciphers, Substitution ciphers, Data Encryption Standard Public Key cryptography: RSA – Cryptographic checksums: HMAC – Key Management: Key Exchange, Cryptographic key infrastructure – Digital Signature.		
UNIT III	**INTRODUCTION TO ASSURANCE AND EVALUATING SYSTEMS**	**9**
Assurance and Trust – Building secure and trusted systems: Life cycle, Waterfall life cycle model, Prototyping Evaluating Systems: Role of formal evaluation, TCSEC requirements, classes, processes, impact. FIPS requirements, Security levels, impact.		
UNIT IV	**AUDITING AND NETWORK SECURITY**	**9**
Auditing: Anatomy of an auditing system, Designing an auditing system, auditing mechanisms. Network Security: Introduction, Policy Development, Network Organization anticipating attacks.		
UNIT V	**SYSTEM SECURITY, USER SECURITY AND PROGRAM SECURITY**	**9**
System Security: Introduction, Policy, Networks. User Security: Policy, Access, Processes. Program Security: Introduction, Requirements and policy, Design, Refinement and Implementation.		
	Contact Hours : 45	

COURSE OUTCOMES: On completion of the course, the students will be able to	
•	Identify the different secure systems and policies.
•	Apply cryptography and key management techniques to design a secure system.
•	Design and evaluate secure trusted system.
•	Apply different auditing mechanisms and ensure network security.
•	Apply various security systems for real time problem.

TEXT BOOKS:	
1	Ross Anderson ,Security Engineering: A Guide to Building Dependable Distributed Systems, 3rd Edition, Kindle Edition, 2021
2	RON ROSS, Systems Security Engineering, Special Publications,2016

REFERENCES:	
1	John Musa D, Software Reliability Engineering, 2nd Edition, Tata McGraw-Hill, 2005.
2	Julia H Allen, Sean J Barnum, Robert J Ellison, Gary McGraw, Nancy R Mead, Software Security Engineering: A Guide for Project Managers, Addison Wesley, 2008
3	Ross J. Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, 2nd Edition,WILEY,2008

Web links
https://www.isms.online/iso-27002/control-8-27-secure-system-architecture-and-engineering-principles/
https://csrc.nist.gov/projects/systems-security-engineering-project

CO – PO – PSO mapping

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
AI23611.1	2	2	2	2	2	-	-	-	-	-	1	2	2	3	3
AI23611.2	2	2	2	2	2	-	-	-	-	-	1	2	2	3	3
AI23611.3	2	2	2	2	2	-	-	-	-	-	2	2	3	3	3
AI23611.4	2	2	2	2	2	-	-	-	-	-	2	2	3	3	3
AI23611.5	2	2	2	2	2	-	-	-	-	-	2	2	3	3	3
Average	2	2	2	2	2	-	-	-	-	-	1.4	2	2.6	2.8	2.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23631	PREDICTIVE AND PRESCRIPTIVE ANALYTICS	PC	3	0	2	4

Objectives:	
●	To introduce the fundamental concepts of predictive analytics.
●	To determine if current and historical data patterns are likely to emerge again.
●	To impart the knowledge on various steps those are necessary before constructing the predictive model.
●	To gain knowledge on the assessment of prescriptive models for decision making.
●	Help organizations allocate resources more efficiently by making informed prescriptive about where they will be most effective.

UNIT-I	INTRODUCTION TO PREDICTIVE ANALYTICS	9
Introduction to Analytics – Predictive Analytics – Parametric vs. Non-Parametric Models -Business Intelligence – Predictive Analytics vs. Business Intelligence – Predictive Analytics vs. Statistics – Predictive Analytics vs. Data Mining – Challenges in using Predictive Analytics.		
UNIT-II	**THE PREDICTIVE ANALYTICS PROCESS**	**9**
Predictive Analytic process, Technical requirements, Data Exploration, Information based learning: Decision trees, Shannons Entropy Model, Information Gain,ID3 Algorithm, Tree Pruning, EDA.		
UNIT-III	**PREDICTIVE DATA ANALYTICS**	**9**
Similarity Based Learning: Nearest Neighbour Algorithm, Handling Noisy Data, Data Normalization, Feature Selection, Probability based learning: Bayes Theorem, Bayesian Prediction, Smoothing, Probability Density function, Binning, Error based learning: Linear Regression, Gradient Descent.		
UNIT-IV	**PRESCRIPTIVE ANALYTICS – GRADIENT DESCENT**	**9**
Introduction to Prescriptive Analytics – Gradient Descent fundamentals - Stochastic Gradient descent regression - Forecasting fundamentals - Forecasting techniques : ARIMA		
UNIT-V	**PRESCRIPTIVE ANALYTICS – OPTIMIZATION AND OPTIMAL DECISION**	**9**
Common problem types for LP Solution- Types of Optimization Models - Linear Programming for Optimization - Transportation Problem - Network models - Heuristics Optimization with Genetic Algorithm.		
	Contact Hours : 45	

List of Experiments		
1	Clustering based data analytics using R/Python. (K-Means, SOM algorithms)	
2	Demonstrate the statistics for a sample data like mean, standard deviation, normal/uniform distribution, variance and correlation.	
3	Demonstrate missing value analysis, fixing missing values and outlier analysis in dataset	
4	Demonstrate data visualization, histograms and multiple variable summaries	
5	Demonstrate transformation, scaling, binning, fixing skewed values and sampling.	
6	Demonstration of Apriori algorithm on transaction dataset to find association rules.	
7	Demonstration of Linear and Logistic regression using various domain datasets.	
8	Demonstration of predictive models such as Decision Tree, Neural network and K-Nearest Neighbor using various domain datasets.	
9	Demonstration of Temporal Mining Techniques	
10	Demonstration of predictive analytics to analysis microarray data	
	Contact Hours	**45**
	Total Contact Hours	**75**

Course Outcomes: On completion of the course, the students will be able to	
•	Develop a foundational understanding of predictive modelling and its applications.
•	Apply regression and classification techniques to real-world problems
•	Gain expertise in using Support Vector Machines and Neural Networks for predictive analytics.
•	Analysing prescriptive modelling techniques for the given data.
•	Assess and interpret different prescriptive models for optimization problem.

Text Books:	
1	Nooruddin Abbas Ali, “Predictive Analytics for the Modern Enterprise: A Practitioner's Guide to Designing and Implementing Solutions”, O’Reilly Media Publications, first Edition, May 2024.
2	Richard Hurley, “Predictive Analytics: The Secret to Predicting Future Events Using Big Data and Data Science Techniques Such as Data Mining, Predictive Modelling, Statistics, Data Analysis, and Machine Learning” Ationa publications, February 2020.
3	Prescriptive Analytics: Prescribe with Python: The Definitive Prescriptive Analytics Python Guide, First Edition,2023
4	Walter R. Paczkowski , "Hands-On Prescriptive Analytics: Optimizing Your Decision Making with Python", First Edition,2024

Reference Books:	
1	Daniel Vaughan, Analytical Skills for AI and Data Science: Building Skills for an AI-Driven Enterprise, O'Reilly Media, 1st Edition, April 2021.
2	Eric Siegel, The AI-Powered Enterprise: Harnessing the Power of Machine Learning to Lead with Confidence and Transform Your Business, McGraw-Hill Education, 1st Edition, February 2022.
3	Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, John Wiley & Sons Inc. Publishers, Second edition, 2016.
4	Dursun Delen, "Prescriptive Analytics: The Final Frontier for Evidence-Based Management and Optimal Decision Making" First Edition 2024
5	Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the professional Data Analyst, John Wiley & Sons Inc. Publishers, First edition, 2014.

Web links:	
1	https://swayam.gov.in/
2	Predictive Modeling and Analytics Course (CU Boulder) | Coursera
3	Predictive Analytics - Regression and Classification - Course (nptel.ac.in)

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23631.1	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
AI23631.2	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
AI23631.3	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
AI23631.4	3	3	3	3	3	2	2	2	2	2	2	3	3	2	3
AI23631.5	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2
Average	2.8	2.8	2.8	2.8	2.8	1.8	1.8	1.8	1.8	1.8	1.8	2.8	2.8	2.8	2.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: “-

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23632	NATURAL LANGUAGE PROCESSING	PC	3	0	2	4

Objectives:

- To introduce the fundamental concepts of Natural Language Processing (NLP for analysing words based on statistical measures and CORPUS.
- To understand the principles of morphological analysis and language modeling using finite state machines and n-gram models.
- To explore vector semantics and learn how to represent words and their relationships through embeddings and similarity measures.
- To analyze and implement Hidden Markov Models (HMMs) and their applications in Part-Of-Speech (POS) tagging
- To study the architecture of transformers and large language models, including pre-training and evaluation techniques.

UNIT-I	INTRODUCTION TO NATURAL LANGUAGE PROCESSING	9

Introduction to NLP - Various stages of NLP –NLP Pipeline, The Ambiguity of Language: Parts of Speech, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language: Cross entropy, Text Prepossessing: Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis

UNIT-II	MORPHOLOGY AND LANGUAGE MODELLING	9

Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer.Bag of words, skip-gram, Continuous Bag-Of-Words, N gram model, n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- - Statistical Estimators- Combining Estimators

UNIT-III	VECTOR SEMANTICS AND EMBEDDINGS	9

Lexical Semantics-Vector Semantics-Words and Vectors-Cosine for measuring similarity- TF-IDF: Weighing terms in the vector- Pointwise Mutual Information (PMI) -Applications of the TF-IDF or PPMI vector models-Word2vec -Visualizing Embeddings - Semantic properties of embeddings - Bias and Embeddings - Evaluating Vector Models - Retrieval-Augmented Generation (RAG)

UNIT-IV	MARKOV MODEL AND POS TAGGING	9

Markov Model: Hidden Markov model, Three Fundamental questions of HMM, Implementation properties, and Variants of HMMs, Multiple input observation. **POS**: The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging.

UNIT-V	TRANSFORMERS AND LARGE LANGUAGE MODELS	9

The Transformer - Attention-Transformer Blocks- Parallelizing computation using a single matrix X , The input: embeddings for token and position-The Language Modeling Head - Large Language Models : Large Language Models with Transformers -Sampling for LLM Generation - Pretraining Large Language Models -Evaluating Large Language Models

	Contact Hours	:	45

List of Experiments	
1.	Develop a morphological analyzer to process and analyze various sentence structures, including interrogative, declarative, and complex sentences with conjunctions. Perform word segmentation and sentence segmentation as part of the analysis. **Suggested Dataset/Corpus: Universal Dependencies (UD) English Treebank**
2.	Design a basic NLP pipeline to preprocess raw text data by performing tokenization, sentence segmentation, and part-of-speech (POS) tagging. Automate the pipeline to process large-scale text efficiently. **Suggested Dataset/Corpus: Universal Dependencies (UD) English Treebank**
3.	Implement a Named Entity Recognition (NER) system using Python libraries such as spaCy or NLTK. Utilize a pre-trained model to extract named entities, including people, organizations, and locations, from a text corpus. **Suggested Dataset/Corpus**: **CoNLL-2003 NER Dataset**

4.	Construct unigram, bigram, and trigram models to analyze their performance on sparse data. Compare the language models based on perplexity and their effectiveness in predicting word sequences. **Suggested Dataset/Corpus**: **The Brown Corpus**
5.	Implement n-gram language models (unigram, bigram, trigram, etc.) and apply smoothing techniques like Laplace smoothing to address data sparsity. Evaluate the models on a large text corpus for accuracy and perplexity. **Suggested Dataset/Corpus**: **Google Ngram Dataset**
6.	Design a spelling correction model using a combination of morphological rules and n-gram probabilities. Test the model on a dataset containing deliberately misspelled words and compare it to established spell-check systems. **Suggested Dataset/Corpus**: **Birkbeck Spelling Error Corpus**
7.	Implement the Term Frequency-Inverse Document Frequency (TF-IDF) model and use cosine similarity to compare the similarity between documents in a given corpus. Visualize the similarity matrix for better insight. **Suggested Dataset/Corpus**: **20 Newsgroups Dataset**
8.	Train a Word2Vec model on a given text corpus and visualize the resulting word embeddings using dimensionality reduction techniques like t-SNE or PCA. Analyze the semantic relationships between words in the embeddings. **Suggested Dataset/Corpus**: **Text8 Dataset**
9.	Build a Hidden Markov Model (HMM) for part-of-speech (POS) tagging. Train the model on a tagged corpus and evaluate its accuracy on a test dataset. **Suggested Dataset/Corpus**: **Universal Dependencies (UD) Treebank**
10.	Use a pre-trained Transformer model (e.g., BERT) to build a sentiment analysis model. Fine-tune the model on a dataset of tweets, classify sentiment (positive, neutral, negative), and evaluate its performance using accuracy and F1-score. **Suggested Dataset/Corpus**: **Sentiment140 Dataset**
11	Use a pre-trained language model to perform sentiment analysis or keyword extraction on a dataset of WhatsApp chat and E mail data. Analyze the conversational patterns, emotions, and key topics discussed in the chats. (Multiple languages such as English, Tamil, etc.) **Suggested Dataset/Corpus**: **WhatsApp Chat Export (User-Generated Data)**
12	Use a pre-trained language model to perform sentiment analysis or keyword extraction from E mail data. Analyze the conversational patterns, information, and key topics from Email Message. (Multiple languages such as English, Tamil, etc.) **Suggested Dataset/Corpus**: **Email Data (User-Generated Data)**
13	Implement a question-answering system using a pre-trained BERT model. Input a passage and a question, and use the model to extract the correct answer from the passage. Evaluate the system on accuracy and relevance of the answers. **Suggested Dataset/Corpus**: **SQuAD (Stanford Question Answering Dataset)**
14	**Mini Project** • Choose a Topic: Identify a deep learning problem of interest, such as image classification, text generation, or anomaly detection. • Research related works using platforms like Google Scholar. • Dataset Selection: Find or collect a suitable dataset from sources like Kaggle or UCI. Ensure it is relevant, well-sized, and consider preprocessing requirements. • Develop Methodology: Start with baseline models, then experiment with advanced architectures (e.g., CNNs, Transformers). Use frameworks like TensorFlow or PyTorch. • Implementation & Evaluation: Train models and evaluate performance using appropriate metrics (e.g., accuracy, F1-score). Document findings systematically. • Discuss & Present: Analyze results, highlight challenges, and present your work with clear insights and

	future directions.			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
•	Analyze the different stages in the NLP pipeline and perform statistical analysis on the data.
•	Apply morphological analysis techniques and construct n-gram models for language processing.
•	Evaluate the effectiveness of word embeddings and semantic vector models
•	Implement and analyze Hidden Markov Models (HMMs) for Part-Of-Speech (POS) tagging and compare their effectiveness..
•	Design and evaluate transformer-based large language models for text generation and other NLP applications

Textbooks:	
1	Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2024
2	T V Geetha ,"Understanding Natural Language Processing" (Machine Learning and Deep Learning Perspectives),1st edition, Pearson,2024

Reference Books:	
1	Christopher D. Manning and HinrichSchutze, "Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003 2009.
2	NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
3	James Allen "Natural Language Understanding", Pearson Publication, 8th Edition. 2012
4	Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2nd edition, 2019.
5	Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2016
6	Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23632.1	3	3	2	2	3	2	1	2	2	2	2	3	3	2	2
AI23632.2	3	3	2	2	3	2	1	1	2	2	2	3	3	2	3
AI23632.3	3	3	3	2	3	2	1	2	2	2	2	3	3	3	3
AI23632.4	3	3	3	2	3	2	1	2	2	2	2	3	3	3	2
AI23632.5	3	3	3	3	3	2	1	2	3	3	3	3	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CS23634	Fundamentals of Generative AI and Prompt Engineering	PC	2	0	2	3

Objectives:	
•	Gain a solid understanding of Generative AI, its applications, and ethical considerations.
•	Learn the foundations of NLP and how transformer models work
•	Develop the skills to design, refine and optimize prompts for various tasks
•	Create practical AI powered tools like chatbots and content generators
•	Analyze and mitigate ethical and technical challenges in Generate AI

UNIT-I	INTRODUCTION TO GENERATIVE AI	6
What is Generative AI – Definition and key concepts, difference between Gen and Discriminative AI, Popular models (GPT, DALL-E etc), Applications of Gen AI – Text, Image, Code Generation, Audio/Video synthesis. Ethics and Challenges of Gen AI – Bias in AI models, Misinformation and deeptakes and Intellectual Property and Copyright issues		
UNIT-II	**FOUNDATIONS OF NATURAL LANGUAGE PROCESSING (NLP)**	**6**
What is NLP, Key NLP tasks (text classification, sentiment analysis, summarization), Tokenization and Text Representation – Word embeddings, Transformers and attention mechanisms. Introduction to Transformer Models – Architecture of Transformers, Overview of BERT, GPT and other transformer-based models		
UNIT-III	**PROMPT ENGINEERING BASICS**	**6**
Prompt Engineering – Definition and Importance, Role of prompts in guiding AI behaviour. Types of Prompts – Zero- shot, few-shot and chain of thought programming, Instruction-based prompts Vs open-ended prompts. Best practices of Prompt Design – clarity, specificity and context, iterative refinements of prompts, Handling ambiguous or complex queries		
UNIT-IV	**ADVANCED PROMPT ENGINEERING TECHNIQUES**	**6**
Prompt Engineering for Specific Domains. Customizing prompts for technical, creative or business use cases, Domain-specific fine tuning. Handling Edge Cases – Dealing with ambiguous or incomplete inputs, Avoiding biased or harmful outputs. Prompt Chaining and Multi Step Reasoning – Breaking down complex tasks into smaller prompts, Using chain of thought prompt for logical reasoning		
UNIT-V	**BUILDING REAL WORLD APPLICATIONS WITH GENERATIVE AI**	**6**
Integrating Gen AI into workflows – API's for Gen AI models (OpenAI API, Hugging Face), Automating tasks using AI. Building Custom Apps – Chatbots and Virtual Assistants, Content generation tools (blog writing, marketing copy), Code generation and debugging tools. Evaluating and Optimizing AI outputs – Metrics for evaluating AI performance, Iterative improvement of prompts and models		
	Contact Hours :	**30**

List of Experiments	
1	**Generative AI** Explore Pre-Trained Gen AI Tools • Use ChatGPT to generate text and DALL-E to create images • Analyze the outputs and discuss their quality and limitations Ethical Implications Exercise • Identify potential ethical issues in AI-generated content • Write a short report on how to mitigate these issues
2	**Foundations of NLP** Text processing with Python Use libraries like spaCy or NLTK to tokenize and preprocess text data Fine Tune a Pre-Trained Model • Use Hugging Face to fine-tune a transformer model to simple NLP task(eg sentimental analysis)
3	**Prompt Engineering Basics** Experiment with Different Prompts • Use ChatGPT to test zero-shot, few-shot and chain-of-thought prompts • Compare outputs and analyze their effectiveness • Create prompts for tasks like summarization, code generation and creating writing

4	**Advanced Prompt Engineering Techniques** Multi-Step Prompt workflow – Design a workflow for a complex task (eg. Writing a research paper or debugging code) Evaluate and Refine Prompts – Test prompts on ChatGPT and refine them based on the outputs			
5	**Building Real-World applications with Gen AI** Build a Chatbot – Use Open API or Hugging Face to create a simple chatbot Develop a Content Generation Tool – Build a tool that generates social media posts or blog articles Building Dashboards			
		Contact Hours	:	**30**
		Total Contact Hours	:	**60**

Course Outcomes: At the end of the course the student will be able to:	
•	**Understand Generative AI Fundamentals**: Gain a solid understanding of Generative AI, its applications, and ethical considerations.
•	**Master NLP Basics**: Learn the foundations of NLP and how transformer models work.
•	**Become Proficient in Prompt Engineering**: Develop the skills to design, refine, and optimize prompts for various tasks.
•	**Build Real-World Applications**: Create practical AI-powered tools like chatbots and content generators.
•	**Develop Critical Thinking**: Analyze and mitigate ethical and technical challenges in Generative AI.

Text Book (s):	
1	Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016, 1st Edition.
2	Lane, Howard, and Hapke, Natural Language Processing in Action, Manning Publications, 2019, 1st Edition.
3	Ben, The Art of Prompt Engineering, Self-Published, 2023, 1st Edition.

Reference Book(s) / Web link(s):	
1	Cathy O'Neil, Weapons of Math Destruction, Crown Publishing Group, 2016, 1st Edition.
2	Vincent C. Müller, Ethics of Artificial Intelligence and Robotics, Springer, 2020, 1st Edition.
3	Daniel Jurafsky and James H. Martin, Speech and Language Processing, Pearson, 2021, 3rd Edition.
4	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2019, 2nd Edition.
5	Denis Rothman, Transformers for Natural Language Processing, Packt Publishing, 2021, 2nd Edition.

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS23633.1	3	2	2	2	3	2	2	3	-	2	-	3	3	3	3
CS23633.2	3	3	2	2	3	-	-	-	-	2	-	3	3	3	2
CS23633.3	3	3	2	2	3	-	-	2	-	3	-	3	3	3	3
CS23633.4	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3
CS23633.5	3	3	2	3	2	3	3	3	2	2	2	3	3	3	3
Average	3	2.8	2.2	2.4	2.8	2.33	2.33	2.5	2.5	2.4	2.5	3	3	3	2.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
GE23627	Design Thinking and Innovation (Type - Project based learning)	EEC	0	0	4	2

Objectives:	
•	To understand the design thinking concepts and deep understanding of user needs and experiences.
•	To find the problem statement and To develop innovative design solutions that address identified user challenges
•	To master the process of prototyping and iterating on designs.
•	To conduct thorough market analysis and financial planning
•	To effectively communicate design concepts and findings.

Unit-I: Introduction to Design Thinking : The design thinking concepts - Different design thinking models - Details of Stanford Design thinking process: Empathize, Define, Ideate, Prototype, Test

Activities:

- Case studies of successful domain based Design Thinking and Innovative projects
- Group discussions on design thinking

Unit 2: Empathize and Define : User research methods (interviews, surveys, observation, contextual inquiry) - Persona development- Journey mapping – Brainstorming Defining the design problem statement

Activities:

- Conducting user interviews and surveys
- Creating user personas and journey maps
- Identifying key user needs and pain points
- Analyze the user needs and Brainstorming to define problem statement

Unit 3: Ideate and Create : Brainstorming techniques (e.g., mind mapping, SCAMPER) - Ideation tools (e.g., design thinking tools, concept sketching) - Concept generation and evaluation (e.g. Brainstorming)

Activities:

- Group brainstorming sessions to select the best idea
- Creating concept sketches and prototypes
- Evaluating ideas based on user needs and feasibility

Unit 4: Prototype and Test : Low, Medium and high level fidelity for prototyping-Usability testing -Iterative design

Activities:

- Building low-fidelity prototypes (e.g., paper prototypes)
- Conducting usability tests with users
- Iterating on designs based on feedback

Unit 5: Market Analysis and Implementation : Market research and analysis - Business model development- Financial planning-Implementation strategies

Activities:

- Conducting market research
- Developing a business model canvas
- Creating a financial projection
- Developing an implementation plan
-

Course Outcomes: On completion of the course, the students will be able to	
CO1	Construct design challenge and reframe the design challenge into design opportunity.
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.
CO3	Develop ideas and prototypes by brainstorming.
CO4	Organize the user walkthrough experience to test prototype
CO5	Develop smart strategies and implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.

Assessment:

- Encourage students to work on real-world design challenges based on the user needs
- Group presentations
- Quizzes and exams
- Evaluation of Project report and viva and also encourage the students for filing patent/ copyright / presenting in conference / publishing in journal

Text Book(s):	
1	Handbook of Design Thinking by Christian Müller-Roterberg, Kindle Direct Publishing, 2018**.**
2	Design Thinking – A Beginner's Perspective, by E Balagurusamy, Bindu Vijakumar, MC Graw Hill, 2024

Reference Books:	
1	Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work – by Beverly Rudkin Ingle, Apress; 1st ed. Edition, 2013
2	Design Thinking: Understanding How Designers Think and Work by Nigel Cross, Bloomsbury Visual Arts; 2 edition 2023

Web links	
1	Design thinking Guide https://www.rcsc.gov.bt/wp-content/uploads/2017/07/dt-guide-book-master-copy.pdf
2	NPTEL Course on Design Thinking and Innovation By Ravi Poovaiah ; https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
3	IITB Design course tools and Resources https://www.dsource.in/

CO-PO Mapping

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	3	3	2	2	3	3	3	3	3
CO2	3	2	3	3	3	2	2	3	3	3	3	3
CO3	3	2	3	3	3	2	2	3	3	3	3	3
CO4	3	2	3	3	3	2	2	3	3	3	3	3
CO5	3	2	3	3	3	2	2	3	3	3	3	3
Average	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**

1-Slight (Low), 2- Moderate (Medium), 3- Substantial (High) , "-" No correlation

Subject Code	Subject Name	Category	L	T	P	C
GE23621	Problem-Solving Techniques	**EEC**	**0**	**0**	**2**	**1**

Course Objectives:

- To improve the numerical ability
- To improve problem-solving skills.

Course topics:

S.No.	Topics
1	Numbers system
2	Reading comprehension
3	Data arrangements and Blood relations
4	Time and Work
5	Sentence correction
6	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning
7	Percentages, Simple interest and Compound interest
8	Sentence completion and Para-jumbles
9	Profit and Loss, Partnerships and Averages
10	Permutation, Combination and Probability
11	Data interpretation and Data sufficiency
12	Logarithms, Progressions, Geometry and Quadratic equations.
13	Time, Speed and Distance

Course Outcome:

On successful completion of the course, students should be able to:

5. Have mental alertness
6. Have numerical ability
7. Solve quantitative aptitude problems with more confident

SEMESTER VII

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
AI23711	SOCIAL AND ETHICAL ISSUES IN AI	PC	1	0	0	1

Objectives:	
●	Study the morality and ethics in AI
●	Learn about the Ethical initiatives in the field of artificial intelligence
●	Study about AI standards and Regulations
●	Study about social and ethical issues of Robot Ethics
●	Study about AI and Ethics- challenges and opportunities

UNIT-I	**INTRODUCTION**	**3**
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust.(Text Book1 :Chapter 1 & 2)		
UNIT-II	**ETHICAL INITIATIVES IN AI**	3
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponisation.((Text Book1 :Chapter 3)		
UNIT-III	**AI STANDARDS AND REGULATION**	3
Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations -Standard for Child and Student Data Governance - Standard for Transparent Employer Data Governance - Standard for Personal Data Artificial Intelligence (AI) Agent -Ontological Standard for Ethically Driven Robotics and Automation Systems-Standard for Ethically Driven Nudging for Robotic, Intelligent and Autonomous Systems - Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems -Standard for the Process of Identifying and Rating the Trustworthiness of News Sources - Standard for Machine Readable Personal Privacy Terms. (Text Book1 :Chapter 4)		
UNIT-IV	**ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS:**	3
Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy. (Link 1)		
UNIT-V	**AI AND ETHICS- CHALLENGES AND OPPORTUNITIES**	3
Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.(Link 2,3,4,5 & Text Book1 :Chapter 5)		
	Contact Hours : 15	

Course Outcomes: On completion of the course, the students will be able to	
●	Learn about morality and ethics in AI
●	Acquire the knowledge of real time application ethics, issues and its challenges.
●	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
●	Understand the concepts of Robotics and Morality
●	Learn about the National and International Strategies on AI

Text Books:	
1	Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- December 2011.

Reference Books:	
1	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington
2	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series
3	John Havens, " Heartificial Intelligence: Embracing Our Humanity to Maximize Machines", Jeremy Tarcher/Penguin, Am imprint of Penguin Random House, New York, 2016
4	Bernd Carsten Stahl, " Artificial Intelligence for a Better Future An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies", Springer, 2021.

Web link:

1. https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
2. https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen-challenges-and-opportunities/
3. https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
4. https://sci-hub.mksa.top/10.1159/000492428

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23711.1	2	1	1	1	-	1	1	2	-	-	1	1	2	1	1
AI23711.2	1	1	1	1	-	1	1	1	-	-	1	1	2	1	1
AI23711.3	1	1	1	1	-	1	1	1	-	-	1	1	2	1	1
AI23711.4	2	1	1	1	-	1	1	1	-	-	1	1	1	1	1
AI23711.5	1	1	1	1	-	1	1	1	-	-	1	1	2	1	1
Average	1.4	1	1	1	-	1	1	1	-	-	1	1	1.8	1	1

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
AI23712	**REINFORCEMENT LEARNING**	PC	3	3	0	3

Objectives:	
●	Demonstrate various Components of Reinforcement Learning.
●	Make use of various exploration and exploitation strategies.
●	Apply Model based and Model Free Prediction techniques.
●	Make use of different value based Reinforcement Learning Algorithms.
●	Demonstrate various Policy based Reinforcement Learning Algorithms.

UNIT-I	**Introduction**	**9**
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	**Planning, Exploitation and Exploration of Reinforcement Learning**	**9**
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	**Model Free Reinforcement Learning**	**9**
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)		
UNIT-IV	**Value Based Reinforcement Learning**	**9**
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	**Policy Based Reinforcement Learning**	**9**
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).		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	List various applications of Reinforcement Learning.
●	Apply Random and Optimistic Exploration Strategies to make correct decision making.
●	Apply different Prediction techniques.
●	Demonstrate deep reinforcement learning agents with feedback.
●	Demonstrate various policy based Reinforcement Learning Algorithms.

Text Books:	
1	Laura Graesser, Wah Loon Keng, ''Foundations of Deep Reinforcement Learning: Theory and Practice in Python" Addison-Wesley Data & Analytics Series, 1st Edition, 2022.

2	Miguel Morales, Grokking Deep Reinforcement Learning, Manning Publications, 2020.
3	Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An Introduction, Second Edition, MIT Press, 2019.

Reference Books:	
1	Marco Wiering, Martijn van Otterlo(Ed),Reinforcement Learning, State-of-the-Art, Adaptation, Learning, and Optimization book series, ALO, volume 12, Springer, 2012.
2	Keng, Wah Loon, Graesser, Laura, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison Wesley Data & Analytics Series, 2020.
3	Francois Chollet, Deep Learning with Python, Manning Publications, 2018.

CO - PO – PSO matrices of course

PO/PSO CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
AI23712.1	-	1	-	2	2	-	-	-	-	-	-	1	3	3	3
AI23712.2	-	2	1	2	2	-	-	-	1	2	-	1	3	3	3
AI23712.3	1	2	1	2	2	-	-	-	1	2	-	1	3	3	3
AI23712.4	1	2	1	2	2	-	-	-	1	2	-	1	3	3	3
AI23712.5	1	2	1	2	2	-	-	-	1	2	-	1	3	3	3
Average	1	1.8	1	2	2	-	-	-	1	2	-	1	3	3	3

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23731	Cloud and Big Data Architecture (Common to IT, AIDS, AIML)	PC	3	0	2	4

- To understand and appreciate the evolution of cloud from the existing technologies.
- To be familiar with cloud computing and have knowledge on the various service models.
- To introduce cloud platforms used in industry.
- To introduce the concepts of Big Data and Hadoop, and implement map reduce.
- To describe the data stream analytics methodologies.
- To understand and appreciate the evolution of cloud from the existing technologies.

UNIT-I	CLOUD ENABLING TECHNOLOGIES	9

Technologies for Network-Based Systems - System Models for Distributed and Cloud Computing - Implementation Levels of Virtualization - Virtualization Structures/Tools and Mechanisms - Virtualization of CPU, Memory, and I/O Devices - Virtual Clusters and Resource Management - Virtualization for Data-Centre Automation.

UNIT-II	CLOUD ARCHITECTURE AND SERVICES	9

Layered Cloud Architecture Design - NIST Cloud Computing Reference Architecture - Public, Private and Hybrid Clouds - laaS – PaaS – SaaS - Architectural Design of Compute and Storage Clouds -Public Cloud Platforms: GAE, AWS, and Azure.

UNIT-III	CLOUD PLATFORMS IN INDUSTRY	

Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.

UNIT-IV	INTRODUCTION TO BIG DATA AND HADOOP	9

Introduction to Big Data, Types of Digital Data, Challenges of conventional systems - Web data, Evolution of analytic processes and tools, Analysis Vs reporting - Big Data Analytics, Introduction to Hadoop - Distributed Computing Challenges - History of Hadoop, Hadoop Eco System - Use case of Hadoop – Hadoop Distributors – HDFS – Processing Data with Hadoop – Map Reduce.

UNIT-V	MINING DATA STREAMS	9

Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real time Analytics Platform (RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

Contact Hours:45

Description of the Experiments

1. Install Virtual box /VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8

2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine
7. Find a procedure to launch virtual machine using try stack (Open stack Demo Version)
8. Install Hadoop single node cluster and run simple applications like word count.
9. Deploy a Web Application with AWS Elastic Beanstalk.
10. Launching and configuring EC2 instances.
Contact Hours : 30
Total Contact Hours :75

Course Outcomes: Students will be able to
• Learn the key and enabling technologies that help in the development of the cloud.
• Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
• To understand cloud platforms usage in industry.
• Understand the usage scenarios of Big Data Analysis and Hadoop framework and apply Mapreduce over HDFS.
• Apply stream data models for mining big data

SUGGESTED ACTIVITIES
• Problem Based Learning • Flipped classroom • Circuit Design using Simulator • Conceptual Online Quiz

SUGGESTED EVALUATION METHODS
• Continuous Assessment Test • Online Quiz Assignments • Offline Assignments • Experiment based VIVA

Text Book(s):
1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel

Processing to the Internet of Things", Morgan Kaufmann Publishers, First Edition, 2013.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley India; Second Edition , 2019.
3. Tamara Munzner, "Visualization Analysis and Design", AK Peters Visualization Series, CRC Press, Nov. 2014.
4. Anand Rajaraman and Jeffrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, Second Edition , 2016
5. Jiawei Han, Micheline Kamber ―Data Mining Concepts and Techniques, Fourth Edition, Elseiver, November 2022.

Reference Books(s) / Web links:
1. Gerardus Blokdyk, AWS Certified Solutions Architect A Complete Guide - 2020 Edition.
2. Iman Ghanizada, "Google Cloud Certified Professional Cloud Arcitect", McGraw-Hill Education Publisher, 23rd April 2021.
3. Dr. Jugnesh Kumar , Dr. Anubhav Kumar , Dr. Rinku Kumar, "Big Data and Analytics: The key concepts and practical applications of big data analytics", 1st Edition, BPB Publications, March 2024

CO-PO-PSO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23731.1	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2
IT23731.2	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2
IT23731.3	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2
IT23731.4	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2
IT23731. 5	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2
Average	3	3	-	2	3	2	-	-	1	-	1	1	3	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

PROFESSIONALELECTIVES (PE)

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23A31	Social Network Analysis	PE	2	0	2	3

OBJECTIVES:

The students will be able

- To understand the concept of semantic web and social network analysis
- To apply ontology for knowledge representation and integration of social network data
- To identify and analyse communities within social networks using various detection methods
- To examine human behaviour in social web and related communities
- To analyse various visualizing tools for social networks.

UNIT I	INTRODUCTION	6

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis: Web-based networks - Applications of Social Network Analysis.

UNIT II	MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION	6

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation Ontological representation of social relationships - Aggregating and reasoning with social network data.

UNIT III	EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS	6

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Page ranking algorithm.

UNIT IV	PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES	6

Understanding and predicting human behavior for social communities - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Combining trust and reputation - Trust derivation based on trust comparisons .

UNIT V	VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS	6

Graph Networks- Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Hybrid representations - Applications - Cover networks - Community welfare - Co-Citation networks.

TOTAL: 30 PERIODS

List of Experiments (can be implemented using any tools: Python (NetworkX), MATLAB,Gephi.

1) Implement a program to compute centrality measures
2) Implementation of community detection using various algorithms
3) Simulation of Diffusion of Information or Influence
4) Implementation of Link Prediction
5) Write a program and analyse Network Resilience and Robustness
6) Simulation of Opinion Dynamics
7) Simulation of Social Influence in Marketing Campaigns

8) Implementation of Sentiment Analysis in Social Media Networks
9) Creation of Network Visualization using different Layouts
10) Mini Project -Modelling and tracking the evolution of a network over time, studying the addition of nodes and edges based on specific growth models (e.g., preferential attachment).

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Suggested Activities:

- Role play- Social Media creation (Unit 1).
- Mind Map, Poster Design - Ontology (Unit 2).
- Flipped Classroom – Web creation (Unit 3).
- Poster Design – Cyber Security (Unit4).
- Implementation of small module- Community Channel(Unit5).

COURSE OUTCOMES:

On completion of the course, the students will be able to:

•	Develop semantic web related applications.
•	Represent knowledge using ontology.
•	Predict human behaviour in social web and related communities.
•	Visualize social networks.
•	Social awareness and its laws

TEXT BOOKS:

1	John Scott , "Social Network Analysis: Research Methods", 1st Edtion, Kindle Edition, 2021
2	David Knickerbocker, "Network Science with Python:Explore the networks around us using network science, Social network analysis, and Machine learning" ,Packt Publishers, 2023
3.	Stephen P Bongatti "Analyzing Social Networks using R". SAGE publishers Ltd., 2021

REFERENCES:

1.	Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2019.
2.	Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2021.
3.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2021.

CO – PO – PSO matrices of course

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AI23A31.1	3	3	2	2	3	2	1	2	2	2	2	3	3	2	2
AI23A31.2	3	3	2	2	3	2	1	1	2	2	2	3	3	2	3
AI23A31.3	3	3	3	2	3	2	1	2	2	2	2	3	3	3	3
AI23A31.4	3	3	3	2	3	2	1	2	2	2	2	3	3	3	2
AI23A31.5	3	3	3	3	3	2	1	2	3	3	3	3	3	3	3
Average	3	3	2.6	2.2	3	2	1	1.8	2.2	2.2	2.2	3	3	2.6	2.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
AI23A32	LARGE LANGUAGE MODELS	PE	2	0	2	3
Common to						

Objectives: This course will enable students to
• To understand the Fundamentals of LLMs and Natural Language Processing
• To develop Proficiency in Prompt-Based Engineering
• To learn Adaptation and Fine-Tuning Techniques for LLMs
• To address Challenges in LLMs and Implement Advanced Solutions
• To apply LLMs in Production and Evaluate their Effectiveness

UNIT-I	INTRODUCTION	6
LLM: An Introduction-Natural Language Processing and Language Models Evolution-The Era of Large Language Models - LLM in Practice-Encoder-Decoder Architecture - Transformers - Data - Pre-Trained LLM Design Choices- Commonly Used Pre-trained LLMs		
UNIT-II	**PROMPT-BASED ENGINEERING**	6
Introduction-Basics of Prompt Engineering-Prompt Engineering-Answer engineering-Multi-prompt Inference-Prompt vs Pre-train and Fine-tune Methods in Text Classification and NER		
UNIT-III	**LLM ADAPTATION AND UTILIZATION, TUNING FOR LLM ALIGNMENT**	6
Instruction Tuning-Parameter-Efficient Fine-Tuning-Compute-Efficient Fine-Tuning-End-User Prompting-Tuning for LLM Alignment: Alignment Tuning-The Reinforcement Learning Framework- Mapping the RL Framework to LLMs with Human Feedback- Evolution of RLHF - Overcoming RLHF Challenges		
UNIT-IV	**LLM CHALLENGES AND SOLUTIONS, RETRIEVAL - AUGUMENTED GENERATION**	6
Hallucination-Bias and Fairness-Toxicity-Privacy-Basics of RAG- Optimizing RAG-Enhancing RAG-Evaluating RAG Applications		
UNIT-V	**LLMs IN PRODUCTION**	6
LLM Application- LLM Evaluation metrics - LLM Benchmark –LLM Selection-Tooling for Application Development- Inference- LLM Ops		
	Total Contact Hours:45	

List of Experiments (can be implemented using any tools: Python , MATLAB.

1) Implement the encoder-decoder architecture of a transformer using a deep learning framework
2) Load and evaluate performance using pre-trained LLMs like GPT, BERT, or RoBERTa on simple NLP tasks.
3) Design and compare different prompts for a text classification task
4) Experiment with combining multiple prompts for Named Entity Recognition
5) Implement instruction tuning using a small custom dataset for a chatbot-like application.
6) Perform LoRA (Low-Rank Adaptation) fine-tuning on a pre-trained LLM.
7) Evaluate and mitigate hallucinated outputs in LLM responses using filtering or post-processing techniques.
8) Develop a basic RAG system using vector search (e.g., FAISS) and integrate it with a pre-trained LLM
9) Build and deploy a simple LLM - powered web application (e.g., Q&A system) using a framework like Flask or FastAPI.
10) Mini Project -Develop a conversational AI system that combines a pre-trained Large Language Model (LLM) with a Retrieval-Augmented Generation (RAG) pipeline to provide accurate and context-aware responses for a specific domain

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	30

Text Book:
1. Kamath, U., Keenan, K., Somers, G., &am; Sorenson, S., ” Large Language Models: A Deep Dive”, Springer-Nature New York , 2024

Course Outcomes: At the end of the course, the students should be able to:
• Comprehend the core principles and evolution of Large Language Models
• Apply prompt engineering techniques to solve natural language processing tasks
• Employ advanced fine-tuning and adaptation strategies for LLM alignment
• Analyze and mitigate challenges associated with LLMs while optimizing RAG frameworks
• Develop, deploy, and evaluate LLM-based applications in real-world scenarios

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AI23A32.**1**	3	3	2	2	3	-	-	-	-	1	1	2	3	2	1
AI23A32.**2**	3	3	2	2	3	3	-	-	-	1	2	2	2	3	-
AI23A32.**3**	3	3	3	3	2	-	-	-	-	1	2	2	3	3	-
AI23A32.**4**	2	3	3	3	3	3	3	1	1	2	2	2	1	3	3
AI23A32.**5**	2	2	3	3	3	2	-	2	2	2	2	3	1	3	3
Average	2.8	2.8	2.6	2.6	2.8	1.6	0.6	0.6	0.6	1.4	1.8	2.5	2	2.8	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23A33	AI for Game Programming	PE	2	0	2	3

OBJECTIVES:

The students will be able

- To understand the role of AI in game design and the complexity of AI behaviors
- To investigate Artificial Intelligence techniques used in traditional and modern computer games.
- To select appropriate artificial intelligence techniques to address specific game design challenges.
- To evaluate the runtime performance of artificial intelligence techniques used in computer games.
- To explore cutting-edge artificial intelligence methods to solve computer game design problems.

UNIT I	INTRODUCTION	6

Introduction to Game AI-Roles of AI in Game design, Game AI Interfaces (Movement, Path finding, Decision Making, Strategy), Complexity (Artificial Stupidity, Intelligent Mistakes)-Game AI Inputs, Outputs, and Behaviors The 2D Rigidbody Agent, Steering Output, Variable Matching

UNIT II	CLASSICAL TECHNIQUES	6

Movement Algorithms-Position Matching: Kinematic and Dynamic Seek, Flee, Arrive-Orientation Matching: Kinematic and Dynamic Align, Wander-Advanced Movement: Delegation and Combination Interfaces, Blending, Arbitration-Advanced Position and Orientation Matching Pursue, Evade, Face, Look Where You Are Going

UNIT III	MODERN TECHNIQUES	6

Structure of Procedural Content Generators Content Selection v. Generation, Expressive Range-Pseudorandom Number Generation Halton Sequence, Poisson Disk, Kaleidoscope Effect-Content Selection L-systems, Grammars, Randomness-Content Generation Parametric Systems, Search-based Methods

UNIT IV	STRATEGY ALGORITHMS	6

Structure of Strategy Algorithms Blackboard, Utility Theory-Game Playing Minimax, Alpha-beta Pruning-Monte-Carlo Tree Search Algorithm, Improving Performance-Coordinated Action Multi-tier AI, Influence Maps

UNIT V	LEARNING	6

Decision Tree Learning ID3 Algorithm-Artificial Neural Networks Credit Assignment, Feedforward and Back propagation, Error Term-Overview, Architectures

TOTAL: 30 PERIODS

List of Experiments (can be implemented using any tools: Play Canvas, jMonkey Engine, Direct 3D 11, Scratch , Python or Unity.)

1. Implementation of Texture the Triangle using Direct 3D 11.
2. Implementation of Diffuse Lightning using Direct3D 11.
3. Implementation of Bouncing Ball Game.
4. Creation of Virtual Pet Game.
5. Simulation of Treasure Hunt Game.
6. Simulation of Shooting Game.
7. Develop an interactive game using Tynker.
8. Study of PyGame program and Unity software for multimedia applications..
9. Develop a 2D Game with Unity.
10. Mini Project -Design video games such as The Last of Us,FIFA 22,Red Dead Redemption 2,Tom Clancy's Splinter Cell: Blacklist,XCOM: Enemy Unknown using gaming tools.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Suggested Activities:	
● **Role play-** The 2D Rigidbody Agent **(Unit 1).** ● **Mind Map, Poster Design -** Kinematic and Dynamic Align **(Unit 2).** ● **Flipped Classroom –** Kaleidoscope Effect **(Unit 3).** ● **Poster Design –** Carlo Tree Search Algorithm **(Unit4).** ● **Implementation of small module-** ID3 Algorithm **(Unit5).**	
COURSE OUTCOMES: On completion of the course, the students will be able to	
•	Develop software code for a range of artificial intelligence techniques used in traditional and modern computer games 5
•	Describe the performance of artificial intelligence techniques used in traditional and modern computer games.
•	Choose, develop, explain, and defend the use of particular artificial intelligence techniques for solving particular game design problems.
•	Evaluate the relative benefits and drawbacks of different artificial intelligence techniques that can be used to solve computer game design problems.
•	Identify and examine state-of-the-art artificial intelligence techniques from the industry and academia to solve computer game design problems.
TEXT BOOKS:	
1	Paul Roberts, "Game AI uncovered", 1st Edition, , CRC press,2024
2	Millington, Ian. "Artificial Intelligence for Games" , 3rd Edition, CRC Press, 2021.
3.	Steve Rabin, "Game AI Pro 3 :Collected Wisdom of Game AI professional " , 1st Edition, CRC press,2021
REFERENCES:	
1.	Fouad Sabry, "Artificial Intelligence Video Games: Fundamentals and Applications" ,One billion Knowledgeable community press,2023
2.	Paul Roberts,"Artificial Intelligence in Games" , CRC press, 2022

CO – PO – PSO matrices of course

COs	POs												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AI23A33.1	3	3	3	3	3	3	2	2	3	-	1	3	3	3	2
AI23A33.2	3	3	3	3	3	3	-	-	-	-	1	1	3	3	2
AI23A33.3	3	3	3	3	3	-	-	2	2	-	2	2	3	2	3
AI23A33,4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	3
AI23A33.5	2	3	3	3	3	3	2	2	-	-	3	3	3	3	3
Average	2.8	3	3	3	3	3.0	2.0	2.0	2.3	2.0	1.8	2.4	3	2.8	2.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23A34	TEXT MINING	PE	2	0	2	3
Common to AIML & AIDS						

Objectives:	
●	To understand the fundamental techniques, terminologies, concepts and issues related to text mining interms of machine learning.
●	To explore news group post and sentiment analysis
●	To explore recommender system in music
●	To study about Wikipedia and detecting offensive language
●	To study the text in chatbot and speech transaction.

UNIT-I	INTRODUCTION MACHINE LEARNING FOR TEXT	6
The Language Phenomenon, the era of AI, The machine Learning paradigm, Taxonomy of machine learning, Visualization of the data. Detecting Spam Emails - Extracting word representations - performing classification - Measuring classification performances.		
UNIT-II	**NEWSGROUP POST AND EXTRACTING SENTIMENT FROM PRODUCT REVIEWS**	**6**
Understanding topics classification - Executing dimensionality reduction - Introducing the k-nearest neighbors algorithm - Extracting word embedding representation. Understanding sentiment analysis – Introducing deep neural networks.		
UNIT-III	**RECOMMENDING MUSICS AND MACHINE TRANSLATION**	**6**
Understanding recommender systems - Performing exploratory data analysis - Introducing content based filtering and collaborative filtering. Understanding machine translation - Introducing rule-based machine translation sequence-to-sequence learning.		
UNIT-IV	**SUMMARIZING WIKIPEDIA ARTICILE AND DETECTING HATEFUL LANGUAGE**	**6**
Summarizing Wikipedia Articles - Understanding text summarization - web scraping - extractive summarization - abstractive summarization - social networks - BERT - boosting algorithm - creating validation sets - Classifying with BERT.		
UNIT-V	**CHATBOT AND SPEECH-TO-TEXT TRANSACTIONS.**	**6**
Understanding text generation - retrieval-based chartbot - language modeling - generative chatbot. Understanding text clustering - preprocessing the data – speech-to-text - k-means algorithm -DBSCAN - hierarchical clustering - LDA algorithm.		
	Contact Hours : 30	

List of Experiments	
1	Create Regular expressions in Python for detecting word patterns and tokenizing text
2	Spam detection emails through machine learning algorithm.
3	Extracting word embedding representation through k-nearest neighbour algorithm.
4	Python program to perform sentimental analysis through linear and logistics regression.
5	Implement the data analysis through content based filtering and collaborative filtering.
6	To implement the BERT for detecting offense language.
7	Design a chatbot with a simple dialog system
	Contact Hours : 30
	Total Contact Hours : 60

Course Outcomes: On completion of the course, the students will be able to	
●	Understand fundamentals of text mining in machine learning.
●	Explore the text relationship with sentiment analysis.
●	To apply text recommendation for music and machine transaction
●	To apply the search offensive language and summarize Wikipedia
●	To deploy the chatbot in various application.

Text Books:	
1	Nikos Tsourakis, “Machine Learning Techniques for Text: Apply modern techniques with Python for text processing, dimensionality reduction, classification, and evaluation”, First Edition, 2022.
2	Gabe Ignatow and Rada Mihalcea, “Text Mining: A Guidebook for the Social Sciences”, SAGE Publications, Inc, 2018
3	Charu C. Aggarwal, “Machine Learning for Text” 1st Edition, 2018.
4	Manu Konchady “Text Mining Application Programming”, Cengage Learning, Fourth Indian Reprint, 2009.

Reference Books:	
1	ChengXiang Zhai, Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining, Association for Computing Machinery and Morgan & Claypool Publisher, 2016
2	Alexandra George, "Python Text Mining: Perform Text Processing, Word Embedding, Text Classification and Machine Translation", First Edition 2022
3	Thomas W. Miller, Prentice Hall, “Data and Text Mining - A Business Applications Approach”, Second impression, 2011.

Web links for virtual lab:	
1	Text Mining and Analytics | Coursera
2	Applied Text Mining in Python | Coursera

CO - PO – PSO matrices of course

COs/POs& PSOs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
AI23P34.1	3	3	2	-	-	-	-	-	1	-	-	-	3	1	-
AI23P34.2	3	3	3	2	-	2	-	-	-	-	-	2	2	3	-
AI23P34.3	3	3	3	2	3	-	-	2	2	-	-	-	-	3	-
AI23P34.4	3	3	3	-	3	1	-	-	-	-	1	2	2	-	-
AI23P34.5	3	3	2	3	2	-	-	1	3	-	3	3	3	3	1
Average	3	3	2.6	1.4	1.4	0.6	-	0.6	0.8	-	0.6	1.4	2	2	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: “-”

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23A35	RECOMMENDATION SYSTEMS	PE	2	0	2	3

Objectives: This course will enable students
• To understand the goals and models of the recommender systems
• To analyse the different neighbor recommendation and models
• To understand the basic components of content-based systems
• To evaluate Knowledge based recommendation and Hybrid approaches
• To evaluate the recommender system by design and metrics.

UNIT-I	Introduction	6
Introduction: Goals of Recommender System, Basic models of Recommender Systems, Domain-Specific Challenges in Recommender System, Applications		
UNIT-II	**Collaborative Filtering**	6
User-based nearest neighbour recommendation, Item based nearest neighbour recommendation, Clustering and Neighbourhood-Based Model, Graph models for Neighbourhood-Based Model		
UNIT-III	**Content-based recommendation**	6
Basic components of content-based systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content based versus Collaborative Filtering		
UNIT-IV	**Knowledge based recommendation and Hybrid approaches**	6
Knowledge based recommendation: Constraint based recommenders, Case based recommenders. Hybrid approaches: Weighted, Switching, Cascade, Meta-level Hybrids, Mixed Hybrids		
UNIT-V	**Evaluating Recommender System**	6
Introduction, Evaluation Paradigms, General goals of evaluation Design, Design issues: Case Study of Netflix, Accuracy metrics, Limitations of Evaluation metrics.		
Total Contact Hours:30		

Text Book(s):
1. Charu C. Aggarwal,,Recommender Systems: The Textbook., 1st edition, Springer ,2016

Reference Books(s) / Web links:
1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, 3rd edition, Springer,2022
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, 1st edition, Springer, 2013.
3. Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Recommender Systems Handbook, 2nd ,Springer ,2010
4. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, 1st edition, Cambridge University Press, 2011.

List of Experiments	
1	Implement Data similarity measures using Python
2	Implement dimension reduction techniques for recommender systems
3	Implement user profile learning
4	Implement content-based recommendation systems
5	Implement collaborative filter techniques
6	Create an attack for tampering with recommender systems
7	Implement accuracy metrics like Receiver Operated Characteristic curves

Contact Hours	**:**	**30**
Total Contact Hours	**:**	**60**

Course Outcomes: At the end of the course, the students should be able:
● To learn the goal and applicability of recommendation systems in various fields.
● To gain knowledge of model based collaborative filtering techniques used in recommendation system
● To acquire knowledge of basics of content based recommendation system.
● To develop skills on knowledge based and hybrid recommendation systems.
● To understand the evaluation of the recommendation system.

SUGGESTED ACTIVITIES

- **Design Taxonomy:** Applications of recommendation systems in various domains (e.g., e-commerce, entertainment, social media, etc.). **(Unit 1).**
- **Flipped Classroom -** To explore and analyze graph models in collaborative recommender systems. **(Unit 2).**
- **Role play –**To represent different methods for learning user profiles (e.g., feature extraction, user feedback, demographic-based methods). **(Unit 3).**
- **Poster Design –** To create posters illustrating case-based recommenders and knowledge-based recommendation. **(Unit4).**
- **Implementation of small module-** Implement a small module to evaluate the accuracy metrics of a recommender system (such as Precision, Recall, and F1-Score). **(Unit5).**

SUGGESTED EVALUATION METHODS

- **Develop Case Studies -** Identify and analyze various issues associated with recommender systems, such as cold-start problems, scalability, bias, and privacy concerns. Example: A case study analyzing Netflix's cold-start problem or how Amazon handles recommendation bias. **(Unit 1).**
- **Tutorial problems -** To evaluate students' understanding of the vulnerabilities in collaborative recommender systems and methods of mitigating these vulnerabilities. Example Problem: How can an attacker exploit user ratings in a collaborative recommender system, and what countermeasures can be applied? **(Unit 2).**
- **Quiz -** Quiz will test students' understanding of the fundamental components and architecture of content-based recommender systems. **(Unit 3).**
- **Assignment problems-** To understand and implement constraint-based recommenders, where recommendations are made by satisfying a set of pre-defined constraints. Example Problem: Design a constraint-based recommender system that recommends a set of vacation destinations considering factors like budget, distance, weather, and user preferences. **(Unit 4).**
- **Quiz –** Quiz will evaluate students' knowledge on how to evaluate recommender systems using real historical datasets. **(Unit5).**

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
AI23A35.1	3	3	2	2	1	-	3	-	-	-	-	-	3	-	-
AI23A35.2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-
AI23A35.3	3	2	3	2	2	-	-	2	-	2	-	1	3	3	-
AI23A35.4	3	3	3	2	3	-	-	2	1	1	-	1	3	3	-
AI23A35.5	3	3	3	2	3	-	-	2	1	1	-	1	3	3	1
Average	3	3	2.6	2	2.2		0.6	1.2	0.4	0.8	0	0.6	3	2.4	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23A36	Big data Analytics	PC	2	0	2	3

Objectives:	
•	To understand the basic concepts of big data and Hadoop.
•	To have knowledge on accessing , storing and manipulating the huge data from different sources.
•	To implement Map-Reduce programs for processing big data.
•	To realize storage and processing of big data using MongoDB, Pig, Hive and Spark.
•	To analyze big data using machine learning techniques.

UNIT-I	Introduction To Big Data	6
Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment. **Big Data Analytics:** Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools , NoSQL.		
UNIT-II	**Hadoop And Map Reduce**	**6**
Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator). **Introduction to Map Reduce Programming:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression.		
UNIT-III	**MongoDB**	**6**
Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language.		
UNIT-IV	**FUNDAMENTALS OF APACHE PIG, HIVE**	**6**
Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). **Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.		
UNIT-V	**Spark And Data Analysis**	**6**
Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark. **Text, Web Content and Link Analytics:** Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph		
	Contact Hours : 30	

List of Experiments	
1.	Install Hadoop and Implement the following file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files and directories. **Note:** A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
2.	Develop a MapReduce program to implement Matrix MultiplicationSuggested Dataset: Iris Dataset
3.	Develop a Map Reduce program that mines weather data and displays appropriate messages indicating the weather conditions of the day.
4.	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.
5.	Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB

6.	Pig Latin scripts to sort, group, join, project, and filter the data			
7.	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.			
8.	Implement a word count program in Hadoop and Spark.			
9.	Use CDH (Cloudera Distribution for Hadoop) and HUE (Hadoop User Interface) to analyze data and generate reports for sample datase			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
•	Identify and list various Big Data concepts, tools and applications.
•	Develop programs using HADOOP framework.
•	Learn the working principles of big data management using MongoDB
•	Use Hadoop Cluster to deploy Map Reduce jobs, PIG,HIVE and Spark programs
•	Analyze the given data set and identify deep insights from the data set.

Text Books:	
1	Seema Acharya and Subhashini Chellappan “Big data and Analytics” Wiley India Publishers, 2nd Edition, 2019.
2	Rajkamal and Preeti Saxena, “Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning”, McGraw Hill Publication, 2019.

Reference Books:	
1	Tom White, “Hadoop: The Definitive Guide” 4th Edition, O’reilly Media, 2015.
2	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016.
3	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition
4	Mohammed Guller, “Big Data Analytics with Spark”, Apress, 2015

Web links and Video Lectures (e-Resources):

- **https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset**
- **https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-g5W1mo37urJQOdCZ**
- **https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&index=4**
- **https://www.youtube.com/watch?v=GG-VRm6XnNk https://www.youtube.com/watch?v=JglO2Nv_92A**

CO - PO – PSO Mapping

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23A36.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI23A36.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI23531.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI23A36.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI23A36.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23A37	Computer Vision and Applications	PC	2	0	2	3

Objectives:
• Understand the basics of computer vision and its applications
• Understand the basic image processing operations to enhance the image quality
• Develop skills to extract and analyze significant features from images
• Apply various segmentation algorithm to segment images into multiple regions
• Latest advancements and future trends in computer vision are explored for real time applications

UNIT-I	**Overview of Computer Vision**	6
Image Formation and Representation: Imaging geometry, radiometry, digitization, cameras and Projections, rigid and affine transformation, Computer Vision and its Applications .		
UNIT-II	**Digital Image Processing**	6
Pixel transforms, color transforms, histogram processing, histogram equalization, filtering, convolution, Fourier transformation and its applications in sharpening, blurring and noise removal		
UNIT-III	**Feature Detection**	6
Edge detection, corner detection, line and curve detection, active contours, SIFT and HOG descriptors, shape context descriptors, Morphological operations .		
UNIT-IV	**Segmentation**	6
Active contours, split & merge, watershed, region splitting, region merging, graph-based segmentation, mean shift and model finding, Normalized Cut.		
UNIT-V	**Motion Analysis**	6
Background Subtraction and Modeling, Optical Flow, KLT, Spatio Temporal Analysis, Dynamic Stereo, Motion parameter estimation		
	Total Contact Hours: 30	

List of Experiments:
1. Implementing various basic image processing operations Reading image, writing image and conversion of images
2. Implement contrast adjustment of an image.
3. Implement Histogram processing and Equalization.

4. Implement the various low pass and high pass filtering mechanisms
5. Use of Fourier transform for filtering the image.
6. Utilization of SIFT and HOG features for image analysis
7. Implement various image segmentation algorithm
8. Implement optical flow computation algorithm.
9. Face Detection on available online human face image datasets
10. Object Recognition on available online image datasets
Contact Hours : 30
Total Contact Hours :60

SUGGESTED ACTIVITIES

- Problem Based Learning
- Flipped classroom
- Conceptual Online Quiz
- Capstone Projects

Course Outcomes: Students will be able to
• Learn fundamentals of computer vision and its applications
• Understand techniques are available to process the image.
• Understand how to analyze the image and extract required features
• Apply different segmentation techniques to different images
• Understand how computer vision solves real world problems

SUGGESTED EVALUATION METHODS

- Continuous Assessment Test
- Online Quiz Assignments
- Offline Assignments
- Experiment based VIVA

Text Book(s):
1. Rafael C. Gonzalez and Richard E. Woods ,"Digital Image Processing", Fourth Edition, Pearson, 2019.
2. Richard Szeliski , "Computer Vision: Algorithms and Applications", Second Edition, Springer, 2022.
3. "Computer Vision: A Modern Approach", 2nd Edition, Pearson Education, Paperback – 1 January 2015.

Reference Books(s):
1. B Cyganek, "An Introduction to 3D Computer Vision Techniques and Algorithms", 1st edition , John Wiley & Sons , 2009
2. V Kishore Ayyadevara & Yeshwanth Reddy, "Modern Computer Vision with PyTorch", Packt Publishing, 2020.

CO-PO-PSO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AI23A37.1	3	–	3	–	3	–	–	–	–	2	–	–	–	–	2
AI23A37.2	3	3	3	–	3	2	–	–	–	–	–	3	–	3	2
AI23A37.3	3	3	3	–	3	2	–	–	–	2	–	3	–	3	2
AI23A37.4	2	3	3	3	3	2	–	1	2	2	–	3	3	3	3
AI23A37.5	3	3	3	3	3	2	2	1	2	2	3	3	3	3	3
Average	2.8	3	3	3	3	2	2	1	2	2	3	3	3	3	2. 4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
AI23B31	Knowledge Representation and Reasoning	PC	2	0	2	3

OBJECTIVES:	
•	To learn the concepts of First Order Logics.
•	To understand the concepts of Knowledge Engineering and Resolution.
•	To acquire the knowledge of Rules, Frames and Structured Description.
•	To familiarize the fundamentals of uncertainty and degrees of belief.
•	To understand the fundamental concepts of Planning

UNIT I	INTRODUCTION	6
Introduction: The Key Concepts, Need for Knowledge Representation and Reasoning - The Role of Logic. Language of First-Order Logic: Introduction-The Syntax- The Semantics-The Semantics-Explicit and Implicit Belief.		
UNIT II	**EXPRESSING KNOWLEDGE AND RESOLUTION**	**6**
Expressing Knowledge: Knowledge Engineering – Vocabulary - Basic Facts -Complex Facts - Terminological Facts Entailments. Resolution : The Propositional Case- Handling Variables and Quantifiers - Dealing with Computational Intractability - Backward Chaining - Forward Chaining.		
UNIT III	**RULES, FRAMES AND STRUCTURED DESCRIPTION**	**6**
Rules in Production System: Basic Operation, Working Memory, Production Rules and examples- Conflict Resolution- Applications and Advantages. Frames: objects and frames - Basic frame formalism- Frame examples.		
UNIT IV	**UNCERTAINTY AND DEGREES OF BELIEF**	**6**
Non-categorical Reasoning- Objective Probability- Subjective Probability- Vagueness. Explanation and Diagnosis: Diagnosis- Explanation- A Circuit Example.		
UNIT V	**PLANNING**	**6**
Planning in the Situation Calculus - The STRIPS Representation- Planning as a Reasoning Task. Hierarchical Planning - Conditional Planning.		
	Contact Hours : 30	

COURSE OUTCOMES: On completion of the course, the students will be able to	
•	Apply the concept of First Order Logic for knowledge representation.
•	Apply the concepts of unification and resolution to solve real time facts.
•	Integrate the concepts of rules and frames for real world phenomena
•	Analyze the concept of uncertainty and degrees of belief to find the varying levels of knowledge and confidence level of real time facts.
•	Explain the concepts of planning to find the difference between plan space and state space.

List of Experiments	
1	Build a rule-based system to recommend activities based on weather conditions
2	Create a knowledge base using dictionaries and query it. Example: Store animal facts and allow the user to query for characteristics.
3	Represent family relationships and query for relations (e.g., parent, sibling). Example: Use nested dictionaries to represent relations.
4	perform data preprocessing, annotation, and dataset creation for a machine learning project
5	Implementation of searching techniques in AI.
6	Creating and Querying a Simple Semantic Network.
7	Create and visualize a knowledge graph

8	Implement a backward chaining algorithm to reason backward from a goal..			
9	Develop a forward chaining inference system where new facts are derived from existing facts.			
10	**Mini Project.** • Simple Chabot for FAQ • Basic Spam Email Filter • Rule-based Weather Prediction System • Basic Production System for Traffic Light Control • Simple Knowledge Base for Book Recommendations • Basic Recipe Recommendation System			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**60**

TEXT BOOKS:	
1	Gerardus Blokdyk,"Knowledge Representation And Reasoning A Complete Guide" , 2020.
2	Gerardus Blokdyk ,"Knowledge representation and reasoning ",Third Edition, ,October 2018.
REFERENCES:	
1	Deepak Khemani,"A First Course in Artificial Intelligence" , McGraw Hill Education (India), 2013.
2	Michael Gelfond and Yulia Kahl ,"Knowledge Representation, Reasoning, and the Design of Intelligent Agents: The Answer-Set Programming Approach", 2014.

CO – PO – PSO matrices of course:

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
AI23B31.1	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**
AI23B31.2	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**
AI23B31.3	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**
AI23B31.4	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**
AI23B31.5	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**
Average	**2.6**	**1.6**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**	**1**

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
AI23B32	SOFT COMPUTING	PE	2	0	2	3

OBJECTIVES:

- Understand the basics and types of neural networks for supervised and unsupervised learning.
- Learn fuzzy logic principles and apply them to fuzzy decision-making and control systems.
- Apply genetic algorithms to solve optimization problems, such as maximizing a function..
- Explore and apply hybrid systems integrating neural networks, fuzzy systems, and genetic algorithms.
- Apply soft computing techniques to real-world problems like image fusion, optimization, and control systems.

UNIT I	**ARTIFICIAL NEURAL NETWORK**	**6**

Fundamental Concept, McCulloch - Pitrs Neuron, Hebb Network. Supervised Learning- Network-Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons (Madaline). Associative memory Network - Bidirectional Associative Memory (BAM) ,Hopfield Networks, Linear Autoassociacive Memory (LAM). Unsupervised Learning Networks, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization

UNIT II	**FUZZY SYSTEMS**	**6**

Introduction-fuzzy logic, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Membership Functions. Defuzzification, Fuzzy Arithmetic and Fuzzy Measures, Fuzzy Decision Making, Fuzzy Logic Control Systems.

UNIT III	**GENETIC ALGORITHM**	**6**

Biological Background, Search Technique, Search Space. Terminologies in Genetic Algorithm- Genes, Fitness, Population, Operators- Encoding, Selection, Crossover, Mutation. Problem Solving Using Genetic Algorithm-Maximizing a Function.

UNIT IV	**HYBRID SOFT COMPUTING TECHNIQUES**	**6**

Neuro - Fuzzy Hybrid Systems- Characteristics, Adaptive Neuro, Fuzzy Inference System (ANFIS).Genetic Neuro – Hybrid Systems- Back-Propagation Network (BPN). Genetic Fuzzy Rule Based Systems (GFRBSs). Supervised ARTMAP System.

UNIT V	**APPLICATIONS**	**6**

Fusion Approach of Multi-spectral Images with SAR (Synthetic Aperture Radar),Optimization Salesman Problem using Genetic Algorithm Approach, Genetic Algorithm-Based Internet Search Technique, Soft Computing Based Hybrid Fuzzy Controllers.

TOTAL : 30

List of Experiments

1. Implementation of fuzzy control/ inference system
2. Programming exercise on classification with a discrete perceptron
3. Implementation of XOR with back propagation algorithm
4. Implementation of self organizing maps for a specific application
5. Programming exercises on maximizing a function using Genetic algorithm
6. Implementation of two input sine function
7. Implementation of three input non linear function
8. Mini Project - Develop a simple application using Hybrid Neural Network and Fuzzy Logic

Contact Hours :	**30**
Total Contact Hours :	**60**

COURSE OUTCOMES:	
•	Understand the advanced neural networks for AI applications.
•	Understand the fundamentals of fuzzy logic operators and inference mechanisms.
•	Learn the functionality of Genetic Algorithms in Optimization problems.
•	Use hybrid techniques involving Neural networks and Fuzzy logic.
•	Apply soft computing techniques in real world applications.

TEXT BOOKS:	
1	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
2	Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.

REFERENCES BOOKS:	
1.	Soft Computing And Its Applications By Matthew N. O Sadiku , Philip O. Adebo , Uwakwe C. Chukwu.,2023
2.	Soft Computing Engineering Applications Edited By Pradip Debnath, Binod Chandra Tripathy Copyright 2025
3.	S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.

CO-PO – PSO matrices of course

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
AI23B32.1	3	3	2	2	2	1			1	1	1	3	3	2	1
AI23B32.2	3	3	2	2	3	1			1	1	2	2	2	3	1
AI23B32.3	3	3	3	3	2	1			1	1	2	3	2	3	2
AI23B32.4	3	3	3	3	3	2	1	1	1	2	2	3	3	3	3
AI23B32.5	3	2	3	2	2	2		2	2	2	2	3	3	3	3
Average	3	2.8	2.6	2.4	2.4	1.4	0.2	0.6	1.2	1.4	1.8	2.8	2.6	2.8	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
AI23B33	Introduction to AI Robotics	PE	2	0	2	3

Objectives:	
●	Students can understand the concepts, methods and application of Artificial Intelligence in Robotics
●	To explore sensor technologies, their integration, and actuator technologies for robotic systems.
●	To develop kinematic analysis skills, including kinematic modeling, coordinate transformations, and solving forward/inverse kinematics.
●	To apply artificial intelligence techniques to enable robot intelligence, task planning, and effective knowledge representation.
●	To study industrial robotics, including cell design, control, and safety, and understand their applications and future scope.

UNIT-I	Introduction	6
Robotics -History - Classification and Structure of Robotic Systems - Basic components –Degrees of freedom - Robot joints coordinates- Reference frames - workspace- Robot languages- Robotic sensors- proximity and range sensors, ultrasonic sensor, touch and slip sensor		
UNIT-II	**Sensors, Drives and Grippers**	**6**
Characteristics of sensing devices, Criterion for selections of sensors, Classification, & applications of sensors. Internal sensors: Position sensors, & Velocity sensors, External sensors, Drives – Basic types of drives. Advantages and Disadvantages of each type. Selection / suitability of drives for Robotic application. Controllers, Types of Controller and introduction to close loop controller Grippers, Mechanical Gripper-Grasping force, mechanisms for actuation, Magnetic gripper vacuum cup gripper considerations in gripper selection & design.		
UNIT-III	**Kinematics of Manipulators**	**6**
Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Forward and inverse kinematics, Jacobian, Dynamic Modelling: Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation.		
UNIT-IV	**Robot Intelligence And Task Planning**	**6**
Artificial Intelligence - techniques - search problem reduction - predicate logic means and end analysis -problem solving -robot learning - task planning - basic problems in task planning - AI in robotics and Knowledge Based Expert System in robotics		
UNIT-V	**Industrial Robotics**	**6**
Robot cell design and control - cell layouts - multiple robots and machine interference - work cell design - work cell control - interlocks – error detection, deduction and recovery - work cell controller- robot cycle time analysis. Safety in robotics, Applications of robot and future scope.		
	Total Contact Hours :	**30**

List of Experiments	
1	Design and implement a workflow that demonstrates the integration of various sensors (such as temperature, humidity, or proximity sensors) with an Arduino microcontroller. Develop and test code for data acquisition, processing, and output display using appropriate libraries.
2	Develop a step-by-step workflow to construct a robotic gripper. Include the selection of materials, actuator integration, and control mechanisms. Evaluate the gripper's performance by testing its ability to grip, lift, and release objects of varying sizes and weights.
3	Construct a detailed kinematic model of a robotic arm, incorporating joint types, degrees of freedom, and link lengths. Use forward and inverse kinematics to calculate the robot's end-effector position and orientation. Validate the model through simulation or practical implementation.
4	Create a workflow to design and implement a closed-loop control system using sensors and actuators. Test the system by controlling a robot or device to achieve a specific goal (e.g., maintaining a desired temperature, position, or speed) while monitoring and adjusting based on feedback.
5	Develop a workflow for programming and controlling a mobile robot to navigate within a predefined environment. Incorporate sensor data for obstacle detection and path adjustments, and evaluate the robot's accuracy in reaching specified locations.
6	Design a workflow for implementing computer vision techniques to detect and recognize objects in an environment. Use image acquisition, preprocessing, feature extraction, and machine learning algorithms to classify objects. Validate the system using real-time or recorded datasets.
7	Develop a workflow to create and implement a path-planning algorithm for a robot. Include considerations for obstacle avoidance, shortest path calculation, and dynamic environment adjustments. Test the algorithm in simulation or real-world scenarios.
8	Create a simulation-based workflow to emulate the behavior of an intelligent agent. Define the agent's environment, decision-making process, and objectives. Evaluate the agent's performance in achieving tasks or adapting to changes in the environment.
9	Design a workflow to create and use ontologies for representing and managing knowledge in a specific domain. Include steps

	for defining concepts, relationships, and rules, as well as integrating the ontology with AI systems for reasoning and inference.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to
• Demonstrate knowledge of the fundamental principles and structure of robotic systems, including history, classification, and basic components.
• Analyze and select suitable sensors, drives, and grippers for various robotic applications.
• Apply kinematic and dynamic modeling techniques to solve problems in robotic manipulations.
• Utilize artificial intelligence methods for robot learning, task planning, and problem-solving in robotics.
• Design and analyze robotic work cells, including control mechanisms, error detection, and cycle time optimization, considering safety and application needs.

Textbooks:	
1.	Paul D. Harrison," AI in Robotics: A Beginner's Guide", Kindle Edition, Self-Published, 2023
2.	John J. Craig," Introduction to Robotics: Mechanics and Control", 3rd Edition, Pearson Education Inc., Asia, 2005

Reference Books(s):	
1	S. K. Saha, "Introduction to Robotics", 1st Edition, TATA McGraw Hills Education, 2014
2	John J. Craig, "Introduction to Robotics, Pearson Education Inc., Asia", 3rd Edition, 2005.
3	S. B. Nikku, "Introduction to Robotics – Analysis, Control, Applications", 3rd edition, John Wiley & Sons Ltd., 2020.
4	Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, "Industrial Robotics", 2nd edition, SIE, McGraw Hill Education (India) Pvt. Ltd., 2012.
5	R. D. Klafter, Thomas A. Chmielewski, and Michael Negin, "Robotic Engineering: An Integrated Approach", 1st Edition, Prentice Hall India (Pearson Education Inc.), 2009.

CO – PO – PSO matrices of course

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
AI23B33.1	1	-	-	-	-	-	1	-	2	3	1	3	-	2	-
AI23B33.2	-	3	-	2	-	-	-	-	-	2	1	1	2	-	-
AI23B33.3	-	-	-	1	-	-	-	-	-	3	-	-	2	-	-
AI23B33.4	-	1	-	1	-	-	-	-	-	3	-	2	3	-	1
AI23B33.5	1	1	1	1	1	1	1	1	2	3	1	1	1	-	-
AVERAGE	1.0	1.7	1.0	1.3	1.0	1.0	1.0	1.0	2.0	2.8	1.0	1.8	2.0	2.0	1.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	**Subject Name (Lab Oriented Theory Course)**	**Category**	**L**	**T**	**P**	**C**
AI23B34	**HUMAN COMPUTER INTERACTION**	**PE**	**2**	**0**	**2**	**3**

Objectives:
• To learn the foundations of Human Computer Interaction.
• To be familiar with the software design process.
• To acquire knowledge about human interaction models and theories.
• To explore various mobile applications development platforms
• To learn the guidelines of design thinking and apply it.

UNIT-I	**FOUNDATIONS OF HCI AND HUMAN FACTORS AS HCI THEORIES**	**6**
What HCI Is and Why It Is Important- Principles of HCI- Specific HCI Guidelines- Human Information Processing- Sensation and Perception of Information- Human Body Ergonomics (Motor Capabilities)		
UNIT-II	**HCI DESIGN**	**6**
The Overall Design Process-Interface Selection Options-Wire-Framing-"Naïve" Design Example: No Sheets 1.0: Requirements Analysis, User Analysis, Making a Scenario and Task Modeling, Interface Selection and Consolidation		
UNIT-III	**USER INTERFACE LAYER**	**6**
Understanding the UI Layer and Its Execution Framework-Input and Output at the Low Level-Processing the Input and Generating Output: Events, UI Objects, and Event Handlers, Event-Driven Program Structure, Output		
UNIT-IV	**UI DEVELOPMENT TOOLKIT & INTERACTIVE SYSTEM DEVELOPMENT FRAMEWORK**	**6**
Model, View, and Controller (MVC), MVC Implementation: Simple Bank Application, No Sheets User Interface Toolkit, Java AWT UI Toolkit, Android UI Execution Framework and Toolkit, Examples: iOS UIKit Framework and Toolkit, Case study experiencing the use of Flutter / React Native / Figma		
UNIT-V	**USER INTERFACE EVALUATION AND FUTURE OF HCI**	**6**
User Interface Evaluation: Evaluation Criteria, Evaluation Methods, **Future of HCI**: Non-WIMP/Natural/Multimodal Interfaces-Mobile and Handheld Interaction-High-End Cloud Service and Multimodal Client Interaction-Natural/Immersive/Experiential Interaction-Mixed and Augmented Reality.		

	Contact Hours	**:**	**30**

Course Outcomes: On completion of the course, the students will be able to	
• Describe the foundations of Human Computer Interaction.	
• Demonstrate the software design process	
• Apply the concepts of human interaction models and theories .	
• Design effective Mobile Applications	
• Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.	
Text Book(s):	
1	Gerard Jounghyun Kim ,"Human-Computer Interaction: Fundamentals and Practice"Apple Academic Press Inc.; 1st edition (20 March 2015)
Reference Book(s)/Web link(s)	
1	Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg,"Human – Computer Interaction", Pearson Education
2	Shneiderman, Plaisan,t Cohen ,Jacobs, Elmqvist"Designing the User Interface Strategies for Effective Human-Computer Interaction" Sixth Edition

CO - PO – PSO matrices of course

PO/PSO / CO	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O 3
AI23B34.01	2	3	-	-	2	2	3	-	-	3	-	-	-	3	-
AI23B34.02	3	3	3	3	2	-	3	2	3	3	2	3	-	3	3
AI23B34.03	2	3	3	2	3	1	2	3	3	3	-	3	2	3	3
AI23B34.04	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
AI23B34.05	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Average	**2.4**	**3.0**	**3.0**	**2.75**	**2.6**	**2.25**	**2.8**	**2.75**	**3.0**	**3.0**	**2.67**	**3.0**	**2.67**	**3.0**	**3.0**

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
AI23B11	INFORMATION VISUALIZATION	PE	3	0	0	3
Common to AIML & AIDS						

Objectives: On completion of this course, the student will be able to	
●	dentify and recognize visual perception and representation of data.
●	llustrate about projections of different views of objects.
●	Apply various Interaction and visualization techniques.
●	Analyze various groups for visualization.
●	Evaluate visualizations

UNIT-I	**NTRODUCTION AND DATA FOUNDATION**	**9**
Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets.		
UNIT-II	**FOUNDATIONS FOR VISUALIZATION**	**9**
Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.		
UNIT-III	**VISUALIZATION TECHNIQUES**	**9**
Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three Dimensional Data - Dynamic Data - Combining Techniques. Geospatial Data : Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data : Point-Based Techniques - LineBased Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.		
UNIT-IV	**INTERACTION CONCEPTS AND TECHNIQUES**	**9**
ext and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations – Extended Text Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space –Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.		
UNIT-V	**Designing of Visualization**	**9**
Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation , Hardware and Applications		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Visualize the objects in different dimensions
●	Design and process the data for Visualization
●	Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical sciences
●	Apply the virtualization techniques for projects
●	Identify appropriate data visualization techniques given particular requirements imposed by the data.

Reference Books:	
1	Colin Ware, “Information Visualization Perception for Design”, 4th edition, Morgan Kaufmann Publishers, 2021.
2	Matthew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications”, 2010.
3	Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition,A K Peters, Ltd 2015.
4	Scott Murray,Interactive Data Visualization for the Web ,2nd Edition, 2017

CO - PO – PSO matrices of course

COs/POs& PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
AI23B11.1	3	3	2	-	-	-	-	-	1	-	-	-	3	1	-
AI23B11.2	3	3	3	2	-	2	-	-	-	-	-	2	2	3	-
AI23B11.3	3	3	3	2	3	-	-	2	2	-	-	-	-	3	-
AI23B11.4	3	3	3	-	3	1	-	-	-	-	1	2	2	-	-
AI23B11.5	3	3	2	3	2	-	-	1	3	-	3	3	3	3	1
Average	3	3	2.6	1.4	1.4	0.6	-	0.6	0.8	-	0.6	1.4	2	2	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
AI23B12	COGNITIVE SCIENCE		3	0	0	3

Objectives: This course will enable students

- To learn the basics of cognitive science
- To understand the integration of psychological and neuroscientific explanations in cognitive science through key frameworks and models.
- To explore symbolic and neural network models of cognitive processes in information processing.
- To explore the mind's organization through modularity theories, hybrid architectures, and brain mapping techniques.
- To examine dynamical systems, situated cognition, and brain connectivity in understanding consciousness and building artificial brain systems

UNIT-I	Introduction to Cognitive Science	9
The prehistory of cognitive science- The discipline matures: Three milestones-The turn to the brain-Cognitive systems as functional systems anatomy of the brain and the primary visual pathway-Extending computational modeling to the brain-Mapping the stages of lexical processing		
UNIT-II	Cognitive science and the integration challenge	9
Levels of explanation: The contrast between psychology and neuroscience-The integration challenge-Local integration I: Evolutionary psychology and the psychology of reasoning-Local integration II: Neural activity and the BOLD signal-Marr's tri-level hypothesis and the integration challenge-Models of mental architecture		
UNIT-III	Information-Processing Models of the Mind	9
The physical symbol system hypothesis- From physical symbol systems to the language of thought -Applying the symbolic paradigm- Neural networks and distributed information processing -Neural network models of cognitive processes: Language learning in neural networks- Neural network models of children's physical reasoning.		
UNIT-IV	The Organization of the Mind	9
Architectures for intelligent agents-Fodor on the modularity of mind massive modularity hypothesis-Hybrid Strategies for brain mapping: Structure and function in the brain-Studying cognitive functioning: Techniques from neuroscience		
UNIT-V	New horizons: Dynamical systems and situated cognition	9
Cognitive science and dynamical systems-Applying dynamical systems-Situated cognition and biorobotics-Information processing without conscious awareness-The global workspace theory of consciousness-Exploring the connectivity of the brain-Building artificial brain systems		
Total Contact Hours:45		

Text Book(s):

1.Bermúdez, José Luis. Cognitive science: An introduction to the science of the mind. Cambridge University Press, 2017.

Reference Books:

1. The Encyclopedia of Cognitive Science
2. Andy Clark: Mindware: An Introduction to the philosophy of cognitive science
3. Andy Clark: Natural born cyborgs: Minds, Technologies, and the Future of Human Intelligence
4. Bradley Voytek & Timothy Verstynen: Do Zombies Dream of Undead Sheep? A Neuroscientific View of the Zombie Brain
5. Fromkin, Rodman, and Hyams. An Introduction to Language, Boston, MA: Thomson Wadsworth, 9th edition, 2011, chapters 1-2

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

- Understand the foundations of cognitive science, including computational modeling, brain anatomy, and lexical processing stages.
- Analyze interdisciplinary integration challenges and frameworks like Marr's tri-level hypothesis to connect psychology and neuroscience.
- Explore symbolic and neural network models of cognitive processes such as language learning and reasoning.
- Evaluate modularity theories, hybrid architectures, and neuroscience techniques for studying brain structure and function.
- Apply dynamical systems, situated cognition, and brain connectivity in understanding consciousness and artificial brain systems.

CO-PO – PSO matrices of course

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
AI23B12.1	3	3	2	2	3	-	-	-	-	1	1	2	3	2	1
AI23B12.2	3	3	2	2	3	3	-	-	-	1	2	2	2	3	-
AI23B12.3	3	3	3	3	2	-	-	-	-	1	2	2	3	3	-
AI23B12.4	2	3	3	3	3	3	3	1	1	2	2	2	1	3	3
AI23B12.5	2	2	3	3	3	2	-	2	2	2	2	3	1	3	3
Average	2.8	2.8	2.6	2.6	2.8	1.6	0.6	0.6	0.6	1.4	1.8	2.5	2	2.8	1.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23B31	C# and .NET Programming (Common to IT, AIML, AIDS, CSE, CSBS, CSE CS)	PE	2	0	2	3

Objectives:
• To learn basic programming in C# and the object oriented programming concepts.
• To study the advance programming concepts in C#.
• To understand the working of base class libraries, their operations and manipulation of data using XML.
• To update and enhance skills in writing Windows application, WPF, WCF and WWF with C# and .NET.
• To implement mobile applications using .Net compact framework.

UNIT-I	**C# LANGUAGE BASICS**	**6**
.Net Architecture – Core C#– Objects and Types- – Inheritance- Generics – Arrays and Tuples – Operators and Casts.		
UNIT-II	**C# ADVANCED FEATURES**	**6**
Delegates – Lambdas – Events– Strings and Regular Expressions – Collections –Asynchronous Programming- Memory Management and Pointers – Errors and Exceptions – Reflection.		
UNIT-III	**BASE CLASS LIBRARIES AND DATA MANIPULATION**	**6**
Diagnostics -Tasks, Threads and Synchronization – Manipulating XML–ADO.NET- Peer-to-Peer Networking –Core Windows Presentation Foundation (WPF).		
UNIT-IV	**WINDOW BASED APPLICATIONS, WCF AND WWF**	**6**
Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)– Introduction to Web Services – .Net Remoting -Windows Service – Windows Workflow Foundation (WWF)		
UNIT-V	**.NET FRAMEWORK AND COMPACT FRAMEWORK**	**6**
Assemblies – Custom Hosting with CLR Objects – Core XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance .		
		Contact Hours: 30

ist of Experiments	
1	Write a console application that obtains four int values from the user and displays the product. Hint: you may recall that the Convert.ToDouble() command was used to convert the input from the console to a double; the equivalent command to convert from a string to an int is Convert.ToInt32().
2	Write an application that receives the following information from a set of students: Student Id: Student Name: Course Name: Date of Birth: The application should also display the information of all the students once the data is Entered. Implement this using an Array of Structures.

3	Write a program to declare a class “staff” having data members as name and post. Accept this data 5 for 5 staffs and display names of staff who are HOD.
4	Write a program to implement multilevel inheritance from following figure. Accept and display data for one student.

5	Write a program to create a delegate called TrafficDel and a class called TrafficSignal with the following delegate methods.
	Public static void Yellow(){
	Console.WriteLine(“Yellow Light Signal To Get Ready”);
	}
	Public static void Green(){
	Console.WriteLine(“Green Light Signal To Go”);
	}
	Public static void Red(){
	Console.WriteLine(“Red Light Signal To Stop”);
	}
	Also include a method IdentifySignal() to initialize an array of delegate with the above methods and a method show() to invoke members of the above array.

6	Write a program to accept a number from the user and throw an exception if the number is not an even number.
7	Create an application that allows the user to enter a number in the textbox named “getnum”. Check whether the number in the textbox “getnum” is palindrome or not. Print the message accordingly in the label control named lbldisplay when the user clicks on the button “check”.
8	Create a project that calculates the total of fat, carbohydrate and protein. Allow the user to enter into text boxes. The grams of fat, grams of carbohydrate and grams of protein. Each gram of fat is 9 calories and protein or carbohydrate is 4 calories. Display the total calories of the current food item in a label. Use to other labels to display and accumulated some of calories and the count of items entered. The form food have 3 text boxes for the user to enter the grams for each category include label next to each text box indicating what the user is enter.
9	Database programs with ASP.NET and ADO.NET. Create a Web App to display all the Empname and Deptid of the employee from the database using SQL source control and bind it to GridView . Database fields are(DeptId, DeptName, EmpName, Salary).
10	Programs using ASP.NET Server controls. Create the application that accepts name, password, age, email id, and user id. All the information entry is compulsory. Password should be reconfirmed. Age should be within 21 to 30. Email id should be valid. User id should have at least a capital letter and digit as well as length should be between 7 and 20 characters.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes:

On completion of the course, the students will be able to

- Write various applications using C# Language.
- Write various applications using advanced C# concepts.
- Create window services, libraries and manipulating data using XML.
- Develop distributed applications using .NET Framework.
- Create mobile applications using .NET compact Framework.

Text Books(s)

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, “Professional C# 2012 and .NET 4”, Wiley, 2012.

2. Andy Wigley, Daniel Moth, Peter Foot, “Mobile Development Handbook”, Microsoft Press, 2007.

Reference Books
1. Ian Gariffiths, Mathew Adams, Jesse Liberty, “Programming C# 4.0‖:,OReilly, Fourth Edition, 2010.
2. D Andrew Troelsen, “Pro C# 5.0 and the .NET 4.5 Framework”, Apress publication, 2012.

CO-PO-PSO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23B31.1	2	2	1	1	1	-	-	-	1	-	-	1	2	1	-
IT23B31.2	2	2	1	2	1	-	-	-	1	-	2	2	2	2	-
IT23B31.3	2	2	2	1	1	-	-	-	1	-	-	1	2	1	-
IT23B31.4	2	2	2	2	2	-	-	-	2	-	2	2	2	2	2
IT23B31.5	3	2	2	2	3	-	-	-	3	-	2	2	2	2	2
Average	**2.2**	**2.0**	**1.6**	**1.6**	**1.6**	**-**	**-**	**-**	**1.6**	**-**	**2.0**	**1.6**	**2.0**	**1.6**	**2.0**

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: “-“

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
IT23B33	DevOps (Common to IT, AIML,AIDS,CSE, CSE CS,CSD,CSBS)	PE	2	0	2	3

Objectives:
• Understand the principles and practices of DevOps.
• Gain proficiency in using DevOps tools like Git, Jenkins, Docker, Kubernetes, and Helm.
• Learn to implement CI/CD pipelines for automation and efficiency.
• Explore advanced topics like DevSecOps, security testing, and reducing deployment downtime.
• Apply DevOps concepts to real-world applications and projects.

Unit – I	**Introduction to DevOps**	6
What is Devop- DevOps Roots and Origin- Why Is DevOps Required- The DevOps Lifecycle and Workflow- DevOps Practices- DevOps Tools		
UNIT-II	**DevOps CI/CD Pipeline**	6
Managing Your Source Code with Git - Overviewing Git and its principal command lines- Understanding the Git process and Gitflow pattern- Continuous Integration and Continuous Delivery- CI/CD principles- Creating a CD pipeline – the release- Using GitLab CI- Using Jenkins for CI/CD implementation- Deploying Infrastructure as Code with CI/CD Pipelines-		
UNIT-III	**Microservices with Docker and Kubernetes**	6
Containerizing Your Application with Docker- Installing Docker- An overview of Docker's elements- Building and running a container on a local machine- Using Docker for running command-line tools- Docker Compose- Installing Kubernetes- Installing the Kubernetes dashboard- Using Helm as a package manager- Creating a CI/CD pipeline for Kubernetes with Azure Pipelines		
UNIT-IV	**More on DevOps**	6
Security in the DevOps Process with DevSecOps- Testing Azure infrastructure- Writing InSpec tests- Reducing Deployment Downtime- Blue-green deployment concepts and patterns- DevOps for Open Source Projects- pull requests- Sharing binaries- GitHub Actions- Analyzing code with SonarCloud		
UNIT-IV	**DevOps Best Practices**	6
Choosing the right tool- Writing all your configuration in code- Designing the system architecture- Building a good CI/CD pipeline- Shifting security left with DevSecOp- Applying web security and penetration testing with ZAP- Running performance tests with Postman		
Contact Hours: 30		

ist of Experiments
1. Exploring Git Commands through Collaborative Coding.
2. Implement GitHub Operations
3. Exploring Git Commands through Collaborative Coding.
4. Implement GitHub Operations
5. Applying CI/CD Principles to Web Development Using Jenkins, Git, and Local HTTP Server
6. Exploring Containerization and Application Deployment with Docker

7. Applying CI/CD Principles to Web Development Using Jenkins, Git, using Docker Containers
8. Demonstrate Container Orchestration using Kubernets.
9. Create the GitHub Account to demonstrate CI/CD pipeline using Cloud Platform.
10. Reduce the Downtown using Blue-Green Deployment
11. Testing Project with ZAP and Postmen
Contact Hours : 30
Total Contact Hours : 60

Course Outcomes: Students will be able to
• Apply DevOps principles and lifecycle workflows to software development.
• Build and manage CI/CD pipelines for application development and deployment.
• Utilize tools like Docker and Kubernetes for containerization and orchestration.
• Implement DevSecOps practices for secure and reliable deployments.
• Demonstrate advanced DevOps practices such as blue-green deployment and testing.

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic

- Lab assessment:
- Quizzes and Assignments
- Group project

SUGGESTED ACTIVITIES **Case Study: E**volution of DevOps in industry-leading companies. Group discussion on the DevOps lifecycle and workflow.

- Code walkthrough:

Implementing a blue-green deployment strategy. Conducting security analysis using SonarCloud and GitHub Actions and walkthrough the code to the group.

Text Book(s):
1. Mark Reed, " DevOps The ultimate beginners guide to learn DevOps step by-step", Amazon,2019.
2. Craig Berg , “DevOps For Beginners: A Complete Guide To DevOps Best Practices, Second edition, Amazon , 2020.
3. Mikael Krief, "Learning Devops" , Second Edition, Packt Publisher, 2022.

Reference Books(s) / Web links:
1. DevOps Tutorial | Microsoft Azure
2. DevOps Fundamentals- Defining DevOps Principles - GitHub - GitHub Resources

CO-PO-PSO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23B33.1	3	2	2	–	3	–	–	2	3	2	–	–	2	2	–
IT23B33.2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
IT23B33.3	3	3	3	3	3	2	3	3	3	3	2	3	3	3	3
IT23B33.4	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
IT23B33. 5	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
Average	3	2.8	2.8	3	3	2	3	2.8	3	2.8	2.75	2.8	2.6	2.8	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
IT23C12	Software Project Management (Common to IT, CSE, AIDS, CSD)	PE	3	0	0	3

Objectives:

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students' complete projects as part of assignments in various courses undertaken.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process management for software development.

UNIT-I	SOFTWARE DEVELOPMENT PROCESS	9

Defining of Software Development Process - Process - Tailoring the Process – Improving the process discipline - Need for implementing discipline. Software Production Process - Identify the Software Model - Software Process Models : Waterfall Model, Prototyping Model, RAD Model, Incremental Model, Spiral Model, Component Assembly Model - Software Life Cycle.

UNIT-II	SOFTWARE PROJECT MANAGEMENT	9

Introduction to Software Project Management- Software Projects – ways of categorizing software projects – problems with software projects – Project Life Cycle– Management -Setting objectives –Stakeholders – Project Team- Step-wise : An overview of project planning -project Evaluation –Selection Of Appropriate Project Objectives- Software Effort Estimation Techniques, Function Point Analysis-Object Point-COCOMO.

UNIT-III	SOFTWARE PLANNING	9

Activity planning– project schedules – sequencing and scheduling projects – Network planning model – AON and AOA-identifying critical activities-Crashing And Fast Tracking-,Risk management—Categories , Risk planning, Management and Control – Evaluating risks to the schedule. PERT- Resource Allocation, Monitoring and Tracking – Monitoring and control – allocation – identifying resource requirements – scheduling resources – creating critical paths – publishing schedule – cost schedules- sequence schedule.

UNIT-IV	SOFTWARE SPECIFICATIONS	9

Product Specifications - Defining the Final Product - Data Flow Diagram, Data Dictionary, Structured English, Decision Trees, Decision Tables - Feasibility Study. Software Testing : Test Plan - Development Testing : Verification and Validation - General Testing Methods : White Box and Black Box Testing - Unit Testing – System Integration Testing - Validation Testing - System testing.

UNIT-V	SOFTWARE QUALITY	9

Software Quality - Quality Measures - FURPS - Software Quality Assurance – Software Reviews - Format Technical Review (FTR) Formal Approaches to SQA – Software Reliability - Introduction to SQA - The Software Quality Assurance Plan – Formal approaches to SQA - Clean room Methodology.

Total Contact Hours:45

Course Outcomes:
• Apply project management concepts and techniques to an IT project.
• Identify issues that could lead to IT project success or failure.
• Explain project management in terms of the software development process.
• Describe the responsibilities of IT project managers.
• Apply project management concepts through working in a group as team leader

SUGGESTED ACTIVITIES

- Problem solving sessions
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1.Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Fifth Edition, Tata McGraw Hill, New Delhi, 2017.
2.Pressman R S, "Software Engineering - A Practitioner,,s Approach", 9 th Edition, Tata McGrawHill Book Company, 2023.

Reference Books(s) / Web links:
1. Gerardus Blokdyk, **"**Software Project Management: A Complete Guide", 5STARCooks ,2020
2. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling**",** 13th Edition, Wiley, 2022
3. Project Management Institute (PMI), " A Guide to the Project Management Body of Knowledge**"**, Seventh Edition, Project Management Institute, 2021

CO-PO-PSO Mapping

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO2	PSO3
IT23C12.1	1	2	3	-	1	-	-	1	2	2	3	3	2	2	2
IT23C12.2	2	1	2	-	2	-	-	-	1	2	2	2	3	2	1
IT23C12.3	2	2	2	-	1	-	-	1	-	2	2	2	2	2	2
IT23C12.4	1	2	3	-	2	-	-	-	1	2	1	1	3	1	2
IT23C12. 5	2	2	3	-	1	-	-	1	-	2	2	1	2	1	2
Average	1.7	1.8	2.6	-	1.4	-	-	1	1.3	2	2	1.8	2.4	1.7	1.8

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
IT23C17	Ubiquitous Computing (Common to IT, CSE)	PE	3	0	0	3

Objectives:
1. Understand the fundamental concepts and principles of ubiquitous computing.
2. Understand the architecture, lifecycle, and integration of smart devices and services in modern technological ecosystems.
3. Design and develop basic ubiquitous computing systems or applications.
4. Explore the principles and design of intelligent systems, focusing on interaction, autonomy, and artificial life.
5. Communicate effectively about ubiquitous computing concepts and applications.

UNIT-I	**INTRODUCTION**	**9**
Applications- Properties- Implicit Human Computer Interaction- Ubiquitous System Environment Interaction - Architectural Design for UbiCom Systems- Applications and Requirements: Example Early UbiCom Research Projects, Everyday Applications in the Virtual, Human and Physical World		
UNIT-II	**SMART DEVICES**	**9**
Smart Devices and Services - Service Architecture Models - Service Provision Life Cycle - Virtual Machines and Operating Systems- Smart Mobile Devices, Users, Resources and Code- Operating Systems for Mobile Computers and Communicator Devices - Smart Card Devices- Device Networks		
UNIT-III	**HUMAN COMPUTER INTERACTION**	**9**
Basic Concepts - User Interfaces and Interaction for Four Widely Used Devices - Hidden UI Via Basic Smart Devices - Hidden UI Via Wearable and Implanted Devices - Human Centred Design (HCD) - Tagging the Physical World - Sensors and Sensor Networks - Control Systems - Robots		
UNIT-IV	**INTELLIGENT SYSTEMS**	**9**
Basic Concepts , IS Architectures , IS System Operations - Interaction Multiplicity- Interaction Design -Generic Intelligent Interaction Applications- Autonomous Systems and Artificial Life		
UNIT-V	**UBIQUITOUS COMMUNICATION**	**9**
Audio Networks, Data Networks, Wireless Data Networks and Ubiquitous Networks- Managing Smart Devices in Virtual Environments and Human User Centered Environments		
	Total Contact Hours: 45	

Course Outcomes:
1. Gain a comprehensive understanding of the principles and concepts underlying ubiquitous computing.
2. Design and implement service-oriented solutions leveraging smart devices and networks.
3. Understanding ubiquitous computing applications across various platforms, including mobile, wearable, and IoT devices.
4. Design intelligent systems with effective interaction and autonomous capabilities.
5. Apply ubiquitous computing principles to solve real-world problems and challenges such as healthcare, smart cities, and personalized services.

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic

- Case study on ubiquitous computing
- Survey on various application
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS (if Any) (UNIT/ Module Wise) – could suggest topic

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1. Stefan Poslad ," Ubiquitous Computing Smart Devices, Environments and Interactions", Wiley, First Edition, 2009.
2. Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, and Loren Schwiebert , " Fundamentals of Mobile and Pervasive Computing" , McGraw-Hill, 2005.
3. John Krumm , "Ubiquitous Computing Fundamentals", Chapman and Hall/CRC, 2009.

Reference Books(s) / Web links:
1. Hideyuki Nakashima, Hamid Aghajan, and Juan Carlos Augusto , "Handbook of Ambient Intelligence and Smart Environments", Springer-Verlag, 2010.
2. Adam Greenfield , " Everyware: The Dawning Age of Ubiquitous Computing", New Riders, First Edition, 2010.
3. Olivier Hersent, David Boswarthick, and Omar Elloumi , "The Internet of Things: Key Applications and Protocols" John Wiley & Sons Inc, Second Edition, 2012

CO-PO-PSO Mapping

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO2	PSO3
IT23C17.1	3	2	3	-	1	-	-	1	2	2	3	3	2	2	2
IT23C17.2	3	2	2	-	2	-	-	-	1	2	2	2	3	2	2
IT23C17.3	3	2	2	-	1	-	-	1	-	2	2	2	2	2	2
IT23C17.4	3	2	3	-	2	-	-	-	1	2	1	1	3	1	2
IT23C17. 5	3	2	3	-	1	-	-	1	-	2	2	1	2	1	2
Average	3	2	2.6	-	1.4	-	-	1	1.3	2	2	1.8	2.4	1.7	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Course)	Category	L	T	P	C
IT23C31	Software Testing (Common to IT, CSE, CSE CS, AIML, AIDS, CSBS, CSD)	PC	2	0	2	3

Objectives:
• To learn the criteria for test cases
• To learn the design of test cases.
• To understand test management and test automation techniques
• To understand test management and test structure group
• To apply test metrics and measurements

UNIT-I	**INTRODUCTION**	6
Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester‘s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design		
UNIT-II	**TEST CASE DESIGN STRATEGIES**	6
Test case Design Strategies – Using Black Box Approach to Test Case Design – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Secured Code Writing – code complexity testing		
UNIT-III	**LEVELS OF TESTING**	6
The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests –Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing –Compatibility testing .		
UNIT-IV	**TEST MANAGEMENT**	6
People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group.		
UNIT-V	**TEST AUTOMATION**	6
Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics		
Total Contact Hours: 30		

Description of the Experiments	Total Contact Hours: 30
1. Demonstrate the working of the following a. constructs: i) do...while ii) while….do iii) if…else iv) switch v) for	
2. Take any system (e.g. ATM system) and study its system specifications and report the various bug	
3. Write the test cases for any known application (e.g. Banking application)	
4. Create a test plan document for any application (e.g. Library Management System)	
5. Study of any testing tool (e.g. Win runner)	
6. Study of any web testing tool (e.g. Selenium)	
7. Study of any bug tracking tool (e.g. Bugzilla, bugbit)	
8. Study of any test management tool (e.g. Test Director)	
9. Study of any open source-testing tool (e.g. Test Link)	

Course Outcomes:

At the end of the course the students will be able to

- Design test cases suitable for a software development for different domains
- Identify suitable tests to be carried out
- Prepare test planning based on the document
- Document test plans and test cases designed
- Use automatic testing tools and Develop and validate a test plan

SUGGESTED ACTIVITIES (if any)

- Survey on various Testing technologies
- Activity Based Learning

SUGGESTED EVALUATION METHODS (if Any)

- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):

1. Andreas Spillner, Tilo Linz, “Software Testing Foundations“, 5th Edition, O’Reilly Publisher, 2021.
2. Arnon Axelrod, “Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects “, Apress Publisher, 1st Edition, September 2018

Reference Books(s) / Web links:

1. Ilene Burnstein, “Practical Software Testing: A Process Oriented Approach“, Springer International Edition, December 2010.
2. James Whittaker , Jason Arbon , Jeff Carollo , “How Google Tests Software“, 1st Edition, Addision Wesley, 2012
3. Rex Black Erik van Veenendaal, Dorothy Graham , **“**Foundations of Software Testing ISTQB Certification**“** , 3rd Edition, Cengage Publications, 2015

CO-PO-PSO Mapping

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
IT23C31.1	3	2	3	-	1	-	-	1	2	2	3	3	2	2	2
IT23C31.2	3	2	3	-	2	-	-	-	1	2	2	2	3	2	2
IT23C31.3	3	2	3	-	1	-	-	1	-	2	2	2	2	2	2
IT23C31.4	3	2	3	-	2	-	-	-	1	2	1	1	3	1	2
IT23C31. 5	3	2	3	-	1	-	-	1	-	2	2	1	2	1	2
Average	3	2	3	-	1.4	-	-	1	1.3	2	2	1.8	2.4	1.7	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23A35	Web Application Security	PE	2	0	2	3

Objectives:
• To understand the fundamentals of Web Application Security
• To know about web application authentication and authorization mechanism
• To identify common web application vulnerabilities
• To focus on wide aspects of secure development and deployment of web applications
• To get insight about mitigations and countermeasures against web application attacks

UNIT I	**INTRODUCTION**	**6**
History of Software Security – OWASP Top Ten List 2021 – Input Validation – Attack Surface Reduction – Classifying and Prioritizing Threats		
UNIT II	**WEB APPLICATION SECURITY PRINCIPLES**	**6**
Authentication - Access Control Overview - Two Factor and Three Factor Authentication - Web Application Authentication – Authorization - Session Management Fundamentals - Securing Web Application Session Management		
UNIT-III	**COMMON WEB APPLICATION VULNERABILITIES**	**6**
Cross Site Scripting- Reflected XSS- Stored XSS- DOM based XSS- Mutation based XSS – Cross Site Request Forgery - SQL Injection – Code Injection – Insecure Direct Object References (IDOR)		
UNIT IV	**SECURE DEVELOPMENT AND DEPLOYMENT**	**6**
Application Security- Training- Threat Modelling- Secure Coding Libraries- Code Review- Security Testing- Security Incident Response Planning – Microsoft Security Development Lifecycle (SDL) – OWASP Comprehensive Lightweight Application Security Process (CLASP) – Software Assurance Maturity Model (SAMM)		
UNIT-V	**MITIGATIONS AND COUNTERMEASURES**	**6**
Anti XSS Coding Best Practices- Sanitizing User Input – Anti CSRF Coding Best Practices – Mitigating Against SQL Injection – Generic Injection Defenses – Defending Against IDOR – Architecture Level Mitigations		
	Total Contact Hours :	**30**

List of Experiments	
1	Identify security issues in web application – Walking An Application in TryHackMe Platform
2	Burp Suite Basics in TryHackMe Platform
3	OWASP ZAP to scan authenticated web application in TryHackMe Platform
4	SQL Injection Lab in TryHackMe Platform
5	Explore OWASP Top Ten -2021 Vulnerabilities in TryHackMe Platform

6	SQLmap to exploit web application in TryHackMe Platform	
7	Exploit File Inclusion and Path Traversal Vulnerabilities in TryHackMe Platform	
8	Server Side Template Injection in TryHackMe Platform	
9	DejaVu Code Injection Vulnerability in TryHackMe Platform	
10	NoSQL Injection on MongoDB in TryHackMe Platform	
	Contact Hours :	**30**
	Total Contact Hours :	**60**

Course Outcomes: On completion of course you will be able to
• Understand the fundamentals of web application security
• Apply security principles in developing a secure web application
• Identify common web vulnerabilities that are exploited by hackers
• Identify the secure model for web application development and deployment
• Apply best practices for mitigations of vulnerabilities

Suggested Activities:
• Assignment problems, Quiz. • Class presentation/Discussion

Textbooks:	
1.	Andrew Hoffman, “Web Application Security: Exploitations and Countermeasures for Modern Web Applications”, 2nd Edition, O’Reilly, 2024
2.	Brian Sullivan and Vincent Liu, “Web Application Security: A Beginners Guide”, 1st Edition, McGrawHill, 2012

Reference Books (s)/Web links:	
1.	Ron Lepofsky, "The Manager's Guide to Web Application Security: A Concise Guide to the Weaker Side of the Web", Apress, 2015
2.	Dafydd Stuttard and Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2nd Edition, Wiley, 2011
3.	Joseph Marshall, "Hands-On Bug Hunting for Penetration Testers: A practical guide to help ethical hackers discover web application security flaws", Packt, 2018
4.	https://owasp.org/www-project-top-ten/

5.	https://tryhackme.com/r/hacktivities/search
6.	https://portswigger.net/web-security/learning-paths

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A35.1	1	2	2	1	3	-	-	-	-	-	-	1	-	-	-
CS23A35.2	2	1	2	1	3	-	-	-	-	-	-	-	-	-	-
CS23A35.3	1	1	1	2	3	-	-	-	-	-	-	1	-	-	-
CS23A35.4	1	2	1	1	2	-	-	-	-	-	-	-	-	-	-
CS23A35.5	1	2	2	2	2	-	-	-	-	-	-	1	-	-	-
Average	1.2	1.6	1.6	1.4	2.6	-	-	-	-	-	-	1	-	-	-

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

Subject Code	Subject Name (Theory Course)	Category	L	T	P	C
IT23A11	Internet of Things (Common to IT, AIML, AIDS, CSE, CSE CS,)	PE	3	0	0	3

Objectives:
●To understand the basics of Internet of Things and communication protocols.
●To understand the basic principles, architecture, and components, Methods of IoT systems.
●To explore the hardware aspects, including microcontrollers (e.g., Arduino, Raspberry Pi) and sensors commonly used in IoT projects.
●To gain hands-on experience with popular IoT platforms, Physical servers and cloud.
●To learn how to process, analyze, and visualize data collected from IoT devices to derive actionable insights

Unit – I	**Introduction to Internet of Things**	9
Introduction – Definition and characteristics of IoT – How IoT Works? – IoT Applications- Challenges of IoT – Advantages and Disadvantages of IoT - IoT Protocols – Logical Design of IoT: IoT Functional blocks – IoT Communication Models – IoT Communication APIs.		
UNIT-II	**Internet of Things Architecture and Design Methodologies**	9
IoT Architecture – IoT Reference Architecture – IOT Design Methodology: Domain Specification- Functional View, Information View, Operation and deployment, Device and Component Integration, Application development and deployment UNIT-III IOT ELEMENT		
UNIT-III	**Internet of Things Hardware and Management**	9
Building blocks of an IoT Device – Raspberry Pi, Arduino – Sensors, Communication Modules: Bluetooth, Zigbee, RFID - Power Sources –Data Management, Business Processes in IoT		
UNIT-IV	**IOT Platforms and Cloud Management**	9
Physical servers and cloud - XaaS, M2M , WAMP- AutoBahn for IoT – Xively Cloud for IoT – Django – Designing a RESTful Web API –Google cloud for IoT.		
UNIT-IV	**Tools and Applications**	9
Retail, Health care, Transportation, Agriculture and environmental, Smart city, Government and military, Smart home		
	Contact Hours: 45	

Course Outcomes: On completion of the course, the students will be able to
● Know about IoT and its functionalities.
●Interpret IoT Architecture.
●Implement the various IoT elements and design the system.
●Understand the IoT physical servers and cloud integration.
●Design and develop the various applications in IoT

SUGGESTED ACTIVITIES
Case Study Analysis: Analyze case studies that implement Internet of Things on the following Sectors- Retail, Health care, Transportation, Agriculture and environmental, Smart city, Government and military, Smart homes.

SUGGESTED EVALUATION METHODS
• Mini Projects • Assignment problems • Quizzes

Text Book(s):
1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,First Edition, 2012
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian, "Architecting the Internet Of Things", 2011 Edition. Springer,April 2011.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Second Edition, John Wiley & Sons Inc, 2012.

Reference Books(s) / Web links:
1. Vijay Madisetti and ArshdeepBahga, ―Internet of Things (A Hands-on-Approach)‖,1st Edition, Orient Blackswan Private Limited, 201 5
2. Amit Kumar Tyag, Internet of Things Theory and Practice: Build Smarter Projects to Explore the IoT Architecture and Applications, BPB Publications, 27 July 2022

CO-PO-PSO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
IT23A11.1	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3
IT23A11.2	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3
IT23A11.3	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3
IT23A11.4	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3
IT23A11. 5	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3
Average	3	3	-	2	3	2	-	-	2	-	1	2	3	2	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab Course)	Category	L	T	P	C
CS23B32	Advanced Application Development with Oracle APEX	PE	0	0	6	3
B.E Programme for CSE						

Course Objectives:	
●	To provide students with an understanding of Oracle APEX as a platform for rapid application development using Oracle Autonomous Database.
●	To enable students to create, design, and manage database-driven applications with interactive features.
●	To introduce advanced techniques for managing interactive reports, grids, and dynamic data visualization tools like cards and smart filters.
●	To teach students how to enhance applications using dynamic actions, computations, processes, validations, and implement robust security features.
●	To prepare students to handle application lifecycle tasks such as migrating development between environments and managing application data effectively.
List of Experiments	
1.	Setting up the environment and getting started with Oracle APEX.
2.	Exploring SQL Workshop, creating tables, and executing SQL queries.
3.	Creating database application and deploying it on APEX.
4.	Adding and customizing pages and regions in an application.
5.	Creating and formatting reports to visualize data.
6.	Modifying interactive reports to enhance user interaction.
7.	Managing and personalizing interactive grids in an application.
8.	Adding page controls like buttons, list items, and selectors.
9.	Integrating computations, processes, and validations for application logic.
10.	Implementing dynamic actions to enhance user interactivity.
11.	Designing and implementing advanced search and filter options.
12.	Creating interactive forms and connecting them with database tables.
13.	Designing and implementing navigation menus and breadcrumbs.
14.	Customizing application look and feel using themes and styles.
15.	Adding plugins and JavaScript to extend functionality.
16.	Importing, exporting, and managing data within an application.
17.	Implementing security measures like authentication and authorization.
18.	Integrating new pages into the existing application structure.
19.	Deploying and migrating applications across different environments.

Contact Hours	**:**	**90**

Course Outcomes:	
Upon completing the course, students will be able to:	
●	Demonstrate the ability to use Oracle APEX to create and deploy scalable database applications.
●	Develop and customize pages, regions, forms, and navigation components for a seamless user experience.
●	Integrate interactive reports, grids, dynamic actions, and search functionalities to enhance application interactivity and usability.
●	Apply best practices for securing applications and managing data, including implementing authentication and authorization techniques.
●	Exhibit proficiency in migrating applications between environments and extending their capabilities using themes, plugins, and advanced customization techniques.

Software Requirements:	
1.	Oracle APEX Installation Requirements URL: https://docs.oracle.com/en/database/oracle/apex/24.1/htmig/apex-installation-requirements.html#GUID-02BE4A34-B631-412C-8A82-EB92DABBACE0
2.	Oracle Database Requirements Oracle APEX release 24.1 requires an Oracle Database release 19c or later. APEX runs on all database editions, including Enterprise Edition (EE), Standard Edition (SE), and Oracle Database Free. APEX can be installed in single-instance database and in Oracle Real Application Clusters (Oracle RAC) database.
3.	Browser Requirements Oracle APEX requires a JavaScript-enabled browser and supports the current and prior major release of Google Chrome, Mozilla Firefox, Apple Safari, and Microsoft Edge.
4.	Web Server Requirements Oracle APEX requires Oracle REST Data Services (ORDS) 20.x or later. The use of Quick SQL requires Oracle REST Data Services (ORDS) 23.3 or later.
5.	Disk Space Requirement • Free space for APEX software files on the file system: 599 MB if using English only download (apex_24.1_en.zip) and 983 MB if using full download (apex_24.1.zip). • Free space in APEX tablespace: 190 MB • Free space in SYSTEM tablespace: 125 MB • Free space in APEX tablespace for each additional language (other than English) installed: 60 MB
6.	Oracle XML DB Requirement Oracle XML DB must be installed in the Oracle database that you want to use if you are installing a full development

	environment. If you are using a preconfigured database created either during an installation or by Database Configuration Assistant (DBCA), Oracle XML DB is already installed and configured.
7.	Free APEX Workspace URL: https://apex.oracle.com/pls/apex/r/apex/quick-sign-up/request-workspace
8.	Run APEX in a Virtual Machine URL: https://www.oracle.com/database/technologies/databaseappdev-vm.html

Text Books:	
1.	Oracle APEX: The Essentials, Patrick Cimolini, Packt Publishing, 1st Edition, 2020.
2.	Pro Oracle Application Express, John Scott and Scott Spendolini, Apress, 2nd Edition, 2021
3.	Oracle APEX Cookbook, Marcel van der Plas, Packt Publishing, 3rd Edition, 2019.

Reference Books:	
1.	Beginning Oracle Application Express, Rick Greenwald, Apress, 1st Edition, 2022.
2.	Oracle APEX Best Practices, Alex Nuijten, Iloon Ellen-Wolff, Learco Brizzi, Packt Publishing, 1st Edition, 2016.
3.	Oracle Database 19c and 21c New Features, Bert Scalzo, Mukesh Sharma, Oracle Press (McGraw Hill), 1st Edition, 2021.
4.	Oracle Application Express for Beginners: A Hands-on Approach, Riaz Ahmed, Independently Published, 1st Edition, 2020.
5.	Advanced Oracle PL/SQL Developer's Guide, Saurabh K. Gupta, Packt Publishing, 3rd Edition, 2019.

Websites:	
1.	Oracle APEX Official Documentation URL: https://docs.oracle.com/en/database/oracle/application-express/index.html
2.	Oracle APEX Community URL: https://apex.oracle.com/community/
3.	Oracle APEX Tutorials on Oracle Learning Library URL: https://apex.oracle.com/en/learn/

CO - PO – PSO matrices of course

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23B32.1	3	2	2	1	3	-	2	-	1	2	1	3	3	2	2
CS23B32.2	3	3	3	2	3	1	2	1	2	3	2	3	3	3	3
CS23B32.3	2	3	3	2	3	1	1	1	2	3	2	3	3	3	2
CS23B32.4	3	2	2	3	2	3	3	3	2	2	3	3	2	2	3
CS23B32.5	3	2	3	3	3	1	2	2	2	3	3	3	3	3	3
Average	**2.8**	**2.4**	**2.6**	**2.2**	**2.8**	**1.5**	**2**	**1.8**	**1.8**	**2.6**	**2.2**	**3**	**2.8**	**2.6**	**2.6**

Note: Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) If there is no correlation, put "-"

Subject Code	Subject Name	Category	L	T	P	C
CS23A32	Robotic Process Automation	OE	1	0	4	3

Objectives:
●Prepare to become Junior RPA Developers.
●Learn the basic concepts of Robotic Process Automation.
●Develop familiarity and deep understanding of UiPath tools.
●Develop the ability to design and create robots for business processes independently.
●Develop skills required to pass UiPath Automation Developer Associate v1.0.

List of Experiments			
1.	Downloading and Installing UiPath Academic Alliance and connect to Orchestrator.		
2.	Installing UiPath Extension in Browsers.		
3.	Installing Activity Packages in UiPath Studio - Manage Packages feature to find, install, update and remove packages.		
4.	Experiments based on variables and arguments.		
5.	Algorithmic Approach: Selection control structures.		
6.	Algorithmic Approach: Iteration control structures.		
7.	Debugging - Debug modes, debug actions and the debug ribbon option to debug a file or the entire Project and simple and conditional breakpoints and simple and conditional trace points.		
8.	Exception Handling - Try Catch, Throw, Rethrow and Retry Scope.		
9.	Logging - Apply logging best practices during development.		
10.	UI Automation – Modern Recorder, Modern UI Automation Input Activities and Input Methods, Modern UI Automation Output Activities and Output Methods, UI Synchronization with activities available in the Modern Design Experience, static and dynamic Descriptors.		
11.	Excel Automation.		
12.	Email Automation.		
13.	PDF Automation.		
14.	Working with Files and Folders.		
15.	Data Manipulation.		
16.	Version Control Integration.		
17.	Libraries and Templates.		
18.	Workflow Analyzer		
19.	Orchestrator: Invoice Processing – Dispatcher.		
20.	Orchestrator: Invoice Processing – Performer.		
		Contact Hours	**:** **45**

Course Outcomes: On completion of the course, students will be able to:
●Start working as Junior RPA Developers.
●Understand the fundamental principles of robotic process automation.
●Become familiar with and gain a thorough knowledge of UiPath's software tools.
●Design and build automation robots for business tasks on their own.
●Successfully pass the UiPath Automation Developer Associate v1.0 certification exam.

	Text Books:
1.	UiPath Associate Certification Guide: The go-to guide to acing your Associate certification exam with the help of mock tests and quizzes, Niyaz Ahmed, Lahiru Fernando, Rajaneesh Balakrishnan, Packt Publishing Limited, 2022.
2.	Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool – UiPath, Alok Mani Tripathi, Packt Publishing Limited, 2018.

	Reference Books:
1.	Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, Nandan Mullakara, Arun Kumar Asokan, Packt Publishing Ltd., 2020.
2.	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Tom Taulli, Apress, 2020.
3.	Democratizing Artificial Intelligence with UiPath: Expand automation in your organization to achieve operational efficiency and high performance, Fanny IP, Jeremiah Crowley, Packt Publishing Limited, 2022.
4.	UiPath Administration and Support Guide: Learn industry-standard practices for UiPath program support and administration activities, Arun Kumar Asokan, Packt Publishing, 2022.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A32.1	3	2	2	1	3	-	-	-	1	3	3	2	2	2	1
CS23A32.2	1	1	2	3	3	-	-	-	1	2	3	1	3	2	1
CS23A32.3	2	3	2	3	3	-	-	-	2	3	1	1	3	3	3
CS23A32.4	1	2	1	2	2	-	-	-	1	2	1	3	3	3	2
CS23A32.5	3	3	3	3	3	-	-	-	3	1	1	1	3	2	1
Average	2	2.2	2	2.4	2.8	-	-	-	1.6	2.2	1.8	1.6	2.8	2.4	1.6

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High) No

Course Code	Course Title (THEORY COURSE)	Category	L	T	P	C
CB23G11	**Quantum Computation and Quantum Information**	PE	3	0	0	3

Objectives:	
●	To learn about Quantum information.
●	To gain knowledge about Quantum algorithms.
●	To understand and learn about Quantum random number generators.
●	To study the basis of post-Quantum cryptography.

UNIT-I	**INTRODUCTION TO QUANTUM INFORMATION**	**9**
States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits.		
UNIT-II	**QUANTUM ALGORITHMS**	**9**
Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems.		
UNIT-III	**QUANTUM TRUE RANDOM NUMBER GENERATORS**	**9**
Detailed design and issues of quantum Ness, Commercial products and applications.		
UNIT-IV	**QUANTUM KEY DISTRIBUTION**	**9**
BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products.		
UNIT-V	**INTRODUCTORY TOPICS IN POST-QUANTUM CRYPTOGRAPHY**	**9**
API-Public-key Signatures, Key Encapsulation Mechanism (KEM), Digital Signature standard, Pair-Wise Key Establishment-Discrete Logarithm Cryptography, Integer Factorization Cryptography.		
	Total Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Apply quantum gates and circuits using quantum information.
●	Apply quantum algorithms in cryptosystems.
●	Understand the importance of Quantum random number generator.
●	Understand the importance of Quantum key distribution.
●	Apply the concept of post-quantum cryptography.

Text Book (s):	
1	M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Edition, 2010.
2	Presskil Lecture notes: Available online: http://www.theory.caltech.edu/~preskill/ph229/

Reference Books(s) :	
1	P. Kaye, R. Laflamme, and M. Mosca, "An Introduction to Quantum Computing". Oxford University Press, New York, 2006.
2	N. David Mermin, "Quantum Computer Science", Cambridge University Press, 2007.
3	Quantum Cryptography. D. Unruh:, Available online: https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/
4	SAPV Tharrmashastha, D. Bera, A. Maitra and S. Maitra, "Quantum Algorithms for Cryptographically Significant Boolean Functions - An IBMQ Experience", Springer, 2020.
5	Quantum Algorithm Zoo. https://quantumalgorithmzoo.org/
6	A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, "Handbook of Applied Cryptography", CRC Press,2018.

CO - PO – PSO matrices of course

PO/PSO CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3	3	3	2	-	-	-	-	2	2	3	3	1
CO2	3	3	3	3	2	1	-	-	-	-	2	2	3	3	1
CO3	3	3	2	2	2	1	-	-	-	-	1	1	3	3	1
CO4	3	3	2	3	2	1	-	-	-	-	1	1	3	3	1
CO5	3	3	2	2	2	1	-	-	-	-	1	1	3	3	1
Average	3.0	3.0	2.4	2.6	2.2	1.2	-	-	-	-	1.4	1.4	3.0	3.0	1.0

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) Nocorrelation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CR23A33	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	PE	2	0	2	3

Objectives:	
•	To understand how blockchain operates and its potential applications beyond cryptocurrency
•	To understand various types of cryptocurrencies, mining processes, wallets, and their economic principles
•	To understand how smart contracts and decentralized applications transform the Ethereum
•	To understand common security challenges in cryptocurrencies and blockchain
•	Explore in setting up a cryptocurrency wallet, interacting with blockchain platforms, and exploring dApps for diverse applications.

UNIT I	INTRODUCTION	9
Overview, distributed ledger, how it works, and its key components like blocks, hashing functions, and consensus mechanisms (Proof of Work, Proof of Stake). Blockchain operation and its potential to revolutionize various industries beyond just cryptocurrency.		
UNIT II	**CRYPTOCURRENCIES**	**9**
Overview of history and evolution of leading cryptocurrencies like Bitcoin and Ethereum, different types of cryptocurrencies available, the mining process that creates new coins, how to securely store them in wallets, and the economic principles that govern their value.		
UNIT-III	**SMART CONTRACTS AND DAPPS**	**9**
Overview of smart contracts and decentralized applications (dApps), Smart contracts functionalities, limitations, and real-world applications, dApp platforms like Ethereum and how these applications are transforming industries such as finance, supply chain management, and even voting systems.		
UNIT IV	**BLOCKCHAIN SECURITY, REGULATION, AND FUTURE APPLICATIONS**	**9**
Overview on common security challenges associated with cryptocurrencies and blockchain platforms, like hacking attempts and fraudulent activities, explore the current regulations and potential future frameworks being developed globally, Future applications of blockchain technology across different sectors like healthcare, data management, and the Internet of Things (IoT).		
UNIT-V	**BLOCKCHAIN IN PRACTICE**	**9**
Provide practical experience with blockchain and cryptocurrency tools, Set up a cryptocurrency wallet, interact with a blockchain platform like Ethereum or another chosen platform, or explore dApps for different purposes (e.g., decentralized finance applications or NFT marketplaces).		
	Total Contact Hours :	**45**

List of Experiments	
1	Simulate a Simple Blockchain creation
2	Simple implementation of Proof of Work
3	Simulate Bitcoin Mining
4	Creating a Crypto-currency Wallet
5	Creating and Deploying a Simple Smart Contract on Ethereum (Remix)
6	Developing a Simple dApp with Web3 and Python
7	Writing a Simple Smart Contract with Python or Solidity
8	Public and Private key generation and basic encryption for Wallet security

9	Creating a cryptocurrency wallet on a platform like MetaMask or Trust Wallet, and perform transactions on a testnet
10	Exploring and Interacting with a Decentralized Finance (DeFi) Application or NFT Marketplace
Contact Hours :	**30**
Total Contact Hours :	**75**

Course Outcomes:	
On completion of course you will be able to	
•	Develop knowledge in the core concepts of blockchain technology, including distributed ledgers, hashing functions, and consensus mechanism
•	Focus on understanding history and evolution of cryptocurrencies, such as Bitcoin and Ethereum
•	Understand the concept of smart contracts and their functionalities on a blockchain platform
•	Understand the potential future applications of blockchain technology across various industries
•	Demonstrate practical skills through hands-on activities, such as setting up a cryptocurrency wallet or interacting with a blockchain platform

Suggested Activities:	
•	Problem solving sessions
•	Mini projects

Course Outcomes:	
On completion of course you will be able to	
•	Tutorial problems.
•	Assignment problems.
•	Quizzes
•	Class presentation/Discussion

Reference Books (s)/Web links:	
1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016
2.	Don and Tapscott, Alex, "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World", 2018, Penguin
3.	Andreas M. Antonopoulos, "Internet of Money", 2018
4.	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017
5.	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing, 2018

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A33. 1	3	2	3	-	1	-	-	-	1	-	1	2	2	1	2
CR23A33. 2	2	2	2	-	1	-	-	-	1	-	1	2	2	1	2
CR23A33. 3	2	2	3	-	2	-	-	-	1	-	1	2	2	1	2
CR23A33. 4	2	2	2	-	2	-	-	-	1	-	1	2	2	1	2
CR23A33. 5	2	2	2	-	2	-	-	-	1	-	1	2	2	1	2
Average	2.2	2	2.6	-	1.6	-	-	-	1	-	1	2	2	1	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:

Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23A36	3D PRINTING AND DESIGN	PE	2	0	2	3

Objectives:
• To discuss on basis of 3D Printing
• To explain the file format of 3D Printing techniques
• To explain the processes of 3D Printing
• To explain and demonstrate INKJET technology
• To explain and demonstrate laser technology

UNIT I	INTRODUCTION TO CAD	6
Coordinate systems: Geometric co-ordinate systems - Cartesian, Cylindrical and Spherical coordinate systems. Display co-ordinate systems - Global, Local, View and Screen coordinate systems. Curves: Definition - Parametric and non- parametric forms of analytical and synthetic curves. Analytical Curve modeling - Line Segment, Circle, Ellipse. Synthetic Curve modeling - Hermite Cubic Spline, Bezier, B-spline .Surfaces and types. Mathematical modeling of Solids: Properties of solid model, Solid modeling Techniques - Boundary representation, Constructive Solid Geometry, Analytical Solid Modeling, Sweep representation schemes. Solid Manipulation Techniques.		
UNIT II	**STL FILE FORMAT AND MANIPULATION**	**6**
Introduction, Preparation of CAD Models – The STL File Format, Binary/ASCII ,Creating STL Files from a CAD System, Calculation of Each Slice Profile, Technology Specific Elements, Problems with STL Files, STL File Manipulation- Viewers, STL Manipulation on the AM Machine,Beyond the STL File- Direct Slicing of the CAD Model, Color Models, Multiple Materials, Use of STL for Machining.		
UNIT-III	**3D PRINTING PROCESSES**	**6**
Vat photo polymerization, Material jetting, Binder jetting, Powder bed fusion, Material extrusion, Directed energy deposition, Sheet lamination, 3D printing Processes limitations and Industrial applications.		
UNIT IV	**INKJET TECHNOLOGY**	**6**
Printer- Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-on-Demand; Material Formulation for jetting; Liquid based fabrication – Continuous jet, Multijet; power based fabrication- Colourjet.		
UNIT-V	**LASER TECHNOLOGY**	**6**
Light Sources – Types ,Characteristics ; Optics – Deflection, Modulation; Material feeding and flow- Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures.		
	Total Contact Hours : 30	

List of Experiments	
1	Analyze the CAD software's interface and fundamental tools

2	Study 3D printers including print head, build envelope , materials used and related support removal systems
3	Review the Commands for moving from 2D to 3D
4	Adept CAD commands for exploring 3D objects
5	Design every Day Object Using Thingiverse, Shapeways, and GitFab ▪ Mobile Stand ▪ Football ▪ Tooth Brush
6	Use the CAM Software to prepare files for 3D Printing
7	Manipulate machine movement and material layering
Contact Hours :	**30**
Total Contact Hours :	**60**

Course Outcomes: On completion of course you will be able to
● Outline and examine the basic concepts of 3D Printing technology suing CAD software
● Outline of File Format and manipulation
● Students can able to understand the basics concepts of printing processes
● Students can able to explain and categories the working principles of Inkjet technology
● Students can able to explain and categories the working principles of laser technology

Textbooks:	
1.	Christopher Barnatt, 3D Printing : The Next Industrial Revolution ,CreateSpace Independent Publishing platform,2013
2.	Ibrahim Zeid , Mastering CAD CAM Tata Mc Graw- Hill Publishing Co.,2007.

Reference Books (s)/Web links:	
1.	C. K. Chua, K. F. Leong, C. S. Lim: Rapid Prototyping: Principles and Applications, Second Edition, World Scientific publishers ,2010
2.	Ian M. Hutchings , Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons,2013
3.	Joan Horvath , Mastering 3D Printing , APress , 2014

-

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A36.1	1	1	2	2	3	1	-	-	2	-	2	2	3	2	1
CS23A36.2	3	2	3	3	3	2	-	-	3	-	3	2	3	2	3
CS23A36.3	2	2	2	2	2	2	-	-	2	-	2	2	3	2	2
CS23A36.4	2	2	2	2	3	2	-	-	2	-	2	2	3	3	2
CS23A36.5	1	3	3	3	3	3	-	-	3	-	3	3	3	3	1
Average	1.8	2	2.4	2.4	2.8	2	-	-	2.4	-	2.4	2.2	3	2.4	1.8

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CS23A33	Cyber Security and Forensics	PE	2	0	2	3

Objectives:
• To learn about Cyber Crime and Cyber Laws
• To understand Cyber attacks and tools to mitigate it.
• To learn about Computer Forensics and understanding computer Investigation
• To become familiar with evidence collection and forensics tools
• To learn to analyze and validate forensic data

UNIT I	INTRODUCTION	6
Cyber Security- History of Internet - Impact of Internet - Reason for Cyber Crime - Need for Cyber Security - History of Cyber Crime–Cybercriminals – Classification of Cybercrimes– A Global Perspective on Cyber Crimes – Cyber Laws-The Indian IT Act.		
UNIT II	**ATTACKS AND COUNTERMEASURES**	**6**
Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures		
UNIT-III	**INTRODUCTION TO COMPUTER FORENSICS**	**6**
Introduction to Traditional Computer Crime and its problems – Introduction to Identity Theft & Identity Fraud – Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation – Preparation for IR: Creating response tool kit and IR team – Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.		
UNIT IV	**EVIDENCE COLLECTION AND FORENSICS TOOLS**	**6**
Processing Crime and Incident Scenes – Working with Windows and DOS Systems –Current Computer Forensics Tools- Software/ Hardware Tools.		
UNIT-V	**ANALYSIS AND VALIDATION**	**6**
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics		
	Total Contact Hours :	**30**

List of Experiments	
1	Linux auditing using Lynis and increase the hardening index using security tools
2	Hardening Linux OS using various configuration to reduce the attack surface
3	Analyze Web Application Security using N-Stalker tool

4	Perform open source intelligence gathering using Netcraft, Whois Lookups, DNS Reconnaissance, Harvester and Maltego	
5	Live Data Acquisition of a folder and take its image using FTKImager	
6	Recover deleted file using FTKImager	
7	Analyze RAM dump using Volatility tool	
8	Collect Email Evidence in Victim PC and Extract Browser Artifacts (ChromeHistory view for Google Chrome)	
9	Perform Live Forensics Case Investigation using Autopsy	
10	Study Email Tracking and Email Tracing and write a report on them.	
	Contact Hours :	**30**
	Total Contact Hours :	**60**

Course Outcomes: On completion of course you will be able to
● Explain the basics of Cybercrime and Cyber Laws
● Identify various types of cyber-attacks and take appropriate countermeasures
● Apply computer forensics investigation and to do data acquisition
● Apply various forensics tools for evidence collection
● Analyze and Validate the evidence collected

Suggested Activities:
● Assignment problems, Quiz.
● Class presentation/Discussion

Textbooks:	
1.	Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021
2.	Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2016.

Reference Books (s)/Web links:	
1.	MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3rd Edition, Prentice Hall, 2013.
2.	Dejey, S. Murugan - Cyber Forensics, Oxford University Press, India, 2018
3.	CEH official Certfied Ethical Hacking Review Guide, Wiley India Edition, 2015.
4.	John R.Vacca, “Computer Forensics”, Cengage Learning, 2005
5.	Xiaodong Lin, "Introductory Computer Forensics: A Hands-on Practical Approach", Springer, 2018

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A33.1	1	1	1	1	-	1	-	-	-	-	1	-	2	2	2
CS23A33.2	1	3	1	3	2	1	-	-	-	-		-	2	2	1
CS23A33.3	2	1	1	1	-	1	-	-	-	-	1	-	2	2	2
CS23A33.4	3	3	2	2	2	1	-	-	-	-		-	2	2	2
CS23A33.5	3	2	1	1	1	1	-	1	-	-	1	-	2	2	2
Average	2	2	1.2	1.6	1.6	1	-	1	-	-	1	-	2	2	1.8

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CR23A11	Security Assessment and Risk Analysis	PE	3	0	0	3

Objectives:	
•	Understand the fundamental principles of information security and the threat landscape.
•	Understand various security assessment methodologies.
•	Develop the ability to identify, assess, and manage information security risks through risk profiling and risk management concepts.
•	Learn risk evaluation and mitigation strategies.
•	Gain an introduction to common security frameworks and standards (NIST CSF and ISO 27001).

UNIT I	INTRODUCTION	9
Fundamentals of information security- CIA triad: Confidentiality, Integrity, Availability. Threat landscape overview: Common security threats, actors, and motivations. Introduction to vulnerability management.		
UNIT II	**SECURITY ASSESSMENT METHODOLOGIES**	**9**
ies: Penetration testing - Vulnerability scanning - Security audits. Penetration testing types: White-box, black-box, grey-box testing. Vulnerability scanning tools and their functionalities.		
UNIT-III	**RISK ANALYSIS AND RISK MANAGEMENT**	**9**
Risk Profiling - Formulating the Risk - Risk Exposure Factors. Risk management concepts: Risk identification-assessment - mitigation and acceptance. Case Study - Work in groups to develop a risk register for a fictional company, identifying potential security risks, their likelihood, and impact.		
UNIT IV	**RISK ASSESSMENT AND ANALYSIS**	**9**
Risk Evaluation and mitigation strategies - Reports and Consulting - Risk Assessment Techniques. Project: Conduct a risk assessment for a specific department within your organization (if applicable) or a chosen cloud service platform.		
UNIT-V	**SECURITY FRAMEWORKS AND STANDARDS**	**9**
Introduction to security frameworks and standards (NIST CSF, ISO 27001) -Aligning security assessments and risk analysis with frameworks - Implementing security controls based on identified risks.		
	Total Contact Hours :	**45**

Course Outcomes:	
On completion of course you will be able to	
•	Understand the CIA triad and identify common security threats, actors, and their motivations.
•	Distinguish between penetration testing, vulnerability scanning, and security audits.
•	Describe the four main risk management concepts: identification, assessment, mitigation, and acceptance
•	Explain risk profiling and risk evaluation techniques.
•	Summarize the purpose and benefits of security frameworks like NIST CSF and ISO 27001

Suggested Activities:	
•	Quizzes
•	Class presentation/Discussion
•	Group Presentation

Reference Books (s)/Web links:	
1.	William Stallings, “Cryptography and Network Security”, Seventh Edition, Pearson, 2017
2.	Mark Talabis and Jason Martin, "Information Security Risk Assessment Toolkit: Practical Assessments through Data Collection and Data Analysis", Syngress, 2012
3.	Thomas R Peltier, "Information Security Risk Analysis", First Edition, Auerbach Publications, 2001
4.	Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First Edition, Syngress, 2011
5.	Jon Erickson, "Hacking: The Art of Exploitation", Second Edition, No Starch Press, 2008

CO-PO-PSO Matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A11.1	3	3	-	2	2	2	1	2	-	1	-	2	3	3	2
CR23A11.2	2	3	-	3	3	-	-	-	-	1	-	1	3	3	2
CR23A11.3	3	3	3	3	3	2	1	2	-	-	-	2	3	3	2
CR23A11.4	3	2	3	3	3	-	2	2	-	-	-	1	3	3	2
CR23A11.5	3	3	2	3	3	2	2	3	-	-	-	2	3	3	2
Average	2.8	2.8	2.6	2.8	2.8	2	1.5	2.25	-	1	-	1.6	3	3	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:”-“

Course Code	Subject Name (Theory course)	Category	L	T	P	C
CS23A11	MALWARE DETECTION AND ANALYSIS	PE	3	0	0	3

Objectives:
• To introduce the malware components and behaviour
• To detect and analyze malware affected documents.
• To introduce malware fundamentals and basic analysis.
• To enable to identify and analyze various malware types by static analysis.
• To enable to identify and analyze various malware types by dynamic analysis.

UNIT I	MALWARE COMPONENTS AND FUNCTIONALITY	9
Malware Components-Payload, Packers, Persistence, Communication, Propagation, Armoring ,Stealth, Distribution Mechanisms, Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection		
UNIT II	**MALWARE DETECTION AND REVERSE ENGINEERING**	**9**
Antivirus Engines-Main Components, Signatures and Signature Modules, File Scanner, Unpacker Module, Memory Scanner, Hook and Rootkit detection Modules, Next Generation Antiviruses, Malware Sandbox Internals, Reverse engineering malicious code - Identifying malware passwords - Bypassing authentication -Advanced malware analysis: Virus, Trojan and APK Analysis - Reverse Engineering Tools: IDA Pro and OLLYDBG		
UNIT-III	**BASIC MALWARE ANALYSIS**	**9**
Objective of Malware Analysis, Malware Analysis techniques, Types of Malware, General Rules for Malware Analysis, Antivirus scanning, Hashing, Finding Strings, Packed and Obfuscated Malware , Portable Executable File Format, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.		
UNIT IV	**MODERN MALWARE STATIC ANALYSIS**	**9**
Levels of Abstraction, Reverse-Engineering, The x86 Architecture, Simple Instructions, The Stacks, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism		
UNIT-V	**MODERN MALWARE DYNAMIC ANALYSIS**	**9**
Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, api calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wire shark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching		
	Contact Hours:	**45**
	Total Contact Hours :	**45**

Course Outcomes: On completion of course you will be able to
• Understand the various components of malware analysis and their functionalities.
• Understand the malware detecting methods and reverse engineering.
• Understand the various concepts of malware analysis and their technologies used.
• Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques
• To be able to safely analyze, debug, and disassemble any malicious software by malware analysis

Textbooks:	
	Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press, 2012.
2.	Abhijit Mohanta, Anoop Saldanha, Malware Analysis and Detection Engineering a Comprehensive Approach to Detect and Analyze Modern Malware, 2020, 1st edition, Apress .
3.	M. Sikorski and A. Honig, Practical Malware Analysis: The Hands-on Guide to Dissecting Malicious Software. 2012, 1st edition, No Starch Press.

Reference Books (s)/Web links:	
1	Monnappa K A, Learning Malware Analysis- Explore the concepts, tools, and techniques to analyze and investigate Windows malware, 2018, 1st edition, Packt Publishing.
2	Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis",CRC Press, Taylor & Francis Group, 2015.
3	Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CS23511.1	2	1	1	1	-	1	-	1	-	-	1	-	2	2	2
CS23511.2	2	1	1	1	-	1	-	1	-	-	1	-	2	2	2
CS23511.3	2	1	1	1	-	1	-	1	-	-	1	-	2	2	2
CS23511.4	2	3	2	2	2	1	-	-	--	-	-	-	2	2	2
CS23511.5	2	3	2	2	2	1	-	-	--	-	-	-	2	2	2
Average	2	1.8	1.4	1.4	2	1	-	1	-	-	1	-	2	2	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High)

No correlation: “-“

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CR23A31	Ethical Hacking and Security	PE	2	0	2	3

Objectives:	
•	To understand the ethical hacker's role, the hacking methodology, and the legal boundaries distinguishing ethical from malicious hacking.
•	To identify system weaknesses, network vulnerabilities, and use scanning tools to find security gaps.
•	To understand using ethical hacking tools and techniques to simulate real-world attacks for defensive purposes.
•	To learn how to prioritize risks, recommend security measures and report vulnerabilities.
•	To understand social engineering tactics, zero-day vulnerabilities.

UNIT I	INTRODUCTION	6
Overview of Ethical Hacking- Importance of ethical hacking for Businesses-Key concepts of Ethical Hacking-Difference between Ethical Hacking and Malicious Hacking-Most used tools in Ethical Hacking Incidents(NMAP, Metasploit)-Ethical hacking challenges and their solutions		
UNIT II	**NETWORK VULNERABILITIES AND VARIOUS SCANNING TOOLS**	**6**
Overview of Network vulnerability scanning- Types of network vulnerability scanning-Key features of network vulnerability scanner-Network vulnerability scanning vs network scanning- Network scanning tools(Burp Suite)		
UNIT-III	**ETHICAL HACKING TOOLS AND TECHNIQUES**	**6**
Overview, Tools and Techniques in Ethical Hacking (Metasploit Framework, Nessus, Wireshark, Burp Suite, Nmap, John-the-Ripper, OWASP Zap.		
UNIT IV	**RISK ASSESSMENT AND TYPES OF SYSTEM HARDENING**	**6**
Overview, Types of system hardening (Network hardening, Server hardening, Application hardening, Database hardening, Operating system hardening), Types of Security Risk assessments (Physical security assessment, IT security assessment, Data security assessment, Application security assessment, Insider Threat assessment)		
UNIT-V	**SOCIAL ENGINEERING AND ZERO DAY ATTACKS**	**6**
Overview of Social Engineering and zero day attacks, Impact of social Engineering and zero day attacks, Prevention and mitigation techniques, Best practices for protecting against social engineering and zero day attacks.		
	Total Contact Hours :	**30**

List of Experiments	
1	Conduct a basic penetration test using Metasploit to exploit a known vulnerability in a controlled environment.
2	Use NMAP to scan a network and identify open ports and services.

3	Perform a web vulnerability scan using Burp Suite and document the identified vulnerabilities and their potential impacts.
4	Perform a vulnerability scan using Nessus and generate a detailed report on the findings, including recommended remediation steps.
5	Conduct a web application security test using OWASP ZAP. Document vulnerabilities and provide remediation recommendations.
6	Assess the security of a sample application and provide a detailed report on vulnerabilities and recommended hardening measures.
7	Perform a risk assessment on a sample IT system and present a risk management plan.
8	Perform Social Engineering attack
9	View and capture network traffic using Wireshark
10	Explore dig tool for vulnerabilities
Contact Hours :	**30**
Total Contact Hours :	**60**

Course Outcomes:	
On completion of course you will be able to	
•	Grasp Core Ethical Hacking Concepts includes exploring the ethical hacker's role, the hacking methodology and the legal boundaries of ethical hacking.
•	Learn in detail about common system weaknesses, network vulnerabilities, and various scanning tools to pinpoint security gaps
•	Able to Understand ethical hacking tools and techniques
•	Gain knowledge in risk assessment and types of system hardening
•	Understand topics like social engineering tactics, zero-day vulnerabilities, and keeping abreast of industry best practices.

Suggested Activities:	
•	Code implementing sessions in NMAP, Metasploit, Burp Suite
•	Mini projects

Course Outcomes:	
On completion of course you will be able to	
•	Tutorial problems.

•	Assignment problems.
•	Quizzes
•	Class presentation/Discussion

Textbooks (s)/Web links:	
1.	Jon Erickson,"The Art of Exploitation", 2nd Edition, No Starch Press, 2017
2.	Dafydd Stuttard ,"Web Application Hacker's Handbook: Finding and Exploiting Security Flaws",2nd edition, John Wiley, 2011
3.	J. Thomas," Mastering Ethical Hacking",1st Edition, TheHackStore, 2023

`

CO-PO-PSO Matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A31.1	3	2	1	2	2	2	-	3	1	2	-	2	3	2	1
CR23A31.2	3	3	2	3	3	1	1	2	2	2	-	3	3	3	2
CR23A31.3	2	3	3	3	3	2	-	2	2	3	-	3	3	3	3
CR23A31.4	2	3	2	3	2	2	-	3	2	2	-	3	3	3	2
CR23A31.5	3	3	2	3	2	2	2	3	2	2	1	3	3	2	3
Average	2.6	2.8	2	2.8	2.4	1.8	1.5	2	2.6	2.2	1	2.8	3	13	2.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:"-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CR23A32	Digital and Mobile Forensics	PE	2	0	2	3

Objectives:	
•	To understand basic digital forensics and techniques.
•	To understand digital crime and investigation.
•	To understand how to be prepared for digital forensic readiness.
•	To understand and use forensics tools for Android devices.
•	To understand and use Anti Forensics.

UNIT I	INTRODUCTION	6
Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process: Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.		
UNIT II	**DIGITAL CRIME AND INVESTIGATION**	**6**
The International Legal Framework of Cybercrime Law - Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence		
UNIT-III	**DIGITAL FORENSIC READINESS**	**6**
Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics		
UNIT IV	**ANDROID FORENSICS**	**6**
Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling		
UNIT-V	**SQLITE DATABASE FORENSICS AND ANTI FORENSICS**	**6**
Sqlite Database Forensics: Relational Databases - Other Viewers - Anti Forensics: Introduction - Steganography – Cryptography - Password Cracking.		
	Total Contact Hours :	**30**

List of Experiments	
1	Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2	Data extraction from call logs using Sleuth Kit.
3	Data extraction from SMS and contacts using Sleuth Kit.
4	Extract installed applications from Android devices.
5	Extract diagnostic information from Android devices through the adb protocol.
6	Generate a unified chronological timeline of extracted records,
7	Implement the sql query database and to handle sqlite in browser

8	Hide InvisibleSecrets in the initial screen using Steganography	
	Contact Hours :	**30**
	Total Contact Hours :	**60**

Course Outcomes:	
On completion of course you will be able to	
•	Have knowledge on digital forensics.
•	Know about digital crime and investigations.
•	Be forensic ready
•	Investigate, identify and extract digital evidence from Android devices.
•	Know about Anti Forensics.

Suggested Activities:	
•	Assignment problems, Quiz.
•	Class presentation/Discussion

Textbooks:	
1	Andre Arnes, "Digital Forensics", Wiley, 2018.
2	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

Reference Books (s)/Web links:	
6.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
7.	Dejay, Murugan, "Cyber Forensics", 1st Edition, Oxford, 2018
8.	Rohit, Oleg, Mahalik, Satish, "Practical Mobile Forensics", 4th Edition, Packt, 2020

CO-PO-PSO Matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A32.1	3	2	2	3	3	-	2	3	-	-	2	3	3	2	2
CR23A32.2	2	3	3	2	3	2	2	3	2	2	-	3	3	3	2
CR23A32.3	3	3	2	3	3	-	-	3	2	-	3	3	3	2	3
CR23A32.4	3	3	3	3	3	2	-	3	-	2	-	3	3	3	3
CR23A32.5	2	2	3	2	3	-	2	3	-	-	-	3	2	3	2
Average	2.6	2.6	2.6	2.6	3	2	2	3	2	2	2.5	3	2.8	2.6	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:"-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CR23A32	Digital and Mobile Forensics	PE	2	0	2	3

Objectives:	
•	To understand basic digital forensics and techniques.
•	To understand digital crime and investigation.
•	To understand how to be prepared for digital forensic readiness.
•	To understand and use forensics tools for Android devices.
•	To understand and use Anti Forensics.

UNIT I	INTRODUCTION	6
Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process: Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.		
UNIT II	**DIGITAL CRIME AND INVESTIGATION**	**6**
The International Legal Framework of Cybercrime Law - Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence		
UNIT-III	**DIGITAL FORENSIC READINESS**	**6**
Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics		
UNIT IV	**ANDROID FORENSICS**	**6**
Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling		
UNIT-V	**SQLITE DATABASE FORENSICS AND ANTI FORENSICS**	**6**
Sqlite Database Forensics: Relational Databases - Other Viewers - Anti Forensics: Introduction - Steganography – Cryptography - Password Cracking.		
	Total Contact Hours :	**30**

List of Experiments:			
	Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.		
	Data extraction from call logs using Sleuth Kit.		
	Data extraction from SMS and contacts using Sleuth Kit.		
	Extract installed applications from Android devices.		
	Extract diagnostic information from Android devices through the adb protocol		
	Generate a unified chronological timeline of extracted records,		
	Implement the sql query database and to handle sqlite in browser		
	Hide InvisibleSecrets in the initial screen using Steganography		
	Contact Hours :		30
	Total Contact Hours :		60

Course Outcomes:	
On completion of course you will be able to	
•	Have knowledge on digital forensics.
•	Know about digital crime and investigations.
•	Be forensic ready
•	Investigate, identify and extract digital evidence from Android devices.
•	Know about Anti Forensics.

Suggested Activities:	
•	Assignment problems, Quiz.
•	Class presentation/Discussion

Textbooks:	
1	Andre Arnes, "Digital Forensics", Wiley, 2018.
2	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

Reference Books (s)/Web links:	
9.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
10.	Dejay, Murugan, "Cyber Forensics", 1st Edition, Oxford, 2018
11.	Rohit, Oleg, Mahalik, Satish, "Practical Mobile Forensics", 4th Edition, Packt, 2020

CO-PO-PSO Matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A32.1	3	2	2	3	3	-	2	3	-	-	2	3	3	2	2
CR23A32.2	2	3	3	2	3	2	2	3	2	2	-	3	3	3	2
CR23A32.3	3	3	2	3	3	-	-	3	2	-	3	3	3	2	3
CR23A32.4	3	3	3	3	3	2	-	3	-	2	-	3	3	3	3
CR23A32.5	2	2	3	2	3	-	2	3	-	-	-	3	2	3	2
Average	2.6	2.6	2.6	2.6	3	2	2	3	2	2	2.5	3	2.8	2.6	2.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:"-"

Subject Code	Subject Name (Lab Oriented Theory course)	Category	L	T	P	C
CR23A35	Social Network Security	PE	2	0	2	3

Objectives:	
•	To understand and develop semantic web related applications
•	To understand privacy and security issues in Social Networking
•	To learn about the data extraction and mining of social networks
•	To discuss the prediction of human behaviour in social communities
•	To learn about the Access Control and identity management

UNIT I	FUNDAMENTALS OF SOCIAL NETWORKING	6
Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security.		
UNIT II	**PRIVACY AND SECURITY ISSUES**	**6**
The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviours, Anonymity in a networked world.		
UNIT-III	**EXTRACTION AND MINING IN SOCIAL NETWORKING DATA**	**6**
Extracting evolution of Web Community from a Series of Web Archive, detecting communities in social networks, Definition of community, evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy.		
UNIT IV	**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES**	**6**
Understanding and predicting human behaviour for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.		
UNIT-V	**ACCESS CONTROL AND IDENTITY MANAGEMENT**	**6**
Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.		
	Total Contact Hours :	**30**

List of Experiments	
1	Developing a social media application.
2	Create a Network model using Neo4j.
3	Read and write Data from Graph Database.
4	Find “Friend of Friends” using Neo4j.
5	Implement secure search in social media.
6	Create a simple Security & Privacy detector.
Contact Hours :	**30**
Total Contact Hours :	**60**

Course Outcomes:	
On completion of course you will be able to	
•	Develop a semantic web related application
•	Address Privacy and Security issues in Social Networking
•	Extract and mine the social networks data
•	To predict human behaviour in social communities
•	To enforce access control mechanism and do identity management

Suggested Activities:	
•	Assignment problems.
•	Class presentation/Discussion

Textbooks:	
1.	Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
2.	BorkoFurht, “Handbook of Social Network Technologies and Application”, First Edition, Springer, 2010.
3.	Jerome Baton and Rik Van Bruggen, "Learning Neo4j 3.x", Second Edition, Packt publishing, 2017
4.	David Easley, Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning about a Highly Connected World", First Edition, Cambridge University Press, 2010.

Reference Books (s)/Web links:	
1.	Easley D and Kleinberg J., “Networks, Crowds, and Markets – Reasoning about a Highly Connected World”, Cambridge University Press, 2010.
2.	Jackson and Matthew O, “Social and Economic Networks”, Princeton University Press, 2008.
3.	GuandongXu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011.
4.	Dion Goh and Schubert Foo, “Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively”, IGI Global Snippet, 2008
5.	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling”, IGI Global Snippet, 2009.
6.	John G. Breslin, Alexander Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009.

CO-PO-PSO Matrices of Course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CR23A35.1	2	3	3	2	3	-	-	-	1	2	-	2	3	2	1
CR23A35.2	3	3	2	-	3	3	-	3	-	1	-	2	3	2	2
CR23A35.3	2	3	2	3	3	-	-	2	-	1	-	2	3	3	1
CR23A35.4	1	3	2	-	2	-	-	2	-	1	-	1	2	2	1
CR23A35.5	2	3	3	2	3	2	-	3	-	1	2	2	3	2	2
Average	2	3	2.4	2.3	2.8	2.5	-	2.5	1	1.2	2	1.8	2.8	2.2	1.4

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:”-“

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
CR23A36	INFORMATION SECURITY AND MANAGEMENT	PE	2	0	2	3

Objectives:	
▪	To understand the basics of Information Security and legal and ethical issues in Information Security.
▪	To understand the information security policy and concepts of access control.
▪	To learn about intrusion detection and prevention techniques and tools.
▪	To learn about auditing techniques and tools.
▪	To Learn to analyze and validate forensics data

UNIT-I	INTRODUCTION	6
Security Trends, OSI security architecture, Security attacks, security services, security mechanisms, Security System Development Life cycle – Legal, Ethical and Professional issues.		
UNIT-II	**SECURITY ANALYSIS**	**6**
Risk Management - Identifying and Assessing Risk - Assessing and Controlling Risk. Blueprint for Information Security - Information Security Policy. Case Study: Healthcare Data Security		
UNIT-III	**SECURITY TECHNOLOGY**	**6**
Intrusion Detection and Prevention Systems (IDPS)-Terminology-Types-Detection methods. Honeypots, Honeynets and padded cell systems. Scanning and Analysis Tools-Port scanners-Firewall analysis tools, Operating system detection tools- Vulnerability scanners-Packet sniffers-Wireless security Tools		
UNIT-IV	**AUDITING**	**6**
Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment- Case Study: Web Application Security Assessment for Online Retailer		
UNIT-V	**ANALYSIS AND VALIDATION**	**6**
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics. -Case Study: WannaCry Ransomware Attack		
	Contact Hours : 30	

List of Experiments	
1	Implementation to gather information from any PC‟s connected to the LAN using whois, port scanners, network scanning, Angry IP scanners etc.
2	Implementation of Steganography
3	Implementation of Mobile Audit and generate the report of the existing Artifacts.
4	Implementation of IT Audit, malware analysis and Vulnerability assessment and generate the report.
5	Implementation of Cyber Forensics tools for Disk Imaging, Data acquisition, Data extraction and Data Analysis and recovery.
6	Perform mobile analysis in the form of retrieving call logs, SMS log ,all contacts list using the forensics tool like SAFT
7	Implementation to identify web vulnerabilities, using OWASP project.

	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes:	
On completion of the course, the students will be able to	
▪	Discuss the basics of information security and legal and ethical issues in Information Security.
▪	Analyze the risk management and information security policy.
▪	Implement intrusion detection and prevention techniques using different tools.
▪	Perform auditing of logs.
▪	Analyze and validate forensics data

Text Book(s):	
1	Michael E Whitman and Herbert J Mattord, “Principles of Information Security with Mindtap”, Cengage Learning, Seventh Edition 2023.
2	Nelson, Phillips, Enfinger, Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2008.

Reference Book(s)/Web link(s):	
1	Micki Krause, Harold F. Tipton, “Handbook of Information Security Management”, CRC Press; 6th Edition, 2007.
2	John R.Vacca, “Computer Forensics”, Cengage Learning, 2005
3	MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3 rd Edition, Prentice Hall, 2013.

CO-PO-PSO Matrices of Course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CR23A36.1	3	2	1	-	-	2	2	3	1	-	-	2	3	1	1
CR23A36.2	2	3	2	2	-	-	2	3	-	2	2	2	2	2	1
CR23A36.3	2	3	3	3	3	-	-	2	-	1	-	2	3	2	1
CR23A36.4	2	2	3	3	3	-	-	-	-	-	-	1	3	3	1
CR23A36.5	3	2	2	3	-	-	2	3	-	-	1	2	3	3	2
Average	2.4	2.4	2.2	2.2	3	2	2	2.75	1	1.5	1.5	1.8	2.8	2.2	1.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (low) 2: Moderate (Medium) 3: Substantial (High) No correlation:”-“

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
CS23A37	AUGMENTED REALITY AND VIRTUAL REALITY	PE	2	0	2	3
For B.E Programme CSE ,CSECS and B.Tech Programme in IT						

Objectives:

- To gain the knowledge of historical and modern overviews and perspectives on virtual reality.
- To learn the fundamentals of sensation, perception, and perceptual training.
- To have the scientific, technical, and engineering aspects of augmented and virtual reality systems.
- To learn the Haptics and modelling from the lens of design.
- To learn the technology of augmented reality and implement it various applications to have practical knowledge.

UNIT-I	INTRODUCTION TO AUGMENTED REALITY AND VIRTUAL REALITY	6

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays.

UNIT-II	SENSATION AND PERCEPTION	6

Physiology of Perception, Cutaneous Senses, Pain, Olfaction, Gustation, Auditory System, Auditory Localization, Speech, Visual System, Object Perception, Motion Detection, Depth and Size Perception, psychophysical methods for computing perceptual thresholds.

UNIT-III	MOBILE VR AND AR	6

VR UX with the Unity API, Interaction and Locomotion, Working with Mobile VR in Unity, Travel and Wayfinding in Virtual Environments, Strategies for Designing and Developing 3D UIs, Evaluation of 3D User Interfaces, Traditional and Emerging VR/AR applications.

UNIT- IV	INTRODUCTION TO HAPTICS and MODELLING	6

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management.

UNIT-V	APPLICATIONS	6

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education. Open-source toolkits/ libraries such as OpenScene Graph, Vega, VRML etc., Future AR/VR applications (holo teleportation, telepresence).

	Contact Hours:	**30**

List of Experiments		
1	Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender	
2	Use the primitive objects and apply various projection types by handling camera. 3. Download objects from asset store and apply various lighting and shading effects	
3	Model three dimensional objects using various modelling techniques and apply textures over them.	
4	Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.	
5	Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.	
6	Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
7	Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
8	Develop simple MR enabled gaming applications.	
	Contact Hours:	**30**
	Total Contact Hours:	**60**

Course Outcomes: On completion of the course, the students will be able to
● Identify, examine, and develop software that reflects fundamental techniques for the design and deployment of VR and AR experiences.
● The strength of how VR and AR systems work.
● Choose, develop, explain, and defend the use of particular designs for AR and VR experiences.
● Evaluate the benefits and drawbacks of specific AR and VR techniques on the human body.
● Identify and examine state-of-the-art AR and VR design problems and solutions from the industry and academia.

Text Book(s):	
1	Ralf Doerner - " Virtual and Augmented Reality (VR/AR) Foundations and Methods of Extended Realities (XR) ", Springer Cham, March 2022.
2	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile",

	Packt Publisher, 2018.
3	Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016

Reference Book(s) / Web link(s):	
1	Paul Mealy – “Virtual & Augmented Reality for Dummies”, For Dummies, July 2018.
2	M. Claudia tom Dieck – “Augmented Reality and Virtual Reality ”, Springer International Publishing, May 2021.
3	Jay David – “ Reality Media Augmented and Virtual Reality”, MIT Press, November 2021.
4	Amber Dailey – “ Current and Prospective Applications of Virtual Reality in Higher Education”, IGI Global, 2020.

Courses :	
1	Introduction to Augmented Reality and ARCore, Coursera
2	Intro to AR/VR/MR/XR: Technologies, Applications & Issues, Coursera

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A37.1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
CS23A37.2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
CS23A37.3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
CS23A37.4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
CS23A37.5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3
Average	3	2.6	2.4	2	3	-	-	-	2.8	2.2	1.8	2.6	2.8	1.8	2.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High) No

Subject Code	Subject Name (Lab Course)	Category	L	T	P	C
CD23C32	DATA VISUALIZATION	PE	0	0	6	3
For B.E Programme CSE and B.Tech Programme in IT						

Objectives:	
•	To introduce students to Excel's basic and advanced data visualization techniques.
•	To familiarize students with Tableau.
•	To develop skills in using Power BI.
•	To enable students to design comprehensive visual dashboards.
•	To apply knowledge through a capstone project.

List of Experiments	
Excel for Data Visualization	
1	**Data Manipulation and Cleaning** • Using Functions and formulae for Data Cleaning. • Sorting, Filtering and Data Validation techniques.
2	**Excel Charts and Tools** • Getting started with charts (Bar, Line, Pie). • Advanced charts (Histograms, Box plots, Area Chart, Bubble chart).
3	**Excel Advanced Features** • Using PivotTables for data analysis. • Dynamic Dashboards with Slicers and Timeline.
Data Visualization with Tableau	
4	**Getting Started with Tableau** • Connecting to data and basic visualizations. • Interactive Dashboards and Storytelling. • Filters, Pages, Hierarchies, Sorting and Dates.
5	**Advanced Data Manipulation Techniques** • Calculated fields and parameters. • Calculations and Expressions -Total and Aggregations, Automatic and Custom split. • Organizing Data and Visual Analytics – Reference lines and bands, Clusters, Forecasting, Trend lines, Summary Card.
Data Visualization with Power BI	
6	**Introduction to Power BI** • Getting started with Data importing and transforming with Power Query. • Report designing with basic visualizations and using the visualization pane. • Measures, Filters. • Features of Power BI- Drill through, Hierarchies.
7	**Advanced Power BI**

	• DAX. • Creating complex reports and dashboards.			
8	**Capstone Project -** Students will select a real-world dataset and use any tools (Excel, Tableau, and Power BI) to create comprehensive dashboards.			
		Total Contact Hours	**:90**	**90**

Course Outcomes:	
On completion of course you will be able to	
CO1	Create basic and advanced visualizations in Excel for data analysis.
CO2	Develop interactive dashboards and perform data manipulations in Tableau.
CO3	Design reports and apply DAX for advanced reporting in Power BI.
CO4	Integrate and organize data to create comprehensive dashboards using various visualization tools.
CO5	Apply their learning to solve real-world data visualization problems using Excel, Tableau, and Power BI.

Textbooks:	
1	Kieran Healy, "Data Visualization: A Practical Introduction", Princeton University Press, 1st Edition, 2022.
2	Claus Wilke, "Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures", O'Reilly Media, 2nd Edition, 2023.
3	Jon Schwabish, Better Data Visualizations: A Guide for Scholars, Researchers, and Wonks", Columbia University Press, 1st Edition, 2023.
4	Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2nd ,2022.
Reference Books (s):	
1.	Excel Visualizations Power BI Documentation
2.	https://learn.microsoft.com/en-us/training/browse/?products=power-bi https://www.tableau.com/learn/training
3.	Online Course: Coursera — Data Visualization with Tableau Excel Visualizations
4.	Power BI Documentation

CO - PO – PSO matrices of course

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CD23C32.1	3	2	2	1	2	-	-	-	-	-	-	-	3	2	1
CD23C32.2	3	3	2	2	3	1	-	-	-	-	-	-	3	3	2
CD23C32.3	3	2	3	2	3	-	1	-	-	-	-	-	3	3	2
CD23C32.4	3	3	3	2	3	-	1	1	-	-	-	-	3	3	3
CD23C32.5	3	3	3	3	3	2	2	1	1	1	2	1	3	3	3

correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
CS23A39	GAME DEVELOPMENT	PE	2	0	2	3
For B.E Programme CSE,CSECS and B.Tech Programme in IT						

Objectives:
● To understand the history and overview of game design
● To develop the Game design document
● To apply the concepts of game loop, collision detection and Cameras
● To understand the concepts of graphics in game design
● To be able to incorporate various Mechanics in Developing game

UNIT-I	**Introduction to Game Development**	**6**
Games Overview; History of Games.Lecture: History and Generations of Video Games-Overview of Game Platforms-the Elements of Gameplay-Maths behind Game Development-Generic Programming		
UNIT-II	**Game Design Document**	**6**
Platforms-Input Devices-Game Genres-Game Design-Characters-Storyline-Levels and Environments-Game Play-Graphic Style and Art-Sound and Music-Game Controls-Accessibility-Marketing.		
UNIT-III	**Concepts of Game Design**	**6**
Game Loop-Collision Detection and Reaction-Common Issues with Collision Detection-Cameras-Screen Space Vs Game Space-Hybrid Approaches-Game Design-Game Mechanics-Rewarding the Player-Tips and Tricks-Virtual Resolution-Layering the Graphics-Palette Swapping		
UNIT-IV	**Graphic Design for Game Development**	**6**
Sound and Music-Digital Sound Processing-Fonts-Shaders-Patterns, containers and Classes-Design Pattern-Resource Manager-Ai in Video Games-Useful Algorithms		
UNIT-V	**Mechanics in Developing in Game Design**	**6**
Game Mechanics-I Frames-2D mechanics-RPG Like Games-Rhythm Games-Matchx Games-Cut Scenes-Testing your Game-Balancing your Game-No BS Principle-Managing Hype-Digital Rights Management-Game Jams		
	Contact Hours:	**30**

List of Experiments	
1	Create a simple sprite animation using an open source tool.

2	Narrate a simple game using scratch 2.0 (Character narration).	
3	Implement a scoring mechanism, such as collecting items or reaching certain milestones.	
4	Enhance the visual appeal of the game by adding animated sprites for player movement and other game elements.	
5	Implement basic AI behaviors, such as following the player when in range or patrolling between predefined points.	
6	Implement level transitions and progression.	
7	Incorporate sound effects for player movement, jumping, and interactions.	
8	Create menu screens for starting the game, pausing/resuming, and displaying game over information	
9	Optimize game performance, fix bugs, and polish game elements to improve the overall quality.	
	Contact Hours:	**30**
	Total Contact Hours:	**60**

Course Outcomes: On completion of the course, the students will be able to
● Understand the history and overview of game design
● Understand and develop the game design document
● Understand the collision mechanism, cameras and game loops
● Analyse and apply graphic design approaches for designing an game
● Choose efficient mechanic in developing and rolling out a game

Text Book(s):	
1	"2D Game Development: From Zero to Hero", Daniele Penazzo, Python Edition, 2020
2	"Game Development Patterns and Best Practices", John P. Doran, Matt Casanova, Packt Publishing, 2017.

Reference Book(s) / Web link(s):	
1	"Game Development with Unity", Michelle Minard Course Technology, 2012.
2	Game Development using Python",James R Parker, Mercury Learning and Information, 2021.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23A39 .1	3	2	2	1	2	-	-	-	-	-	-	-	2	2	2
CS23A39 .2	1	2	2	1	2	-	-	-	-	-	-	-	2	2	1
CS23A39 .3	1	1	1	2	1	-	-	-	-	-	-	-	2	2	2
CS23A39 .4	3	3	1	3	3	-	-	-	-	-	-	-	2	2	3
CS23A39 .5	3	3	2	1	3	-	-	-	-	-	-	-	2	2	3
Average	2.2	2.2	1.6	1. 6	2.2	-	-	-	-	-	-	-	2	2	2.2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
CS23B31	Introduction to METAVERSE	PE	2	0	2	3
For B.E Programme CSE and B.Tech Programme in IT						

Objectives:
• To learn the basics of Metaverse characteristics, concepts and layers.
• To understand and analyze Metaverse technologies, tools and platforms.
• To discuss design theories and practices relevant to the Metaverse.
• To explore cybersecurity and cybercrime in the Metaverse.
• To explore metaverse applications and examine open challenges in the Metaverse.

UNIT-I	Metaverse fundamentals	9
Metaverse evolution-Metaverse importance and characteristics-The interdisciplinary nature of the Metaverse-Metaverse opportunities and risks- Computer-mediated communication -Avatar-mediated communication-layers of Metaverse: Experience-Discovery-Creator economy- Spatial computing- Decentralization - Human interface-Infrastructure		
UNIT-II	**Metaverse technologies, tools and platforms**	**9**
Metaverse Technologies: AR/VR/MR/XR - 3D reconstruction - Game engines - Smart glasses- wearables, haptic devices, headsets and headwear -Blockchain, smart contracts, tokens, NFTs - Cryptography - Artificial Intelligence (AI) - Internet of Things (IoT) - Edge computing and 5G, 6G **Tools and technologies for Metaverse UX and UI:** Tools and services for avatar systems - Spatial user interface design - Cross-platform user experience design - Multimodal user interface- Technologies and devices for human computer interaction in Metaverse **Metaverse Platforms:** Decentraland, SANDBOX - Roblox, Axie Infinity- uHive, Hyper Nation - Nakamoto (NAKA), Metahero (HERO), Star Atlas (ATLAS)- Bloktopia (BLOK), Stageverse - Spatial, PalkaCity, Viverse -Sorare, Illuvium, Upland - Second Life, Sansar, Sensorium Galaxy		
UNIT-III	**Design theories and practices**	**9**
Social presence and co-presence - Motion sickness and cybersickness- Uncanny valley - Sense of self- location, sense of agency and sense of body ownership-Universal simulation principle- Prototyping- Evaluation techniques		
UNIT-IV	**Cybersecurity and Cybercrime in the Metaverse**	**9**
Metaverse and cybersecurity: Cybersecurity concerns in Metaverse: social engineering attacks, Data theft, Decentralization vs vulnerabilities - Cybersecurity risks in Metaverse: process, people, technology - Best practices for preventing cyberattacks in Metaverse: Risk assessment and mitigation, Physical security, Data encryption, Controlled access, Protect outbound data - Implementing cybersecurity in the Metaverse: Platform owners, Property owners/renters, Consumers/users **Metaverse and cybercrime**: Scam and theft- Rug pull- Money manipulation and wash trading- Money laundering		
UNIT-V	**Metaverse applications, challenges and open issues**	**9**
Metaverse applications: Gaming and entertainment- Travel and tourism - Education and learning- Real estate - Banking and Finance- Healthcare- Social media- Fashion **Metaverse challenges and open issues:** Persistency - Interoperability and scalability- Maturity- Regulation- Usefulness and ease-of-use - Privacy and data security- Content creation- NFTs and creator economy - Social, legal and ethical issues in the Metaverse		
	Contact Hours :	**45**

List of Experiments	
1	Create and customize an avatar in a Metaverse platform (Decentraland, Second Life, or Roblox).
2	Analyze different layers of the Metaverse (Experience, Discovery, Creator Economy, etc.).
3	Build a simple AR application using WebAR or Unity.

4	Create a simple NFT and understand its role in the Metaverse.	
5	Measure motion sickness symptoms when using VR applications.	
6	Design a simple 3D virtual space.	
7	Identify phishing and scam techniques used in the Metaverse.	
8	Create a virtual classroom using a Metaverse platform.	
Tools: Mozilla Hubs, Spatial.io, Gather.town. Unity, Unreal Engine, culus Quest 2, VRChat, Unity VR.		
	Contact Hours:	**30**
	Total Contact Hours:	**60**

Course Outcomes:On completion of the course, the students will be able to
• Understand the characteristics, and interdisciplinary nature of the Metaverse, the opportunities and risks it presents.
• Analyze Metaverse layers, the technologies used in creating them, as well as design theories and practices for Metaverse.
• Examine and discuss Metaverse platforms, applications and the latest technological developments in this area
• Identify cybersecurity issues, understand cybercrime in the Metaverse
• Discuss various applications and the open challenges in Metaverse

Text Books:	
1	Terry Winters ,"The Metaverse : Prepare Now For the Next Big Thing! ", Independently published, 2021 (ISBN: 979-8450959283)

Reference Books:	
1.	Ball, M., 2022, "The Metaverse and How It Will Revolutionize Everything ", Liveright, ISBN: 978-1324092032
2.	Christodoulou, K. Katelaris, L., Themistocleous, M, Christoudoulou P. and Iosif E, 2022, "NFTs and the Metaverse Revolution: Research Perspectives and Open Challenges", Blockchains and the Token Economy: Theory and Practice, Eds: Lacity M., Treiblmaier H., (2022), Palgrave Macmillan, Cham, pp. 139-178
3.	Damar, M. (2021). Metaverse shape of your life for future: A bibliometric snapshot. Journal of Metaverse, 1(1), 1–8.
4	Day, J. (2022) Metaverse will see cyberwarfare attacks unlike anything before: 'Massively elevated', February 28, https://www.express.co.uk/news/science/1570844/metaverse-news-cyberwarfare-attacks-virtual-worlds-russia-china-spt.
5	Davis, A., Khazanchi, D., Murphy, J., Zigurs Ilze, & Owens, D. (2009). Avatars, people, and virtual worlds: Foundations for research in metaverses. Journal of the Association for Information Systems, 10(2), 90–117. https://doi.org/10.17705/1jais.00183

Learning Activities and Teaching Methods:
• Faculty Lectures

- Guest-Lectures Seminars
- Directed and Background Reading
- Case Study Analysis
- Academic Paper Discussion
- Simulations
- Student-led Presentations
- In-Class Exercises

Assessment Methods:

- Interactive Activities
- Assignments / Project
- Quiz
- CAT & Final Exams

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS23B31.1	3	2	2	2	3	3	2	3	-	2	-	3	3	2	3
CS23B31.2	3	3	3	3	3	2	2	2	-	2	-	3	3	3	3
CS23B31.3	3	3	3	3	3	2	2	2	-	2	-	3	3	3	3
CS23B31.4	3	3	3	3	3	3	2	3	-	3	-	3	3	3	3
CS23B31.5	3	3	3	3	3	2	2	2	3	3	2	3	3	3	3
Average	3	2.8	2.8	2.8	3	2.4	2	2.4	3	2.4	3	3	3	3	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3:Substantial (High) No correlation"-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
IT23E31	Graphics and Multimedia (Common to IT, CSE, CSE CS, CSD)	PE	2	0	2	3

Objectives:
• To gain knowledge about graphics hardware devices and software used.
• To understand the two-dimensional graphics and their transformations.
• To understand the three-dimensional graphics and their transformations.
• To appreciate illumination and color models
• To become familiar with hypermedia models

UNIT-I	INTRODUCTION	9
An Introduction Graphics System : Computer Graphics and Its Types, Application of computer graphics - Graphics Systems : Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors and Work Stations, Input Devices, Hard Copy Devices, Graphics Software - Scan Conversion Basics, Line, Circle and Ellipse drawing algorithms – Parallel Curve Algorithm – Filled Area Primitives.		
UNIT-II	**2D PRIMITIVES**	9
Two-dimensional Geometric Transformations: Basic Transformations, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Reflection and Shearing. Two-Dimension Viewing : The viewing Pipeline, Window to view port coordinate transformation, Clipping Operations, Point Clipping, Line Clipping, Polygon Clipping, Text Clipping, Exterior Clipping.		
UNIT-III	**3D CONCEPTS**	**9**
Three-Dimensional Concepts : Three Dimensional Display Methods, 3D Transformations, Parallel Projection and Perspective Projection Parallel and Perspective projections - 3D Concepts – 3D Object Representation, Polygons, Curved Lines, Splines, Quadratic Surfaces, Splines, B-Splines, Bezier Curves, Beta Splines, 3D Transformations, 3D Viewing – Visible surface identification, Elements of Color, Color Perception, Color Matching, Color Models – XYZ, RGB, YIQ, CMY, HSV -		
UNIT-IV	**MULTIMEDIA SYSTEM DESIGN**	**9**
Multimedia basics − Multimedia applications − Multimedia system architecture – Evolving technologies for multimedia − Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases. Compression and decompression − Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.		
UNIT-V	**HYPERMEDIA**	**9**
Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems. CASE STUDY: BLENDER GRAPHICS Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures		
		Total Contact Hours:45

Description of the Experiments	Total Contact Hours: 30
1. Implement Bresenham's line algorithm, Midpoint Circle Algorithm, and Midpoint Ellipse Algorithm. Draw different geometric objects on the screen.	
2. Implement the scan conversion of a polygon and use flood-fill algorithms to fill areas in a graphics window.	
3. Write a program that performs translation, scaling, and rotation on basic 2D shapes (e.g., triangle, rectangle) using matrices.	
4. Write a program that clips polygons to a specified window and displays the clipped polygon.	
5. Write a program that allows the user to perform 3D transformations on basic 3D objects (cube, pyramid) and view the results.	
6. Create and render 3D objects (like cubes, spheres) using polygons and apply basic color and shading techniques.	
7. Create a multimedia application that integrates images, sound, and video in a simple user interface.	
8. Create a program that captures video/audio from a webcam or microphone and displays it on a multimedia interface.	
9. Create an application that allows users to send and receive multimedia messages including text, image, and audio.	
10. Create a simple 3D model using Blender (e.g., a house or object) and apply basic shading and textures to the model.	

Course Outcomes:

- To gain knowledge about graphics hardware devices and software used.
- To understand the two-dimensional graphics and their transformations.
- To understand the three-dimensional graphics and their transformations.
- To appreciate illumination and color models
- To become familiar with multimedia and hypermedia

SUGGESTED ACTIVITIES (if any) (UNIT/ Module Wise) – Could suggest topic

- Problem solving sessions
- Flipped classroom - Comparing SOA with Client-Server and Distributed architectures
- Survey on various storage technologies
- Activity Based Learning
- Implementation of small module

SUGGESTED EVALUATION METHODS

- Tutorial problems
- Assignment problems
- Quizzes
- Class Presentation/Discussion

Text Book(s):
1.Donald Hearn and Pauline Baker M, "Computer Graphics", 2nd Edition, Prentice Hall, 2014.
1. Richard E. Mayer, "Multimedia Learning" , 3rd Edition, Cambridge University Press, 2020

Reference Books(s) / Web links:
1.Judith Jeffcoate, "Multimedia in Practice: Technology and Applications", Pearson Publisher, Edition 2009.
2. John F. Hughies, Andries Van Dam, Morgan Mcuire, David F. Sklar, James D Foley Steven K Feiner, Kurt Akeley, "Computer Graphics: Principles and Practice", 3rd Edition, Addison Wesley Professional , 2013.
2. Steve Marschner , Peter Shirley, Fundamentals of Computer Graphics ,4th Edition , CRC Press, December 2015

CO-PO-PSO Mapping

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
IT23E31.1	3	2	3	-	1	-	-	1	2	2	3	3	3	2	2
IT23E31.2	3	2	3	-	2	-	-	-	1	2	2	2	3	2	2
IT23E31.3	3	2	3	-	1	-	-	1	-	2	2	2	3	2	2
IT23E31.4	3	2	3	-	2	-	-	-	1	2	1	1	3	1	2
IT23E31. 5	3	2	3	-	1	-	-	1	-	2	2	1	3	1	2
Average	3	2	3	-	1.4	-	-	1	1.3	2	2	1.8	3	1.7	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3: Substantial (High) No correlation: "-"

Subject Code	Subject Name (Lab course)	Category	L	T	P	C
CD23721	VISUAL EFFECTS	PE	0	0	6	3
For B.E Programme CSE ,CSECS ,CSD and B.Tech Programme in IT , AIML ,AIDS						

Objectives:
● To Undestand the basic principles of visual effects, including CGI, compositing, and integration with liveaction footage.
● To learn how to combine multiple elements (live-action,CGI, background) seamlessly into a single frame.
● To explore techniques for creating and animating 3D models and environments for VFX projects.
● To understand how to track motion in footage to integrate 3D elements effectively with real-world video.
● To learn to simulate natural phenomena such as fire, smoke,water, nd explosions for realistics effects.

	LIST OF EXPERIMENTS
	GREEN SCREEN COMPOSITING
1	**Green Screen Compositing** **Tools:** Adobe After Effects, Nuke, or DaVinci Resolve. **Experiment Variants:** Experiment with different lighting setups on the green screen to minimize spill and maximize keying quality.
2	**Rot scoping Techniques** **Tools:** After Effects, Nuke, Mocha. **Focus Areas:** Vary the complexity by tracking subjects with different motions and adding elements behind or in front of the rotoscoped layer
3	**Motion Tracking and Match Moving** **Tools:** After Effects, Blender, Cinema 4D. **Variants:** Try planar tracking for surfaces and 3D tracking to simulate the camera movement for more immersive VFX scenes
4	Particle Simulation for Environmental Effects **Tools:** Blender, Houdini, Maya. **Experiment Variants:** Adjust particle behaviour to control effects like the density of snow or smoke spread based on environmental conditions
5	**Dynamic Lighting and Shadow Matching** **Tools:** Maya, Blender, or Nuke. **Experiment Variants:** Test different lighting angles, intensities, and shadow softness to match the original footage's conditions.
6	**Physics-Based Animation** **Tools:** Blender, Houdini, Cinema 4D.

	Focus: Experiment with gravity, elasticity, and friction settings to see how they impact object interactions.	
7	**Time Manipulation Effects** **Tools:** After Effects, Premiere Pro. **Variants:** Test speed-ramping (changing speeds mid-shot) and frame blending to make fast actions smoother or simulate slow-motion effects	
	Total Contact Hours	**90**

Course Outcomes:
• Identify user interface for compositing, Views and Previews, Layers and Properties & Animation, Colours, Masks, Transparency and Keying, Text, Drawing and Painting, Motion Tracking, Effects and Animation, Presents, Rendering and Exporting.
• Differentiate Image Based Motion Graphics & Video Based Motion Graphics.
• Create Effects & Title effects.
• Do colour correction & Keying after effects tools.
• Use Match mover, Motion tracking Overview, Motion Tracking, Workflow and Controls, Rotoscoping, Wire Removal

Text Book(s):	
1	Visual Effects Society (VES),"The VES Handbook of Visual Effects", Routledge, Edition: 2nd,2024.
2	Steve Wright Year, "Compositing Visual Effects: Essentials for the Aspiring Artist", Focal Press, Edition: 3rd, 2022
3	Adobe Creative Team, "Adobe After Effects Classroom in a Book", Adobe Press, Edition: 1st,2023

Reference Book(s)/web links:	
1	William C. Smith, **"The Complete Guide to Digital Effects for the Screen"**, Focal Press, 1st Edition, 2019
2	**Barnes & Noble** A large bookstore with a variety of titles: www.barnesandnoble.com
3	**Book Depository** Offers free shipping worldwide: www.bookdepository.com

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CD23721.1	2	2	2	1	1	-	-	-	3	2	2	2	2	2	2
CD23721.2	2	3	2	1	1	-	-	-	3	2	3	2	2	2	2
CD23721.3	2	3	2	2	2	-	-	-	-	-	-	2	2	3	2
CD23721.4	2	-	-	2	3	-	-	-	-	-	-	-	2	2	-
CD23721.5	2	2	-	3	3	-	1	2	3	2	1	3	2	3	-
Average	2	2.5	2	1.8	2	-	1	2	3	2	2	2.25	2	2.4	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	T	P	C
CD23731	FILM MAKING and RADI PODCASTING	PE	2	0	2	3
For B.E Programme CSE ,CSECS,CSD and B.Tech Programme in IT,AIML,AIDS						

Objectives:
• To understand the fundamentals of visual storytelling, including scriptwriting and storyboarding.
• To learn the technical aspects of camera operations, lighting, and shot composition.
• To learn technical aspects of audio recording, mixing, and editing.
• To design and produce a variety of radio content such as interviews, advertisements, and podcasts.
• To create complete radio programs incorporating jingles, sound effects, and music.

UNIT-I	Introduction to Media Production	6
Radio as a means of Mass Communication - Brief history of Radio from early years to the present stage - Print vs Electronic Media - Studio set-ups and productions - Field reporting		
UNIT-II	Radio Broadcasting Technologies	6
Public vs Private broadcasting systems in India - Radio Broadcasting Systems--MW, SW, FM - Internet Radio, Space Radio, Community Radio		
UNIT-III	A Guide to Radio Scriptwriting and Management	6
Scriptwriting for different formats of Radio - Elements of Radio scripts - Listing, scheduling and traffic management - Importance of Audience Surveys		
UNIT-IV	Functions of Radio in Public and Private Broadcasting Systems	6
Functions of Radio in the context of Public and Private Broadcasting systems - Types and formats of Radio programmes - News, Music, Interviews, Talks, Dramas – Discussions.		
UNIT-V	Art and Craft of Radio News Reporting	6
Art and Craft of Radio News Reporting - Locating radio news stories - Structure a radio news report - Tools and techniques of radio news reporting - Radio news interviews and vox pops		
	Contact Hours:	30

List of Experiments	
1	Create a short video focusing on different shot types (close-up, medium, wide), camera angles, and movement techniques (panning, tilting, tracking).
2	Set up different lighting setups (3-point lighting, high key, low key) and capture a scene to understand their impact on mood and aesthetics.

3	Record audio separately from video and then synchronize it in post-production, focusing on lip-sync and ambient sound.	
4	Shoot footage with a green screen, remove the background in post-production, and place the subject into a virtual environment.	
5	Write a short script and direct a scene with actors, focusing on dialogue delivery, blocking, and character motivation.	
6	Design and mix sound effects, music, and dialogue for a short film clip.	
	Mini project: Produce a short documentary (5-7 minutes) on a subject of choice, utilizing interviews, voice-over narration, and B-roll footage and create a 2-3 minute stop-motion animation using physical objects or clay figures.	
	Contact Hours:	**30**
	Total Contact Hours:	**60**

Course Outcomes: On completion of the course, the students will be able to
• Students understand the conceptual process of Radio Production.
• Students evaluate the complexities of Radio Production as a means of mass communication.
• Students create the Radio scripts and other practical implications of the radio production.
• Students evaluate the complexities of the Radio Broadcasting in detail.
• Students create Radio News Report and also the Radio feature reporting.

Text Book(s):	
1	John J. Lee, “The Roadmap for the Balanced Film Producer”, Routledge, edition:1st, 2024.
2	Steven D. Katz, “Film Directing Shot by Shot: Visualizing from Concept to Screen”, Routledge, edition: 1st, 2024.
3	David F. O’Connell, “Radio Production”, Oxford University, Edition:2nd,2022.
4	Andrew Thom’s, “The Radio Producer's Handbook”, Sage Publications,dition:1st, 2023**.**

Reference Book(s):	
1	John O. M. McCarthy**, “The Encyclopaedia of Film Making Techniques", Focal Press, 1st Edition,** 2020.
2	https://www.amazon.com/Filmmakers-Handbook-Comprehensive-Digital-ebook/dp/B00E19FWG0
3	https://www.amazon.com/Film-Directing-Shot-Techniques-Aesthetics/dp/0941188268
4	https://www.amazon.com/Directing-Techniques-Aesthetics-Michael-Rabiger/dp/1285428982

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CD23731.1	2	2	2	1	1	-	-	-	3	2	2	2	2	2	2
CD23731.2	2	3	2	1	1	-	-	-	3	2	3	2	2	2	2
CD23731.3	2	3	2	2	2	-	-	-	-	-	-	2	2	3	2
CD23731.4	2	-	-	2	3	-	-	-	-	-	-	-	2	2	-
CD23731.5	2	2	-	3	3	-	1	2	3	2	1	3	2	3	-
Average	2	2.5	2	1.8	2	-	1	2	3	2	2	2.25	2	2.4	2

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium)

3:Substantial (High) No

OPEN ELECTIVE COURSES OFFERED BY AIML

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
AI23O11	ARTIFICIAL INTELLIGENCE AND NEURAL NETWORK	OE	3	0	0	3

Objectives:	
●	Understand the various characteristic of a problem solving agent.
●	Learn about the different strategies involved in problem solving.
●	Learn about Knowledge Representation and reasoning.
●	To interpret the basic concepts of Neural Networks.
●	To learn various Neural Architecture Models.

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM SOLVING AGENT	9
Introduction : AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation CHAPTER – 1, 2 & 3 (R1)		
UNIT-II	**SEARCHING TECHNIQUES**	**9**
Heuristic search techniques: Generate and test - hill climbing - Breadth first search - A* algorithm - problem reduction - AO* algorithm - constraint satisfaction - means-ends analysis CHAPTER – 3 (T1)		
UNIT-III	**KNOWLEDGE REPRESENTATION AND REASONING**	**9**
Knowledge Representation - Using Predicate logic: representing simple facts in logic - representing instance and ISA relationships - computable functions and predicates - resolutions. Representing knowledge using rules: procedural Versus declarative knowledge - logic programming - forward versus backward reasoning. CHAPTER – 5 & 6 (T1)		
UNIT-IV	**INTRODUCTION TO NEURAL NETWORKS**	**9**
Introduction - Basic Architecture of Neural Networks: Single Computational Layer - Multilayer Neural Networks - Multilayer Network as a Computational Graph - Training a Neural Network with Backpropagation CHAPTER – 1 (T2)		
UNIT-V	**NEURAL ARCHITECTURE MODELS**	**9**
Common Neural Architectures - Advanced Topics: Reinforcement Learning - Separating Data Storage and Computations - Generative Adversarial Networks - Two Notable Benchmarks - The MNIST Database of Handwritten Digits - The ImageNet Database. Neural Architectures for Binary Classification Models: Revisiting the Perceptron - Least-Squares Regression - Logistic Regression - Support Vector Machines. CHAPTER – 1 & 2 (T2)		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Acquire the basic concepts of Artificial Intelligence and Problem solving agent.
●	Apply various searching techniques.
●	Understand the Knowledge Representation and Reasoning.
●	Explain the basic concepts of Neural Networks.
●	Apply various Neural Architecture Models.

Text Books:	
1	Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).
2	CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018.

Reference Books:	
1	Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education
2	Neural networks and learning machines, simon haykin, 3rd edition, pearson, 2009.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23O11.1	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
AI23O11.2	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
AI23O11.3	2	2	3	1	2	-	-	-	-	1	-	-	2	2	2
AI23O11.4	2	3	3	1	2	2	-	-	2	1	2	2	1	2	3
AI23O11.5	2	3	3	1	2	2	-	-	2	1	2	2	1	2	3
Average	2	2	2.2	1	2	2	-	-	2	1	2	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI23O31	INTRODUCTION TO MACHINE LEARNING	OE	2	0	2	3

Objectives:	
●	To know the fundamentals of machine learning.
●	Be exposed to regression models.
●	Be familiar with basic supervised learning algorithms
●	To understand machine learning algorithms with tree model.
●	To learn and apply unsupervised learning techniques.

UNIT-I	INTRODUCTION	6
Components of learning – learning models – geometric models – probabilistic models – logical models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve.		
UNIT-II	**REGRESSION MODELS**	**6**
Linear classification – univariate linear regression - bivariate regression – multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's – Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models – Bayesian Logistic Regression.		
UNIT-III	**SUPERVISED LEARNING**	**6**
Perceptron: – multilayer neural networks – back propagation - learning neural networks structures – **support vector machines:** – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation.		
UNIT-IV	**TREE MODELS**	**6**
Decision trees: Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy - **Ensemble methods:** Bagging- Boosting- Boosting AdaBoost - Gradient Boosting – Xg boost.		
UNIT-V	**UNSUPERVISED LEARNING**	**6**
Clustering: Nearest neighbor models – K-means – clustering around Medoids. **Dimensionality Reduction:** – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.		
	Contact Hours : 30	

List of Experiments			
1.	A python program to implement univariate regression, bivariate regression and multivariate regression.		
2.	A python program to implement logistic model.		
3.	A python program to implement single layer perceptron.		
4.	A python program to implement multi layer perceptron with back propagation.		
5.	A python program to do face recognition using SVM classifier.		
6.	A python program to implement decision tree.		
7.	A python program to implement KNN and K-means.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Understand basics of machine learning.
●	Analyze the regression models for refining parameters.
●	Understand and explore the supervised learning algorithms.
●	Apply tree models for feature extraction.
●	Examine the supervised learning algorithms.

Text Books:	
1	AurélienGéron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. September 21019, O'Reilly Media, Inc., ISBN: 9781492032649.
2	Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition,Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

Reference Books:	
1	Alex Smola and S.V.N. Vishwanathan," Introduction to Machine Learning", Cambridge University Press 2008.
2	Andreas C. Müller and Sarah Guido," Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, Inc,2016.
3	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.
4	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

Web link:

1. https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So

2. https://nptel.ac.in/courses/106/106/106106139/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23O31.1	2	1	1	1	2	-	-	-	-	-	-	-	1	2	1
AI23O31.2	2	1	1	1	2	-	-	-	-	-	-	-	1	2	1
AI23O31.3	2	1	3	1	3	-	-	-	-	1	-	-	1	2	2
AI23O31.4	2	1	3	2	3	2	-	-	2	1	2	2	1	2	3
AI23O31.5	2	1	3	2	3	2	-	-	2	1	2	2	1	2	3
Average	2	1	2.2	1.4	2.6	2	-	-	2	1	2	2	1	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AI23O21	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	OE	0	0	6	3

Objectives:	
●	Prepare to become Junior RPA Developers.
●	Learn the basic concepts of Robotic Process Automation.
●	Develop familiarity and deep understanding of UiPath tools.
●	Develop the ability to design and create robots for business processes independently.
●	Develop skills required to pass UiPath RPA Associate v1.0 Exam.

List of Experiments

1.	Downloading and Installing UiPath Academic Alliance.		
2.	Installing UiPath Extension in Browsers.		
3.	Installing Activity Packages in UiPath Studio.		
4.	Version Control.		
5.	Experiments based on variables and arguments.		
6.	Algorithmic Approach: Selection control structures.		
7.	Algorithmic Approach: Iteration control structures.		
8.	Experiments based on Basic Recording.		
9.	Experiments based on Desktop Recording.		
10.	Experiments based on Web Recording.		
11.	Experiments based on Selectors.		
12.	Experiments based on Data Manipulation.		
13.	Screen Scraping.		
14.	Data Scrapping.		
15.	PDF Extraction.		
16.	Excel Automation (Read / Write)		
17.	Workbook Automation.		
18.	Email Automation.		
19.	Orchestrator: Invoice Processing – Dispatcher.		
20.	Orchestrator: Invoice Processing – Performer.		
21.	Mini Projects.		
	Contact Hours	**:**	**45**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Become Junior RPA Developers.
●	Understand the basic concepts of Robotic Process Automation.
●	Understand the UiPath tools.
●	Design and create robots for business processes independently.
●	Develop projects using UiPath.

Text Books:	
1	Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool – UiPath, Alok Mani Tripathi, Packt Publishing Ltd., 2018.
2	Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant Paperback, 2018.

Reference Books:	
1	Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, Nandan Mullakara, Arun Kumar Asokan, Packt Publishing Ltd., 2020.
2	Tom Tauli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems" 1st Edition, Kindle Edition.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI23O21.1	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
AI23O21.2	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
AI23O21.3	2	2	3	1	3	-	-	-	-	1	-	-	2	2	2
AI23O21.4	2	3	3	2	3	2	-	-	2	1	2	2	1	2	3
AI23O21.5	2	3	3	2	3	2	-	-	2	1	2	2	1	2	3
Average	2	2	2.2	1.4	2.6	2	-	-	2	1	2	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"