

CURRICULUM

2023

(Autonomous)

B.TECH

Computer Science and Engineering (AI)



**MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY  
(AUTONOMOUS)**

**Mar Ivanios Vidyanagar, Nalanchira,**

**Thiruvananthapuram – 695 015**

**August 2023**

**CURRICULUM AND DETAILED SYLLABI**

FOR

**B. TECH DEGREE PROGRAMME**

IN

**COMPUTER SCIENCE AND ENGINEERING  
(Artificial Intelligence)**

**SEMESTER VII & VIII**

**2023 SCHEME  
(AUTONOMOUS)**



**MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY**

(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University) MAR IVANIOS VIDYANAGAR, NALANCHIRA, THIRUVANANTHAPURAM – 695015,

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## MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

### **Vision and Mission of the Institution**

#### Vision:

To be an Institution moulding globally competent professionals as epitomes of Noble Values.

#### Mission:

To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

### **Vision and Mission of the Department**

#### Vision:

To be a Centre of Excellence in Computer Science and Engineering providing quality education and research for the betterment of the society.

#### Mission:

To impart sound knowledge in theoretical and applied foundations of Computer Science and Engineering, and to train the students to solve real life issues to effectively define and shape life.

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

- PEO1:** Graduates will be successful professionals in Industries of core or interdisciplinary nature or entrepreneurs, demonstrating effective leadership and excellent team work.
- PEO2:** Graduates will expand the horizon of knowledge through higher education or research, leading to self-directed professional development
- PEO3:** Graduates will demonstrate competency in AI & ML, professional attitude and ethics while providing solutions in societal and environmental contexts

### **PROGRAMME OUTCOMES (POs)**

Engineering graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
  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.
  5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
  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.
  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.
  8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
  9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
  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.
  11. **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.
  12. **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.

### **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

**PSO1:** To apply Algorithmic Principles, Programming Skills and Software Engineering Principles to design, develop and evaluate Software Systems of varying complexities.

**PSO2:** To apply knowledge of System Integration to design and implement computer-based systems

**PSO3:** To solve real world and socially relevant problems using AI



**MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY  
(AUTONOMOUS)**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**B. TECH DEGREE PROGRAMME  
IN  
COMPUTER SCIENCE AND ENGINEERING  
(ARTIFICIAL INTELLIGENCE)**

**DETAILED SYLLABI OF FOURTH YEAR**

Items	Board of Studies (BoS)	Academic Council (AC)
Date of Approval	23/02/2026	12/03/2026

Head of the Department  
Chairman, Board of Studies

Principal  
Chairman, Academic Council

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

### B.TECH COMPUTER SCIENCE AND ENGINEERING (Artificial Intelligence)

*For the students admitted from 2023*

#### Scheduling of Courses

##### i) Knowledge Segments and Credits

Every course of B. Tech Programme is placed in one of the nine categories as listed in the following table. No semester shall have more than six lecture-based courses and two laboratory courses, and/or drawing/seminar/project courses in the curriculum.

Sl. No.	Category	Category Code	2023
1	Humanities and Social Sciences including Management Courses	HSC	6
2	Basic Science Courses	BSC	26
3	Engineering Science Courses	ESC	24
4	Programme Core Courses, Comprehensive Course Work and Viva Voce	PCC	72
5	Programme Elective Courses	PEC	18
6	Institute Elective Courses	IEC	6
7	Project Work and Seminar	PWS	15
8	Professional Development Courses	PDC	--
9	Mandatory Student Activities (P/F)	MSA	3
	<b>Total Mandatory Credits</b>		<b>170</b>
	Value Added Courses (Optional) – Honours/Minor		15

##### ii) Semester-wise Credit Distribution

Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Credits for Courses	19	21	23	22	25	23	20	14	<b>167</b>
	40		45		48		34		<b>167</b>
Credits of Activities	3								<b>3</b>
Total Credits									<b>170</b>
	Value Added Courses (Optional) – Honours/Minor								<b>15</b>
	<b>Total Credits</b>								<b>185</b>

SEMESTER VII										
Slot	Category	Course Code	Courses	Credit Structure				SS	Hours	Credit
				L	T	P	J			
A	PCC	23CTL40A	Generative AI	3	1	0	0	5	4	4
B	PCC	23CTB40B	Software Engineering	3	0	2	0	5.5	4	4
D	PEC	23CTL43X	Programme Elective III- Course3	2	1	0	0	3.5	3	3
E	IEC	23IEL42X	Institute Elective 2	3	0	0	0	4.5	3	3
T	PWS	23CTV48A	Comprehensive Course Viva	0	0	2	0	1	2	1
U	PWS	23CTJ48A	Project	0	0	10	0	10	10	5
		23CTI48A	Internship							
M/H	VAC		Minor/Honours	0	0	6	0	3	6	3
				3	0	0	0	4.5	3	3
<b>TOTAL</b>								<b>29.5/37</b>	<b>26,33/36</b>	<b>20/23</b>

SEMESTER VIII										
Slot	Category	Course Code	Courses	Credit Structure				SS	Hours	Credit
				L	T	P	J			
A	PEC	23CTL44X	Programme Elective IV- Course4	2	1	0	0	3.5	3	3
B	PEC	23CTL45X	Programme Elective V- Course5	2	1	0	0	3.5	3	3
C	PEC	23CTL46X	Programme Elective VI- Course6	2	1	0	0	3.5	3	3
U	PWS	23CTJ48B	Project	0	0	10	0	10	10	5
		23CTI48A	Internship*	0	0	-	0			
M/H	VAC		Minor/Honours	0	0	6	0	3	6	3
<b>TOTAL</b>								<b>20.5/23.5</b>	<b>19/25</b>	<b>14/17</b>

\*Students can opt for Internship either in S7 or S8. However, in S7, the internship can be permitted only if there are no pending Programme/Course requirements in the semester, that need to be completed in College in the offline mode, such as laboratory sessions.

**PROGRAMME ELECTIVE I**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
E	PEC	23CSL31A	Parallel Computer Architecture	2-1-0-0	3	3
		23CSL31C	Computer Graphics and Multimedia	2-1-0-0	3	3
		23CTL31A	Web Technology	2-1-0-0	3	3

**PROGRAMME ELECTIVE II**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
D	PEC	23CSL32A	Cloud Computing	2-1-0-0	3	3
		23CSL32B	Applied Data Science Using Python	2-1-0-0	3	3
		23CSL32D	Virtual and Augmented Reality Systems	2-1-0-0	3	3
		23CTL32A	Natural Language Processing	2-1-0-0	3	3
		23CTL32B	Foundations of Security in Computing	2-1-0-0	3	3
		23CTL32C	Data Analytics	2-1-0-0	3	3

**PROGRAMME ELECTIVE III**

Slot	Category Code	Course Number	Course	L-T-P-J	Hours	Credit
C	PEC	23CSL43A	Internet of Things	2-1-0-0	3	3
		23CSL43E	Human Computer Interaction	2-1-0-0	3	3
		23CTL43A	Computer Vision	2-1-0-0	3	3
		23CTL43B	Data Engineering	2-1-0-0	3	3
		23CTL43C	AI For Cyber Security	2-1-0-0	3	3

**PROGRAMME ELECTIVE IV**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
A	PEC	23CSL44A	Virtualization	2-1-0-0	3	3
		23CTL44A	Reinforcement Learning	2-1-0-0	3	3
		23CTL44B	Time Series Analysis & Forecasting	2-1-0-0	3	3
		23CTL44C	Cybercrime Forensics and Digital Forensics	2-1-0-0	3	3
		23CTL44D	Social Network Analytics	2-1-0-0	3	3

**PROGRAMME ELECTIVE V**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
B	PEC	23CTL45A	Agentic AI and Multi agent Systems	2-1-0-0	3	3
		23CTL45B	Privacy and security in IoT	2-1-0-0	3	3
		23CTL45C	Big Data and Scalable AI Systems	2-1-0-0	3	3
		23CSL45E	Quantum Computing and Programming	2-1-0-0	3	3

**PROGRAMME ELECTIVE VI**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
C	PEC	23CSL46D	Vibe Coding	2-1-0-0	3	3
		23CTL46A	AI for Healthcare	2-0-0-0	3	3
		23CSL46C	Block chain and Crypto Currencies	2-1-0-0	3	3

**INSTITUTE ELECTIVE 1**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
E	IEC	23IEL31E	Data Science for Engineers	3-0-0-0	3	3
		23IEL31F	Introduction to Mobile Application	3-0-0-0	3	3
		23IEL31G	Introduction to Cyber Security and Ethical Hacking	3-0-0-0	3	3
		23IEL31H	Digital Marketing and E-commerce	3-0-0-0	3	3

**INSTITUTE ELECTIVE II**

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
E	IEC	23IEL42E	Responsible AI	3-0-0-0	3	3
		23IEL42F	Prompt Engineering	3-0-0-0	3	3
		23IEL42G	Business Intelligence and Analytics	3-0-0-0	3	3
		23IEL42H	Game Development	3-0-0-0	3	3

## MINOR

Semester	BASKET I Specialization: SOFTWARE ENGINEERING				BASKET II Specialization: MACHINE LEARNING				BASKET III Specialization: NETWORKING			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
S3	23CSL2 MA	Object Oriented Programming	3-0-0-0	3	23CSL2 MC	Mathematics for Machine Learning	3-0-0-0	3	23CSL2 ME	Data Communication	3-0-0-0	3
S4	23CSL2 MB	Programming Methodologies	3-0-0-0	3	23CSL2 MD	Concepts in Machine Learning	3-0-0-0	3	23CSL2 MF	Introduction to Computer Networks	3-0-0-0	3
S5	23CSL3 MA	Concepts in Software Engineering	3-0-0-0	3	23CSL3 MC	Concepts in Deep Learning	3-0-0-0	3	23CSL3 ME	Client Server Systems	3-0-0-0	3
S6	23CSL3 MB	Introduction to Software Testing	3-0-0-0	3	23CSL3 MD	Reinforcement Learning	3-0-0-0	3	23CSL3 MF	Wireless Networks and IoT Applications	3-0-0-0	3
S7	23CSJ4 MA	Mini Project	0-0-6-0	3	23CSJ4 MC	Mini Project	0-0-6-0	3	23CSJ4 ME	Mini Project	0-0-6-0	3
S8	23CSJ4 MA	Mini Project	0-0-6-0	3	23CSJ4 MC	Mini Project	0-0-6-0	3	23CSJ4 ME	Mini Project	0-0-6-0	3

Semester	Basket IV Specialization: Data Science				Basket V Specialization: Network Security			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
S3	23CSL2MG	Statistics for Data Science and Time Forecasting	3-0-0-0	3	23CSL2MI	Basics of Computer Systems	3-0-0-0	3
S4	23CSL2MH	Data Visualization & ML	3-0-0-0	3	23CSL2MJ	Cyber Security	3-0-0-0	3
S5	23CSL3MG	Natural Language Processing	3-0-0-0-0	3	23CSL3MI	Introduction to Block-chain technologies	3-0-0-0	3
S6	23CSL3MH	Deep Learning	3-0-0-0	3	23CSL3MJ	Privacy and security in IoT	3-0-0-0	3
S7	23CSJ4MG	Mini Project	0-0-6-0	3	23CSJ4MI	Mini Project	0-0-6-0	3
S8	23CSJ4MG	Mini Project	0-0-6-0	3	23CSJ4MI	Mini Project	0-0-6-0	3

**HONOURS**

Semester	Basket I Specialization: SECURITY IN COMPUTING				Basket II Specialization: COMPUTATIONAL BIOLOGY				Basket III Specialization: COMPUTER VISION			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
<b>S4</b>	23CSL2HB	Number Theory	3-0-0-0	3	23CTL2HB	Computational Fundamentals for Bioinformatics	3-0-0-0	3	23CTL2HD	Advanced Topics in Computer Graphics	3-0-0-0	3
<b>S5</b>	23CSL3HA	Cryptographic Algorithms	3-0-0-0	3	23CTL3HA	Computational Biology	3-0-0-0	3	23CTL3HC	Advanced Concepts In Computer Vision	3-0-0-0	3
<b>S6</b>	23CSL3HB	Network Security	3-0-0-0	3	23CTL3HB	Machine Learning in Computational Biology	3-0-0-0	3	23CTL3HD	Image And Video Processing	3-0-0-0	3
<b>S7</b>	23CSL4HA	Cyber Forensics	3-0-0-0	3	23CTL4HA	Computational Health Informatics	3-0-0-0	3	23CTL4HC	Surveillance Video Analytics	3-0-0-0	3
<b>S8</b>	23CSJ4HB	Mini Project	0-0-6-0	3	23CTJ4HB	Mini Project	0-0-6-0	3	23CTJ4HD	Mini Project	0-0-6-0	3

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL40A	Generative AI	PCC	3	1	0	0	4	2023

### i. COURSE OVERVIEW

This course covers the key concepts, models, and tools behind AI systems that create new content, such as text, images, audio, and code. It begins with foundational knowledge of classical AI and machine learning, providing context for how GenAI differs in its goal to generate rather than just predict or classify. Students explore foundational language models like GPT, BERT, and T5, learning how these models are trained and applied in real-world tasks. Retrieval-Augmented Generation (RAG), a technique that enhances GenAI outputs with up-to-date or domain-specific information from external sources. Prompt engineering—designing effective inputs to steer model outputs. Through hands-on practice and conceptual learning, the syllabus aims to equip students with the skills to build, evaluate, and apply GenAI systems responsibly and creatively across different domains.

### ii. COURSE OUTCOMES

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

CO1	Explain the principles and concepts behind generative AI models	Understand
CO2	Apply different architectures used in large language models.	Apply
CO3	Develop the ability to explore and analyze word embeddings, perform vector arithmetic to investigate word relationships, visualize embeddings using dimensionality reduction techniques	Apply
CO4	Apply the fundamentals of Stable Diffusion and other generative tools to create images and videos	Apply
CO5	Apply prompt engineering skills to real-world scenarios, such as information retrieval, text generation.	Apply

### iii. SYLLABUS

Overview of Classical Machine Learning and Artificial Intelligence

Difference between Gen AI and other types of AI, advantages, and disadvantages of Gen AI technologies Foundational Language Models Retrieval Augmented Generation RAG Frame work Generative Text and Speed Models Generative Image models Prompt Engineering.

#### iv. a TEXTBOOKS

1. Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4, by Valentina Alto, Packt Publishing Ltd, 2023.

2. Generative AI for Cloud Solutions: Architect modern AI LLMs in secure, scalable, and ethical cloud environments, by Paul Singh, Anurag Karuparti ,Packt Publishing Ltd, 2024

#### b. REFERENCES

1. Foster, D. (2023). Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play (2nd ed.). O'Reilly Media. ISBN: 978-1-098-13418-1.
2. Tunstall, L., von Werra, L., & Wolf, T. (2022). *Natural Language Processing with Transformers: Building Language Applications with Hugging Face*. O'Reilly Media. ISBN: 978-1-098-10324-8

#### v. COURSE PLAN

Module	Contents	No. of hours
I	Overview of Classical Machine Learning and Artificial Intelligence Data Types and State of the Art models Tabular Data - Gradient Boosted Models Image Data - Convolutional Neural Networks Sequential and Time Series Data - Recurrent Neural Networks Text and Speech Data - Transformers Generative AI- GPT class of Models for Text, Diffusion for Images/Video Difference between Gen AI and other types of AI, advantages, and disadvantages of Gen AI technologies	12
II	Foundational Language Models LLAMA3 Instruct 8B / 70B. LLAMA3 Chat, LLAMA3 code, E5 embedding ,MIXTRAL 8X7B , SLMs (PHI3, bitNet B1.58) LLM fine tuning -Para Efficient Fine tune (LORA, P tuning, fine tuning of embedding models) Retrieval Augmented Generation Alignment- RLHF, DPO. RPO. RAGs -Advanced ingestion, Chunking, Embedding, Search. Ranking, Generation. Evaluation, RAG frameworks LLANGCHAIN basics, LLAMAINDEX ,LLANGRAPH	12
III	Generative Text and Speech Models Tokenization Fundamentals and Byte Pair Encoding, GPT class of models to Generate Text, Training GPT Models, Speech Models, Interacting with Trained Models	12
IV	Generative Image models Stable Diffusion Fundamentals, Image and Video Generation, Tools for Generating Images. Gen AI Use cases	12
V	Agentic AI, Retrieval Augmented Generation, and Advanced Prompt Engineering Vector Data Base, Lang Chain with RAG and LLM Agents, Advanced Prompting Strategies (e.g., CoT, ReAct, DSP)	12

	Basic Prompting to Build AI Applications, Hosting GenAI	
	Total	60

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTB40B	Software Engineering	PCC	3	0	2	0	4	2023

### i. COURSE OVERVIEW

This course contains fundamental knowledge in the Software Development Process including Software development, Object Oriented Design, Project Management concepts, quality assurance and technology trends and to enable the learners to apply state of the art industry practices in Software development. To equip students with both theoretical knowledge and practical skills in software development, from requirements to deployment by applying tools and techniques such as UML, testing frameworks, and Agile practices through hands-on projects and labs.

### ii. COURSE OUTCOMES

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

CO 1	Apply principles of requirements engineering process and develop requirements specification documents.	Apply
CO 2	Model software systems using UML diagrams, architectural styles, and component-level models.	Apply
CO 3	Apply testing and maintenance strategies on the developed software product to enhance quality.	Apply
CO 4	Make use of software project management concepts while planning, estimation, scheduling, tracking and change management of a project, with a traditional/agile framework.	Apply
CO 5	Explain SQA practices, Process Improvement techniques and Technology advancements in cloud-based software models and containers & microservices	Understand

### iii. SYLLABUS

**Process Models and Requirements Engineering** - Software engineering, Software characteristics and types, Layers of Software Engineering-Process, Methods, Tools and

Quality focus. Software Process models –Requirement engineering process.Development of requirement specification documents.

**Design concepts** –Architectural Styles, UML diagrams and relationships–Designing Class-Based Components, Conducting Component level design.

**Coding, Testing and Maintenance:** Coding guidelines - Code review, Code walkthrough and Code inspection, Code debugging and its methods. Testing - Unit testing , Integration testing, System testing and its types, Black box testing and White box testing, Regression testing. Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD)

**Software Project Management** - Project size metrics – LOC, Function points and Object points. Cost estimation using Basic COCOMO. Risk management: Software Project Management Software Configuration Management and its phases, Kanban methodology and lean approaches.

**Software Quality Management** – ISO 9000, CMM, Six Sigma for software engineering. Cloud-based Software -Virtualization and containers, Everything as a service (IaaS, PaaS), Software as a service. Microservices Architecture - Microservices, Microservices architecture, Microservice deployment.

#### iv. a TEXTBOOKS

1. Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015.
2. Roger S. Pressman, Software Engineering: A practitioner’s approach, McGraw Hill publication, Eighth edition, 2014
3. Ian Sommerville, Engineering Software Products: An Introduction to Modern Software Engineering, Pearson Education, First Edition, 2020.

#### b REFERENCES

1. Pankaj Jalote, Pankaj Jalote’s Software Engineering: With Open Source and GenAI Wiley India 1/e, 2024
2. A Primer Waman S Jawadekar Tata, Software Engineering: McGraw-Hill 1/e, 2008
3. Michael Blaha, James Rumbaugh, Object-Oriented Modeling and Design with UML, Pearson Education 2/e, 2007
4. Yingux Wang, Software Engineering Foundations : A Software Science Perspective Auerbach Publications 1/e, 2008.

**v. COURSE PLAN**

<b>Module</b>	<b>Contents</b>	<b>No. of hours</b>
<b>I</b>	Introduction to Software Engineering and Process Models - Software engineering, Software characteristics and types, Layers of Software Engineering-Process, Methods, Tools and Quality focus. Software Process models – Waterfall, Prototype, Spiral, Incremental, Agile model – Values and Principles. Requirement engineering - Functional, Non-functional, System and User requirements. Requirement elicitation techniques, Requirement validation, Feasibility analysis and its types, SRS document characteristics and its structure. Case study: SRS for College Library Management Software, Developing use cases, Personas, Scenarios, User stories, Feature identification. Overview of AI in SDLC .AI-Assisted Requirement Analysis	9
	Laboratory experiments Develop a Software Requirement Specification (SRS) for a hospital management system.  Develop Use Case diagrams, personas, scenarios and user stories for a banking software system.	6
<b>II</b>	Design concepts – Design within the context of software engineering, Design Process, Design concepts, Design Model, Architectural Styles, UML diagrams and relationships– Static and dynamic models, Class diagram, State diagram, Use case diagram, Sequence diagram. Component level design - What is a component?, Designing Class-Based Components, Conducting Component level design, Component level design for web-apps. AI-Assisted Design Generation.u	9
	Laboratory experiments: Create an Activity Diagram and Class Diagram for a library management system using UML tools.	4
<b>III</b>	Coding, Testing and Maintenance: Coding guidelines - Code review, Code walkthrough and Code inspection, Code debugging and its methods. Testing - Unit testing , Integration testing, System testing and its types, Black box testing and White box testing, Regression testing Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD), Case study – Netflix. Software maintenance and its types-	9

	Adaptive, Preventive, Corrective and Perfective maintenance. Boehm's maintenance models (both legacy and nonlegacy). AI-Assisted Coding and Testing Tools	
	Perform white-box and black-box testing on a user registration form. Develop test cases for a simple calculator application. Implement unit testing using JUnit or PyTest for a small module	<b>6</b>
<b>IV</b>	Software Project Management - Project size metrics – LOC, Function points and Object points. Cost estimation using Basic COCOMO. Risk management: Risk and its types, Risk monitoring and management model Software Project Management - Planning, Staffing, Organizational structures, Scheduling using Gantt chart. Software Configuration Management and its phases, Kanban methodology and lean approaches	<b>9</b>
	Laboratory experiments: Simulate a collaborative project where multiple students contribute using GitHub or GitLab	<b>8</b>
<b>V</b>	Software Quality Management – ISO 9000, CMM, Six Sigma for software engineering. Cloud-based Software -Virtualisation and containers, Everything as a service (IaaS, PaaS), Software as a service. Microservices Architecture - Microservices, Microservices architecture, Microservice deployment. Concept of Agentic AI. Agentic AI in Software Engineering Workflows.	<b>9</b>
	Create a project schedule for a Library Management System using WBS, PERT estimation, Gantt chart, and Critical Path Method. Design and develop a Student Attendance Management System by applying all phases of the Software Development Life Cycle (SDLC).	<b>6</b>
	<b>Total</b>	<b>75</b>

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 60: 40

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
Assessment of Lab Work	: 10 marks
Lab Exam	: 10 marks
<b>Total Continuous Assessment</b>	<b>: 60 marks</b>

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<b>End Semester Examination</b>	<b>:</b>	<b>40 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100</b>

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 40
- Exam Duration: 2 hours

**PROGRAMME ELECTIVE III**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CSL43A	Internet of Things	PEC	2	1	0	0	3	2023

**i. COURSE OVERVIEW**

This course equips the learners with fundamental of the Internet of Things (IoT) and the IoT ecosystem. It covers the architecture of IoT, communication mechanisms, protocols, hardware, software, data analytics, and the cloud platforms for IoT. This course enables the students to design smart IoT applications for real world problems using Raspberry Pi.

**ii. COURSE OUTCOMES**

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

Course Outcomes	Description	Level
CO 1	Describe the fundamentals of IoT and its underlying physical and logical architecture.	Understand
CO 2	Illustrate the hardware architectures for IoT.	Understand
CO 3	Explain the Network architectures for IoT.	Understand
CO 4	Implement data analytics on the IoT platforms.	Apply
CO 5	Interpret the security considerations in IoT.	Understand
CO 6	Implement IoT applications using the available hardware and software.	Apply

**iii. SYLLABUS****Module 1: IoT Architecture**

Introduction to IoT – Genesis, Digitization, and Impact. Convergence of IT and IoT. IoT challenges and network architectures. Core IoT functional stack. IoT data management and compute stack.

**Module 2: Engineering IoT Networks**

Smart objects and IoT components – sensors, actuators, and networks. Connecting smart objects. Communication criteria and IoT access technologies.

**Module 3: IoT Network Layer**

Role of IP in IoT networks. IP optimization and compliance. IoT transport and application protocols. IoT application transport methods.

**Module 4: Data Analytics for IoT**

IoT data analytics and machine learning. Big data and edge analytics. Network analytics and IoT security. IT vs. OT security practices. Risk analysis frameworks – OCTAVE, FAIR.

**Module 5: Developing IoT Systems**

IoT system design using Python. Raspberry Pi interfaces and programming. IoT devices and cloud integration. Cloud storage models, WAMP, Django, and RESTful APIs for IoT applications.

**iv. a TEXT BOOKS**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint).
2. Arshadeep Bahga, Vijay Madiseti, "Internet of Things: A hands-on approach", University Press, 2015 (First edition)

**b. REFERENCES**

1. Rajkamal, "Internet of Things: Architecture and Design Principles", McGraw Hill (India) Private Limited
2. Dieter Uckelmann, Mark Harrison, Michahelles Florian (Ed.), Architecting the internet of things, Springer, 2011
3. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
4. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw Hill Publications.

**v. COURSE PLAN**

Module	Contents	Hours
I	<b>IoT Architecture</b> What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	9
II	<b>Engineering IoT Networks</b> Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, IoT Access Technologies –IEEE 802.15.4 (g/e), 1901.2a, IoT Access Technologies - 802.11ah, LoRaWAN, IoT Access Technologies – LoRaWAN, NBIoT, LTE.	9
III	<b>IoT Network Layer</b> IP as the IoT Network Layer, The Business Case for IP, the need for Optimizing IP for IoT, Optimizing IP for IoT, Profiles, and Compliance, Application Protocols for IoT – CoAP, Application Protocols for IoT – MQTT, The Transport Layer, IoT Application Transport Methods, The Transport Layer, IoT Application Transport Methods.	9
IV	<b>Data Analytics for IoT</b> An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, A Brief History of OT Security, Common Challenges in OT Security, Differences between IT and OT Security Practices and Systems, Formal Risk Analysis Structures: OCTAVE and FAIR.	9
V	<b>Developing IoT Systems</b> IoT Logical Design using Python, IoT Physical Devices and Endpoints, Raspberry Pi interfaces, Programming Raspberry Pi using Python, Other IoT devices, Cloud Storage Models, WAMP-Autobahn for IoT, Django, Designing RESTful Web API, Cloud Web Services for IoT	9
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

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Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
<b>23CSL43E</b>	<b>HUMAN COMPUTER INTERACTION</b>	<b>PEC</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>2023</b>

### i. COURSE OVERVIEW

This course provides an overview of Human-Computer Interaction (HCI), with an understanding of user interface design in general. The course covers topics which include user-centered design, human cognitive and physical abilities, prototyping and evaluation techniques, graphical design fundamentals and emerging areas of HCI research including mobile interaction, augmented-reality and ubiquitous computing. This course helps the learners to design and evaluate interactive systems by following the fundamental principles of human-computer interaction.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Demonstrate the usability based on a variety of classic universal user-centric models.	Understand
CO 2	Summarize the different interaction styles and the methodologies for designing interactive systems.	Understand
CO 3	Interpret the core and complex user experience design issues.	Understand
CO 4	Identify the evaluation methodologies of interactive system design.	Apply
CO 5	Make use of the different contexts and suggest suitable designs for applications related to web, mobile and wearable computing.	Apply

### iii. SYLLABUS

Human-Computer Interaction (HCI) focuses on designing interactive systems that enhance user experience through understanding user cognition, ergonomic principles, and user-centered approaches. It emphasizes usability goals, universal usability for diverse users—including older adults, children, and those with disabilities—and addresses cultural and personality differences. HCI integrates guidelines, principles, and design theories alongside frameworks, prototyping methods, and interaction styles like direct manipulation, immersive environments, and expressive human-command languages. It also explores models of collaboration, system response times, frustrating experiences, and information search strategies. Cognitive models such as GOMS help in understanding user behavior, while various evaluation methods, including usability testing and heuristic evaluation, ensure design effectiveness. Furthermore, HCI encompasses the development of apps and websites, considering information architecture and social media integration, and extends into collaborative environments, AI interface agents, and

pervasive technologies like mobile and wearable computing, emphasizing smart materials and material design for seamless user interaction.

#### iv (a) TEXT BOOKS

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist *Designing the User Interface: Strategies for Effective HumanComputer Interaction*, Sixth Edition, Pearson Education, 2017.
2. Preece, J., Sharp, H., Rogers, Y., *Interaction Design: Beyond Human-Computer Interactio*, Fifth Edition, Wiley, 2019.
3. David Benyon, *Designing User Experience: A guide to HCI, UX and interaction design*, 4th Edition, Pearson, 2018.

#### (b) REFERENCES

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, *Human Computer Interaction*, Third Edition, Prentice Hall, 2004. 2.
2. The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech 3.
3. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, *Research Methods in HumanComputer Interaction*, Wiley, 2010. 4.
4. Samit Bhattacharya, *Human-Computer Interaction: User-Centric Computing for Design*, McGraw-Hill India, 1st Edition, 2019.

#### v. COURSE PLAN

Module	Contents	Hours
I	<b>Introduction to HCI and Usability</b> Introduction- - Components of Interaction – Ergonomics Designing Interactive systems – Understanding Users cognition and cognitive frameworks, User Centered approaches, Usability goals and measures, Universal Usability-Diverse Cognitive and Perceptual abilities, Personality differences, Cultural and International diversity, Users with disabilities- Older Adult users and Children. Guidelines, Principles and Theories.	8
II	<b>Design Process and Interaction Styles</b> HCI patterns, Design frameworks, Design methods, Prototyping. Understanding interaction styles - Direct Manipulation and Immersive environments, Fluid navigation - Navigation by Selection, Small Displays, Content Organization, Expressive Human and Command Languages-Speech Recognition, Traditional Command Languages, Communication and Collaboration-Models of Collaboration, Design considerations.	8
III	<b>User Experience Design</b> Frameworks for User Centric Computing, Computational models of users, Advancing the User Experience- Display Design, View (Window) Management, Animation, Webpage Design, Color. Timely user Experience- Models of System Response Time (SRT) Impacts, Frustrating Experiences,	9

	Information Search- Five Stage Search Framework, Data Visualization-Tasks in Data Visualization, Challenges	
<b>IV</b>	<b>Cognitive Systems and Evaluation of HCI</b> Cognitive Models- Goal and task hierarchies, GOMS Model. Introducing Evaluation Types of Evaluation, Other Issues to Consider When Doing Evaluation. Conducting Experiments. Usability testing – Heuristic evaluation and walkthroughs, Analytics and predictive models.	<b>10</b>
<b>V</b>	<b>Contexts for Designing UX</b> Designing apps and websites – Website and app development, The information architecture of apps and websites. Social media -Social Networking, Sharing with others. Collaborative environments- Issues for cooperative working, Technologies to support cooperative working, AI and Interface Agents, Ubiquitous computing -Blended Spaces. Mobile Computing – Designing for Mobiles. Wearable Computing- Smart Materials, Material Design.	<b>10</b>
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL43A	Computer Vision	PEC	2	1	0	0	3	2023

### i COURSE OVERVIEW

This course introduces the foundational principles of computer vision, covering how images are formed, represented, filtered, and analysed. Students learn techniques for feature detection, segmentation, and object recognition, along with essential methods for motion analysis in dynamic scenes. The course then advances to deep learning models used in modern vision tasks, including classification, detection, and segmentation architectures. Learners explore practical applications such as image editing, super-resolution, 3D object generation, tracking, and automated captioning. The course concludes with emerging topics like zero-shot learning, few-shot learning, and self-supervised approaches that shape the future of vision systems.

### ii. COURSE OUTCOMES

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

CO1	Explain the fundamental concepts, principles, and working mechanisms of Computer Vision systems.	Understand
CO2	Apply feature extraction, segmentation, and object detection techniques for image analysis.	Apply
CO3	Apply motion patterns using optical flow, tracking, background modeling, and other motion analysis methods.	Apply
CO4	Develop and evaluate deep learning models tailored for various computer vision applications.	Apply
CO5	Develop complete computer vision solutions for real-world applications and explore recent trends such as zero-shot and self-supervised learning.	Apply

### iii. SYLLABUS

Basics of Computer Vision, Image Formation-Image Representation.  
 Image Analysis, Features & Object Detection, Image Segmentation, Feature matching.  
 Motion Analysis - Background Subtraction and Modeling-Optical Flow- KLT- Spatio-Temporal Analysis-Dynamic Stereo- Motion  
 Deep Learning models for Computer Vision  
 Applications and recent trends in Computer Vision

**iv a) TEXTBOOKS**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", 2016.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2010.
3. Simon Prince, "Computer Vision: Models, Learning, and Inference", 2012.
4. Adrian Kaehler, Gary Bradski, "Learning OpenCV 3", 2017

**b) REFERENCES**

- 1) Yoshua Bengio, Learning Deep Architectures for AI, 2009.
- 2) David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.
- 3) Michael Nielsen, Neural Networks and Deep Learning, 2016.
- 4) Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004
- 5) Fei-Fei Li – CS231n Lecture Notes (CNNs & Deep Learning for Vision)

**v. COURSE PLAN**

Module	Contents	No. of hours
I	Basics of Computer Vision Introduction to Computer Vision: Importance, applications, challenges, Computer Vision vs Image Processing vs Graphics - Image Formation-Image Representation-Linear Filtering-Image in frequency domain- Image Sampling.	7
II	Image Analysis, Features & Object Detection Feature detection - Feature descriptors - SIFT and its variants- Feature matching - Edge detection - Image Segmentation: Graph-based segmentation, Mean shift, and Normalized cuts.	9
III	Motion Analysis Background Subtraction and Modeling-Optical Flow- KLT- Spatio-Temporal Analysis-Dynamic Stereo- Motion	9
IV	Deep Learning models for Computer Vision Object Classification-VGGNET, RESNET, ALEXNET, DENSENET, EFFICIENT NET, MOBILENET, INCEPTION V3, Object Detection-R-CNN, F-RCN, SSD, Retinanet, YOLO, CornerNet, Image Segmentation- UNet, SegNet, Mask-RCNN, Attention Models-Transformers	11
V	Applications and recent trends in Computer Vision Applications- Image Editing, Inpainting, Superresolution, 3D Object Generation, Security, Surveillance-Object Tracking-Automatic Image Captioning. Recent Trends- Zero-shot, One-shot, Few-shot Learning-Self-supervised Learning and Reinforcement Learning in Vision	9
	Total	45

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL43B	DATA ENGINEERING	PEC	2	1	0	0	3	2023

### i COURSE OVERVIEW

This course provides a comprehensive foundation in the data engineering lifecycle, focusing on the practical transition from raw data ingestion to scalable storage and processing architectures. Students will apply modern dimensional modelling and distributed computing frameworks to build resilient, high-throughput data pipelines. Students will be equipped to implement end-to-end automated workflows that integrate data quality, security, and governance within cloud-native environments.

### ii COURSE OUTCOMES

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

CO1	Illustrate the data engineering lifecycle and examine the trade-offs between different cloud-native storage and scalability strategies.	Understand
CO2	Apply dimensional modelling techniques to implement relational and NoSQL database schemas for structured and semi-structured data	Apply
CO3	Develop automated ETL/ELT pipelines using orchestration tools like Apache Airflow for dependency management.	Apply
CO4	Apply distributed processing frameworks to optimize data throughput and implement real-time stream processing solutions.	Apply
CO5	Make use of data quality checks and apply encryption and access control measures to ensure regulatory compliance.	Apply

### iii SYLLABUS

Core Foundations & Cloud Infrastructure Data Engineering Lifecycle, Ingestion-to-Serving, Cloud Platforms (AWS/GCP/Azure), Horizontal vs. Vertical Scalability, Distributed File Systems (S3/HDFS), Serverless Architectures, Load Balancing.

Storage Systems & Data Modeling Polyglot Persistence, Relational Tuning (PostgreSQL), NoSQL Ecosystems (MongoDB, Cassandra, Redis), Dimensional Modeling, Star & Snowflake Schemas, Data Warehousing (Redshift, Snowflake), OLAP vs. OLTP.

Pipeline Engineering & Orchestration ETL vs. ELT Paradigms, Data Ingestion Tools (NiFi, Talend), Workflow Automation, Apache Airflow, Dependency Management, Data Lineage, Metadata Governance.

Distributed Processing & Streaming Batch vs. Stream Processing, Apache Spark (In-memory computing), MapReduce Fundamentals, Apache Kafka, Real-time Event Streaming, Partitioning & Performance Tuning.

Data Quality, Security & Compliance Data Profiling & Cleansing, Automated Testing for Data, Encryption (At-rest/In-transit), Access Control (IAM), Regulatory Compliance (GDPR/HIPAA), DataOps Practices.

#### iv a) TEXTBOOKS

1. Reis, Joe, and Matt Housley. Fundamentals of Data Engineering. 1st Edition, O'Reilly Media, 2022.
2. Kleppmann, Martin. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems. 1st Edition, O'Reilly Media, 2017.

#### b) REFERENCES

1. Kimball, Ralph, and Margy Ross. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling. 3rd Edition, Wiley, 2013.
2. Chambers, Bill, and Matei Zaharia. Spark: The Definitive Guide: Big Data Processing Made Simple. 1st Edition, O'Reilly Media, 2018.

#### v COURSE PLAN

Module	Contents	No. of hours
I	<b>Concepts:</b> Evolution of Data Engineering, the Data Engineering Lifecycle (Ingestion to Visualization), <b>Comparison:</b> Differentiating Data Engineering vs. Data Science vs. Data Analytics, <b>Infrastructure:</b> Introduction to Cloud Computing (AWS, Azure, GCP) and Serverless paradigms, Storage Foundations: Distributed File Systems (HDFS, Amazon S3, Google Cloud Storage), <b>Performance Concepts:</b> Scalability (Horizontal vs. Vertical), Partitioning, Sharding, and Load Balancing.	8
II	<b>Advanced Data Storage &amp; Modelling</b> Relational Systems: Normalization, Schema Design, and Database Tuning (PostgreSQL/MySQL). <b>NoSQL Ecosystem:</b> Key-value (Redis), Document (MongoDB), and Column-family (Cassandra/HBase) databases. <b>Data Warehousing:</b> OLAP vs. OLTP, Data Marts, Dimensional Modeling (Star and Snowflake Schemas). <b>Modern Warehousing:</b> Introduction to Snowflake and Amazon Redshift.	10
III	<b>Data Integration and ETL/ELT Pipelines</b> <b>Pipeline Architecture:</b> Extraction from structured/unstructured sources; Transformation and Loading (ETL vs. ELT). <b>Orchestration:</b> Workflow automation, scheduling, and dependency management using Apache Airflow.	9

	<b>Tools:</b> Overview of Apache NiFi and Talend for data ingestion. <b>Data Governance:</b> Metadata management, data lineage, and data profiling strategies.	
<b>IV</b>	<b>Distributed Data Processing</b> Computing Paradigms: Batch vs. Stream Processing. <b>Big Data Frameworks:</b> MapReduce fundamentals and Parallelism. <b>Apache Spark:</b> In-memory computing, Spark SQL, and Data frames for scalable processing. <b>Real-time Streaming:</b> Introduction to Apache Kafka and Stream processing concepts. <b>In-Memory Tools:</b> Using Redis and Memcached for high-performance data retrieval.	<b>10</b>
<b>V</b>	<b>Security, Quality, and Emerging Trends</b> Data Quality: Automated testing frameworks, validation, and cleansing strategies. Security: Data encryption (at rest and in transit), masking, and access control (IAM). <b>Compliance:</b> Understanding GDPR and HIPAA in the data domain. <b>Trends:</b> DataOps practices, Machine Learning integration (MLOps), and Microservices in data architectures. <b>Case Study:</b> Designing a complete end-to-end pipeline for E-commerce or Healthcare.	<b>8</b>
	<b>Total</b>	<b>45</b>

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment

Attendance : 5 marks

Assignments : 15 marks

Assessment through Tests : 20 marks

**Total Continuous Assessment : 40 marks**

**End Semester Examination : 60 marks**

**TOTAL : 100 marks**

#### vii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

#### viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTL43C	AI FOR CYBERSECURITY	PEC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

This course introduces the integration of Artificial Intelligence (AI) and Machine Learning (ML) techniques in strengthening cybersecurity mechanisms. It focuses on how AI models can enhance threat detection, automate response systems, and predict potential security breaches. The course also emphasizes the ethical and legal considerations surrounding the use of AI in cybersecurity, encouraging responsible and transparent technology adoption. By the end of this course, students will be able to identify and apply different AI-based security solutions for modern cybersecurity challenges.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the fundamental concepts of Artificial Intelligence, Machine Learning, and their relevance in cybersecurity.	Understand
CO 2	Apply machine learning and anomaly detection techniques to identify and predict cybersecurity threats.	Apply
CO 3	Summarize AI-based intrusion detection and automated threat response mechanisms for enhanced network security.	Understand
CO 4	Identify AI-specific security risks such as adversarial attacks and propose mitigation strategies.	Understand
CO 5	Describe ethical, legal, and future implications of AI adoption in cybersecurity.	Understand

### iii. SYLLABUS

**Introduction to AI and Cybersecurity** – Definition, scope, and types- Historical evolution of AI in technology and security domains- Basics of Machine Learning, Algorithms, Models, Training, Overfitting & Underfitting- Applications , Case Studies, Benefits and Limitations.

**AI Techniques for Security** – Anomaly Detection Techniques, Threat Intelligence and Prediction, Predictive Models for Threat Forecasting, Behavioral Analysis.

**Addressing AI Security Risks** – Designing AI-based Intrusion Detection Systems (IDS)-, Automated Threat Response, Integrating AI Solutions with Existing Security Tools, -Case Studies.

**AI Security Threats and Risks** – AI Security Threats and Risks, Mitigation Strategies, AI Governance.

**Future Trends and Emerging Technologies** - Emerging Technologies in AI-driven Cybersecurity , Future Research Directions in AI for Cybersecurity Case Studies on Next-Generation Security Frameworks, Discussion: The Future of Human–AI Collaboration in Cyber Defense.

### iv (a) TEXT BOOKS

1. Melanie Mitchell, "Artificial Intelligence: A Guide for Thinking Humans", Penguin Books, 2019.
2. Noura Al Moubayed, Pardeep Kumar , "AI in Cybersecurity: Applications, Risks and Challenges" CRC Press, 1/e, 2020.
3. Andreas C. Müller, Sarah Guido Introduction to Machine Learning with Python, O'Reilly Media, 1/e, 2016.
4. Vincent C. Müller , "Ethics of Artificial Intelligence and Robotics", Springer, 1/e, 2020.  
David M. Hawkins , "Anomaly Detection for Monitoring Systems: A Practical Guide", Wiley, 1/e, 2019.  
Michael L. Santarcangelo , " Threat Intelligence: A Practical Guide", Syngress, 1/e, 2020.

#### (b) REFERENCES

1. Ian Goodfellow, Jonathon Shlens, Christian Szegedy, Adversarial Machine Learning, MIT Press 1/e, 2021.
2. Ben Goertzel, Cassio Pennachin, Artificial Intelligence: The Next Generation, Wiley, 1/e, 2020.
3. Chris L. Bader, Patrick W. O'Leary, Behavioral Cybersecurity: The Psychology of Cybersecurity, CRC Press, 1/e, 2021.

#### v. COURSE PLAN

Module	Contents	Hours
I	<b>Introduction to AI and Cybersecurity</b> - Introduction to Artificial Intelligence – Definition, scope, and types (Narrow AI vs. General AI) Historical evolution of AI in technology and security domains-Basics of Machine Learning – Supervised, Unsupervised, and Reinforcement Learning- Key AI Terminologies: Algorithms, Models, Training, Overfitting & Underfitting-Applications of AI in Cybersecurity. Case Studies: Real-world applications of AI for threat detection, malware analysis, and phishing prevention-Benefits and Limitations of AI in Security Context.	9
II	<b>AI Techniques for Security</b> -Anomaly Detection Techniques-Statistical Methods for anomaly detection-Machine Learning Models: Isolation Forest, One-Class SVM, etc. Threat Intelligence and Prediction-Data Collection and Preprocessing-Feature Extraction and Engineering-Predictive Analytics-Building and Evaluating Predictive Models for Threat Forecasting. Case Studies on Threat Intelligence Systems. Behavioral Analysis-Behavioral Profiling and Pattern Recognition-Detecting Anomalies in User/System Behavior.	8
III	<b>Building AI Security Solutions</b> -Designing AI-based Intrusion Detection Systems (IDS)-Types of IDS: Network-based and Host-based-Enhancing Detection with AI Models. Automated Threat Response-Response Strategies and Automation Workflows-Integration with Threat Detection Systems.	9

	Integrating AI Solutions with Existing Security Tools-Compatibility and Effectiveness of Legacy Systems-Case Studies: Implementation of AI-Driven IDS and Threat Response.	
IV	<b>Addressing AI Security Risks</b> -AI Security Threats and Risks-Adversarial Attacks on AI Models-Model Poisoning and Data Privacy Issues. Mitigation Strategies-Securing AI Models from Adversarial Manipulation-Data Protection and Model Validation Techniques. AI Governance-Ethical and Legal Implications of AI in Security-Responsible AI Practices and Compliance Requirements.	9
V	<b>Future Trends and Emerging Technologies</b> : Emerging Technologies in AI-driven Cybersecurity-Deep Learning and Reinforcement Learning in Security-AI in Cloud, IoT, and Edge Security. Future Research Directions in AI for Cybersecurity-Explainable AI (XAI) for Transparency-Quantum Computing and its Security Implications. Case Studies on Next-Generation Security Frameworks. Discussion: The Future of Human-AI Collaboration in Cyber Defense	10
Total Hours		<b>45</b>

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

##### Continuous Assessment

Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

#### vii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

#### viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

**INSTITUTE ELECTIVE II**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42E	Responsible AI	IEC	3	0	0	0	3	2023

**i. COURSE OVERVIEW**

The objective of the course is to know about the responsibility of artificial intelligence (AI) to make AI more useful for society and humanity. The course will also teach principles and practices to perform responsible AI.

**ii. COURSE OUTCOMES**

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

Course Outcomes	Description	Level
1	Explain the sources of bias in AI systems and their impact on fairness.	Understand
2	Develop frameworks for ethical reasoning in AI decision-making processes.	Apply
3	Explain the importance of interpretability in AI models.	Understand
4	Develop real-world case studies on privacy preservation.	Apply
5	Explain the ethical status of AI systems and levels of ethical behavior.	Understand

**iii. SYLLABUS**

Fairness, Bias, and Ethics in AI, Bias sources, fairness (group/individual/counterfactual), AI harms, risks, and case studies.

Ethical Decision Making, Seven Principles of Responsible AI, ethical theories, values, and ART (Accountability, Responsibility, Transparency).

Interpretability and Explainability, Interpretability importance, methods, scope, evaluation, and interpretable models (linear/logistic regression, decision trees).

Privacy Preservation Data privacy, protection methods, privacy-utility balance, differential privacy, federated learning, and case studies.

Responsible AI Ethical reasoning, artificial moral agents, governance, codes of conduct, inclusion, and diversity.

**iv. a TEXTBOOKS**

1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 2019.

**b REFERENCES**

1. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli, "Responsible AI in the Enterprise", Packt Publishing, 2023.
2. Beena Ammanath, "Trustworthy AI", Wiley, 2022.
3. Christoph Molnar "Interpretable Machine Learning". Lulu, 1st edition, 2019.

**v. COURSE PLAN**

Module	Contents	Hours
I	Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis, limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness - AI harms – AI risks: Case Study	<b>11</b>
II	Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI Accountability, Responsibility, Transparency	<b>8</b>
III	Importance of Interpretability and explainability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Model Transparency Techniques – Local and Global Explanation Methods: feature importance, SHAP, LIME) –Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.	<b>10</b>
IV	Introduction to data privacy - Methods of protecting data - Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning - Differential Privacy – Federated Learning – Case Study	<b>8</b>
V	Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity	<b>8</b>
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

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**Continuous Assessment**


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Attendance : 5 marks

Assignments : 15 marks

Assessment through Tests : 20 marks

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**Total Continuous Assessment : 40 marks**

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**End Semester Examination : 60 marks**

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**TOTAL : 100 marks**

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23IEL42F	Prompt Engineering	IEC	3	0	0		3	2023

### i. COURSE OVERVIEW

This course introduces students to the fundamentals of prompt engineering, focusing on designing effective prompts to leverage large language models (LLMs) such as OpenAI's GPT and other generative AI tools. It covers techniques to elicit accurate, creative, and domain-specific responses, manage limitations of LLMs, and apply prompting techniques across various domains, including natural language processing (NLP), creative writing, and problem-solving. By the end of the course, students will have a comprehensive understanding of prompt engineering principles and the ability to design, test, and refine prompts for real-world applications.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the fundamental concepts of Generative AI and prompt engineering.	Understand
CO 2	Develop well-structured prompts to improve response quality and mitigate bias, ambiguity, and redundancy.	Apply
CO 3	Explain advanced prompt engineering techniques to enhance LLM performance and scalability.	Understand
CO 4	Explain ethical challenges, best practices, and emerging trends in prompt engineering to design and deploy responsible and effective AI-driven prompts for real-world applications.	Understand
CO 5	Utilize prompt engineering techniques for domain-specific applications.	Apply

### iii SYLLABUS

Introduction to Generative AI and Prompt Engineering, Introduction to Large Language Models: Architecture, Types of prompts – zero-shot, one-shot, and few-shot prompts. Evaluation Metrics for Prompts: Designing Basic Prompts. Common Pitfalls in Prompt Design. Advanced Prompt Engineering: Dynamic Prompting, Applications of Prompt Engineering: Domain-Specific Prompting: Debugging and Improving Model Responses: Identifying and mitigating model errors. Integrating Prompt Engineering with APIs: Using OpenAI API and other LLM services. Ethical Considerations and Future Directions: Ethical Challenges in Prompt Engineering: Bias mitigation, content filtering, and responsible AI usage. Best Practices for Safe and Reliable Prompt Design.

**iv. a Text Books**

- 1) Smith, John. Prompt Engineering: A Guide to Conversing with AI Models. AI Press, 2024.
- 2) Johnson, Alice. Generative AI and You: Harnessing the Power of Language Models. FutureTech Publications, 2023.

**b REFERENCES**

- 1) OpenAI Team. ChatGPT Prompt Engineering for Developers. Online Guide, 2023.
- 2) Brown, Tom, et al. Language Models are Few-Shot Learners. NeurIPS Proceedings, 2020.
- 3) Patil, Surya, and Henshall, Emily. Practical Prompting for AI Models. Digital Insights Publishing, 2023.

**v. COURSE PLAN**

Module	Contents	Hours
I	<b>Introduction to Generative AI and Prompt Engineering:</b> Overview of Generative AI: Key concepts, types, and applications. Introduction to Large Language Models: Architecture, capabilities, and limitations. Fundamentals of Prompt Engineering: Types of prompts – zero-shot, one-shot, and few-shot prompts. Evaluation Metrics for Prompts: Accuracy, relevance, and user satisfaction.	9
II	<b>Designing Basic Prompts:</b> Structuring Prompts: Clarity, context, and specificity. Techniques for Improving Prompt Responses: Iterative refinement and phrasing. Experimenting with Prompt Styles: Open-ended vs. directive, creative, and instructional prompts. Common Pitfalls in Prompt Design: Bias, ambiguity, and redundancy.	9
III	<b>Advanced Prompt Engineering:</b> Chain-of-Thought Prompts: Step-by-step reasoning for complex queries. Multi-turn Conversations: Maintaining context and coherence over multiple interactions. Role-based Prompts: Using roles to guide LLM behaviour <b>Dynamic Prompting:</b> Using placeholders and templates for scalable applications.	9
IV	<b>Ethical Considerations and Future Directions:</b> Ethical Challenges in Prompt Engineering: Bias mitigation, content filtering, and responsible AI usage. Best Practices for Safe and Reliable Prompt Design. Innovations in Prompt Engineering: Emerging techniques and trends.	9

<b>V</b>	<b>Domain-Specific Prompting:</b> Applications in healthcare, education, customer support, and creative industries. Prompting for Creative Writing: Story generation, poetry, and scriptwriting. Debugging and Improving Model Responses: Identifying and mitigating model errors. Integrating Prompt Engineering with APIs: Using OpenAI API and other LLM services <b>Project: Designing and deploying a prompt for a real-world use case.</b>	<b>9</b>
		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23IEL42G	<b>BUSINESS INTELLIGENCE AND ANALYTICS</b>	IEC	3	0	0	0	3	2023

### i. COURSE OVERVIEW

This course provides a comprehensive understanding of Business Intelligence and Analytics, covering essential concepts, methodologies, and tools used to transform raw data into actionable insights for business decision-making. The course covers both technical aspects and practical application of analytics techniques, including data mining, predictive modeling, and data visualization. By applying these concepts to real-world business scenarios, students will learn how to leverage data for informed decision-making across various domains like marketing, and finance.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Summarize Business Intelligence concepts and the various types of analytics.	Understand
CO 2	Explain fundamental concepts and techniques of data management, including OLTP, relational databases, data warehousing, OLAP, and data mining, and their application in real-world business scenarios.	Understand
CO 3	Utilize data pre-processing, OLAP, and data warehousing methods to design and implement effective data management systems and analytical models for business intelligence.	Apply
CO 4	Explain the principles of classification, clustering, and machine learning techniques and recognize their role in advanced analytics and predictive modeling	Understand
CO 5	Apply data mining techniques to solve business problems.	Apply

**iii. SYLLABUS**

Overview of BIA- drivers of BIA, types of analytics, Technical architecture of BIA, Fundamentals of data management-OnLine Transaction Processing (OLTP), design process of databases, Relational databases, data warehousing, OnLine Analytical Processing (OLAP), data cube, Data Warehousing to Data Mining, Data Mining Concepts and Applications, Architecture of typical data mining system, Data Mining Functionalities, Data Mining Issues, Data pre-processing, overview of data mining techniques

Descriptive analytics and visualization- customer analytics, survival analysis, customer lifetime value, Classification- classification techniques, scoring models, classifier performance, ROC and PR curves, ensemble methods, Cluster analysis- clustering algorithms, cluster quality, Artificial Neural Networks (ANN), Text mining

**iv. a TEXTBOOKS**

1. Ramesh Sharda, Dursun Delen and Efraim Turban, Business Intelligence and Analytics: System for Decision Support, 10th Edition, Pearson Global Edition, 2013
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2013
3. Jiawei Han, Jian Pei, Hanghang Tong, Data Mining Concepts and Techniques, 4th edition, Morgan Kaufmann Publishers, 2022.

**b REFERENCES**

1. Ramesh Sharda, Dursun Delen and Efraim Turban R. Sharda, Business Intelligence: A Managerial Perspective on Analytics, 4th Edition, Pearson, 2017.
2. Wayne Winston and S. Albright, Business Analytics: Data Analysis & Decision Making, 5th Edition, South-Western College Publishing, 2014.
3. Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, First Edition, O'Reilly Media.
4. Rajkumar Buyya, Rodrigo N. Calheiros and Amir Vahid Dastjerdi, Big Data: Principles and Paradigms, Morgan Kaufmann Publishers, 2016.

**v. COURSE PLAN**

Module	Contents	No. of hours
I	Introduction to Business Intelligence & Analytics (BIA)-Overview of BIA, drivers of BIA, types of analytics: descriptive to prescriptive, technical architecture of BIA, Case study	8
II	Data Management Fundamentals-Fundamentals of data management, OnLine Transaction Processing (OLTP), design	9

	process of databases, Relational databases, data warehousing, OnLine Analytical Processing (OLAP), data cube	
III	Data Warehousing to Data Mining, Data Mining Concepts and Applications, Architecture of typical data mining system, Data Mining Functionalities, Data Mining Issues, Data pre-processing, overview of data mining techniques, case study Descriptive analytics and visualization, customer analytics, survival analysis, customer lifetime value, case study	9
IV	Classification- classification techniques, scoring models, classifier performance, ROC and PR curves, Introduction to decision trees, tree induction, measures of purity, tree algorithms, pruning, ensemble methods Clustering- measures of distance, clustering algorithms, K-means and other techniques, cluster quality	10
V	Artificial Neural Networks (ANN)- topology and training algorithms, back propagation, financial time series modelling using ANN Text mining- process, key concepts, sentiment scoring, text mining using R.	9
	<b>Total</b>	<b>45 hours</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42H	Game Development	IEC	3	0	0	0	3	2023

### i. COURSE OVERVIEW

This course introduces the fundamentals of game engines and explores the intricate art of game development. It emphasizes using the Unity platform, enabling students to gain a deeper understanding of programming concepts and the tools used while developing the games.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the fundamentals of game engines and features of Unity IDE required to develop and deploy interactive video games	Understand
CO 2	Develop Scripting code with C# programming language	Apply
CO 3	Develop features of 2D games by using Unity IDE.	Apply
CO 4	Apply techniques to create dynamic audiovisual experiences that enhance gameplay using Unity IDE	Apply
CO 5	Explain the processes to successfully publish video games	Understand

### iii. SYLLABUS

This course covers fundamental game design and C# coding skills such as: Game Engines, Using the Unity framework, C# scripting concepts, Simple Movement and Input, Decisions and Flow Control, Object-Oriented Concepts and Functions, Exceptions and Debugging, Loops and Arrays, Animation and sound effects, User Interfaces, Publishing Games

### iv. a TEXTBOOKS

1. Hands-On Unity 2021 Game Development, Nicolas Alejandro Borromeo , 2nd Edition
2. Learning C# by Developing Games with Unity , Harrison Ferrone, 2021

### b REFERENCES

1. Unity 2021 Shaders and Effects Cookbook, 4th Edition
2. <https://docs.unity3d.com/Manual/UnityManual.html>

### v. COURSE PLAN

Module	Contents	Hours
I	<b>Game Engines</b> – Engine Concepts, Development Tools, Installation of Unity Software, IDE basics, Unity Concepts, Sprites. <b>Introduction to Scripting</b> – C# Language Concepts, Creating Scripts, C# coding Fundamentals, Game Loops and Functions. Data types and Variables, Mathematical Operations, Variable Scope and Access, Displaying Data (Develop Pinball Scoring)	8
II	<b>Simple Movement and Input</b> – Simple Movement of objects, Rotation and Scaling, Easy Input Handling in Unity (Develop the game Alien Dance Squad). <b>Decisions and Flow Control</b> – Logical Expressions, If/Else statements, switch statements. Organizing Game Objects – Parent-Child Objects, Sorting Layers, Tagging Game Objects, Collision Layers. (Develop the game Thunder Road/Mower Dodgeball)	14
III	<b>Object-Oriented Concepts and Functions-</b> Defining Classes, Creating and Using Classes, Defining Functions, Accessing Game Objects, Constructor and Property Functions. (Develop the game Deep Space). <b>Exceptions and Debugging-</b> Run-Time Exceptions, Finding Run-time Errors, Using the Debugger. (Develop the game Bug Hunt)	14
IV	<b>Loops and Arrays</b> -Arrays, for, foreach and while loops. <b>Animation and Sound Effects</b> -Simple Unity Animation, Animator States, Scripting Animations, Animations and Colliders, Adding Sounds to Game Objects, Scripting Sounds. (Develop games Banana Breakout / RoboDash Animation)	14
V	<b>User Interfaces</b> - Unity Buttons, Other UI Controls, UI Design Concepts. (Develop the game Space Creeps Settings) <b>Publishing Games</b> - Splash Screens, Credit Scenes and Icons, Publishing to PC, Mac and Linux Computers, Publishing to Smartphones, Publishing to Game Consoles.	10
<b>Total Hours</b>		<b>45</b>

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment

Attendance : 5 marks

Assignments : 15 marks

Assessment through Tests : 20 marks

**Total Continuous Assessment : 40 marks**

**End Semester Examination : 60 marks**

**TOTAL : 100 marks**

#### vii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTV48A	Comprehensive Viva Voce	PWS	0	0	2	0	1	2023

### ii. COURSE OVERVIEW

The objective of this course is to evaluate the students' basic understanding and application capability in the core domains of their respective engineering branch.

### iii. COURSE OUTCOMES

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

CO1	Apply fundamental concepts from core engineering courses to analyze and solve basic engineering problems relevant to the branch of study.	Apply
CO2	Demonstrate comprehensive technical understanding by articulating engineering concepts, reasoning, and solutions effectively during viva voce examination.	Understand

### iii. SYLLABUS (CSE)

**Data Structures:** Basic Concepts of Data Structures, Arrays and Searching, Linked List and Memory Management, Trees and Graphs, Sorting and Hashing.

**Algorithm Analysis and Design:** Introduction to algorithm analysis, Advanced data structures and graph algorithms, Various algorithm design techniques, Introduction to complexity theory and approximation algorithms.

**Computer Organization and Architecture:** Basic Structure of computers, Register transfer logic, Arithmetic algorithms, Control Logic Design, I/O organization: accessing of I/O devices.

**Operating Systems:** Introduction to Operating Systems, Process Management, Inter Process Communication, Process Synchronization, Memory Management, Storage Management, File System Interface, Virtual machines.

**Database Management Systems:** Introduction to Database and Entity Relationship (ER) Model, Relational Model, Normalization, Physical Data Organization, Transactions, Concurrency Control, Recovery

**Introduction to Artificial Intelligence:** Introduction to artificial intelligence, foundations, history and applications. Intelligent agents and environments, rationality and agent architectures. Problem solving and search techniques including uninformed and informed search. Knowledge representation and reasoning using propositional and first-order logic with inference mechanisms. Search in complex environments including adversarial search, game playing, and constraint satisfaction problems.

**Introduction to Machine Learning and Deep Learning:** Machine learning paradigms, Bayesian foundations and parameter estimation, Regression and regularization techniques, Classification algorithms, Support Vector Machines and kernel methods, Ensemble learning methods, Neural networks and backpropagation, Deep learning architectures (CNN, RNN, LSTM, GRU), Optimization and regularization in deep learning, Applications of machine learning and deep learning in computer vision, speech and NLP.

**iv. a TEXTBOOKS**

1. Prescribed textbooks for the core courses from the first to the sixth semester

**b REFERENCES**

1. Prescribed reference books for the core courses from the first to sixth semester.

**v. COURSE PLAN (CSE)**

Module	Contents	No. of hours
I	Data Structures	4
	Algorithm Analysis and Design	4
II	Computer Organization and Architecture	4
	Operating Systems	4
III	Database Management Systems	4
IV	Introduction to Artificial Intelligence	4
V	Introduction to Machine Learning and Deep Learning	6
	<b>Total</b>	<b>30 hours</b>

**COURSE GUIDELINES AND EVALUATION**

i) The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum. Mock tests, mock viva voce sessions, technical discussions may be conducted by the faculty in charge during the hours assigned for the course.

ii) **Total marks: 50**

**Continuous internal evaluation-25 marks**

Attendance – 5 marks

Multiple choice questions test and comprehensive viva (minimum 2 each) - 20 marks

**Final viva voce examination-25 marks**

The mark will be treated as internal and should be uploaded along with internal marks of other courses.

The final viva voce examination shall be conducted by a panel of two evaluators. The panel shall consist of one senior faculty member from the Department and an expert from Industry/research institute/academia **or** two senior faculty members from the Department.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTJ48A	PROJECT	PWS	0	0	10	0	5	2023

**i. COURSE OVERVIEW** The aim of this course is to apply engineering knowledge in solving practical problems, to foster innovation in design of products, processes or systems, and to develop creative thinking in finding viable solutions to engineering problems. The course is mainly intended to evoke the innovation and invention skills of a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation.

**Desirable:** The project outcome should be published in a peer-reviewed journal or presented at a conference, or a patent application should be filed.

It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

**ii. COURSE OUTCOMES** After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply multidisciplinary knowledge to model and solve real world problems.	Apply
CO 2	Apply innovative and creative problem-solving to develop sustainable and socially relevant products, processes, or technologies.	Create
CO 3	Exhibit effective teamwork and leadership skills in diverse environments, with the ability to comprehend and carry out designated responsibilities.	Apply
CO 4	Execute tasks by planning effectively and utilizing available resources to meet deadlines, while adhering to ethical and professional standards.	Apply
CO 5	Effectively document, present, and communicate technical and scientific outcomes in professional written and verbal formats.	Apply

**iii. Evaluation Guidelines**

Total: 100 marks (Minimum required to pass: **50** Marks).

- Project progress evaluation by guide: **20** Marks.

- Two interim evaluations by the Evaluation Committee: **30 Marks** (15 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: **30 Marks**
- Quality of the report evaluated by the evaluation committee: **20 Marks**

**Interim Evaluation:**

The Evaluation committee comprises of HoD or a senior faculty member, Project coordinator and Project supervisor.

**Final Evaluation:**

The final evaluation committee comprises of Project coordinator, domain expert from the Department and expert from Industry/research/academic Institute / senior faculty from a sister department

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTI48A	INTERNSHIP	PWS	0	0	-	0	5	2023

### i **COURSE OBJECTIVES**

The internship is an integral component of the undergraduate programme aimed at providing students with immersive learning through practical exposure in industry, research organizations, or academic institutions.

#### **BENEFITS OF INTERNSHIP**

##### **Benefits to Students**

- Provides practical exposure to real-world industrial and organizational environments, enabling the application of theoretical knowledge gained in classrooms.
- Enhances professional competencies such as communication, teamwork, time management, interpersonal skills, and workplace ethics.
- Facilitates the development of technical and domain-specific skills, thereby strengthening overall professional readiness.
- Assists students in assessing their career interests and determining the suitability of a particular industry or profession.
- Improves employability by strengthening profiles for placements, higher education, and potential recruitment by the host organization.
- Encourages professional networking and relationship - building with industry experts and peers.
- Offers an opportunity to evaluate the organization and work culture before committing to full-time employment.

##### **Benefits to the Institute**

- Strengthens industry - academia collaboration.
- Facilitates smoother and more effective placement processes.
- Enhances institutional credibility and brand value.
- Supports student engagement and retention.
- Enables curriculum updates based on industry and student feedback.
- Improves the overall teaching - learning process through industry relevance.

##### **Benefits to the Industry**

- Provides access to a pool of motivated, job-ready students who can contribute immediately.
- Offers a cost-effective mechanism to evaluate and recruit potential employees.
- Enables the availability of a flexible workforce for temporary, project-based, or seasonal requirements.
- Brings fresh perspectives and innovative approaches to problem-solving.
- Enhances organizational visibility and employer branding within academic institutions.
- Strengthens corporate image by contributing to education and skill development.

**TYPES OF INTERNSHIPS**

- Industry Internship with/without Stipend
- Government / PSU Internship (BARC/Railway/ISRO etc.)
- Internship with prominent education/ Research Institutes
- Internship with Incubation centres /Start-ups

**ii. COURSE OVERVIEW**

Students can undertake an internship at an industry, research organization, or a reputed academic institution with prior approval of the respective Head of the Department. Each student shall be assigned a faculty guide/supervisor for monitoring and evaluation. The internship shall be relevant to the student's stream of study and can be carried out in Semester **VII** or Semester **VIII**, as specified by the Department, for a minimum duration of **three months**.

A student shall be permitted to undertake the internship only after the respective semester registration. During the internship period, any other courses or academic activities shall be pursued in online mode or as specified by the Department, to ensure timely fulfillment of all academic requirements.

On successful completion of the internship, students are expected to demonstrate improved technical competence, professional conduct, and the ability to address practical problems in their chosen field.

**iii. COURSE OUTCOMES**

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

CO1	Apply theoretical knowledge and engineering principles to practical problems encountered in professional practice.	Apply
CO2	Demonstrate technical competence and understanding of tools, techniques, and processes relevant to the chosen field of specialization.	Apply
CO3	Analyse social, environmental, economic, safety, and administrative factors influencing industrial operations and decision-making processes.	Analyze
CO4	Communicate effectively through technical reports, presentations, and professional interactions in an industrial or research environment.	Apply
CO5	Apply professional ethics, teamwork, and adaptability while performing assigned tasks in a multidisciplinary work setting.	Apply

**iv. GUIDELINES FOR STUDENTS**

- Duration of internship is three to six months (One semester).
- Students may undertake mini projects, case studies, or related technical tasks during the internship with the prior approval of the competent authority at the host organisation.
- Students shall strictly adhere to the rules, regulations, code of conduct, and working hours prescribed by the host organisation.

- Prior permission shall be obtained from the host organisation before using or reproducing any data, documents, drawings, photographs, or proprietary information for academic purposes.
- Students shall follow all ethical practices, confidentiality requirements, and Standard Operating Procedures (SOPs) of the host organisation.
- Students shall comply with all health, safety, and environmental guidelines prescribed by the host organisation during the internship period.
- Students shall maintain regular contact with the assigned faculty guide/supervisor and submit weekly progress updates on the work carried out.
- Each student shall maintain a diary/logbook recording daily activities, learning outcomes, and progress throughout the internship period.
- On completion of the internship, students shall submit the following documents to the Department:
  - ✓ Internship report detailing the work carried out and learning outcomes
  - ✓ Internship Completion Certificate issued by the host organisation
  - ✓ Feedback from the employer
  - ✓ Proof of stipend received, if applicable

#### v. **ASSESSMENT PATTERN**

The marks awarded for the Internship will be based on the following:

- (i) Evaluation done by the industry,
- (ii) Student's diary,
- (iii) Internship report, and
- (iv) Internship viva voce.

<b>Continuous Assessment</b>		
Student's diary/ Daily Log	:	25 marks
Evaluation done by the industry	:	25 marks
<b>Total Continuous Assessment</b>	<b>:</b>	<b>50 marks</b>
<b>Summative Assessment</b>		
Internship Report	:	25 Marks
Internship Viva Voce	:	25 marks
<b>Total Summative Assessment</b>	<b>:</b>	<b>50 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

### **Student's Diary/ Daily Log**

The purpose of maintaining a daily diary is to cultivate systematic documentation habits and to encourage students to record observations, impressions, information gathered and suggestions, if any, during the internship period. The diary shall contain a day-to-day record of activities, learning experiences, technical details, and relevant sketches or drawings related to the work carried out. The daily diary shall be signed regularly by the industry supervisor and shall be verified and ratified by the faculty guide during the interim review.

The interim review shall be conducted midway through the internship by the Internship Review Committee, comprising the internship coordinator, faculty supervisor, and a senior faculty member of the Department. The review may be conducted in online or offline mode, based on the feasibility of the student's physical presence on campus.

### **Internship Report**

On completion of the internship, each student shall prepare and submit a comprehensive internship report to the faculty supervisor. The report shall present a systematic account of the activities undertaken, observations made and knowledge gained during the training period. Students may consult the industry supervisor during the preparation of the final report, subject to compliance with the confidentiality policies and norms of the host organisation. The completed report shall be duly certified and signed by the Industry Supervisor, Faculty guide and the Head of the Department.

The internship report shall be evaluated based on the following criteria:

- Originality and technical content
- Adequacy, clarity and relevance of the written presentation
- Organization, format, use of drawings, sketches, language and overall style
- Variety and relevance of learning experiences documented
- Demonstration of practical applications and linkage with theoretical concepts covered in the curriculum

### **Evaluation done by the industry**

The performance of the student during the internship shall be evaluated by the industry supervisor or the person-in-charge using a prescribed evaluation format provided by the institution. The evaluation shall cover key parameters such as professional behaviour, technical competence, learning ability, initiative, quality of work, communication skills, teamwork, discipline, time management, and overall professional attitude.

The faculty guide shall share the evaluation format with the host organisation and coordinate the assessment process. The completed evaluation form shall be duly signed and sealed by the industry supervisor and submitted to the Department as part of the internship assessment records.

### **Internship Viva Voce**

The viva voce examination shall be conducted by the Internship Review Committee. The committee shall assess the student's understanding of the internship work, technical competence, learning outcomes, and professional orientation.

**MINOR**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTJ4MX	MINIPROJECT	VAC	0	0	6	0	3	2023

**i) COURSE OVERVIEW**

The course encourages students to **apply the concepts, methods, and tools** learned to solve **real-world or socially relevant problems**. The course also emphasizes **innovation, and critical thinking**, encouraging students to explore new ideas and technologies. The mini project topic selected will be assigned to a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. It helps students develop skills in teamwork, project planning, technical documentation, and communication.

**iii) COURSE OUTCOMES**

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

CO 1	Identify real life engineering problems that are socially relevant, technically feasible and economically viable.	Apply
CO 2	Design proper scientific methodology to successfully complete the project	Apply
CO 3	Develop solutions to socially relevant practical problems by applying suitable scientific tools	Apply
CO 4	Evaluate the performance of the developed solution using suitable data analysis, validation techniques, and engineering judgement.	Evaluate
CO 5	Prepare a technical report and present the project outcomes effectively using appropriate engineering and communication tools	Apply
CO6	Build the culture of working effectively in a team, upholding professional and ethical responsibilities	Apply

**ii) COURSE PLAN**

In this course, each group consisting of a maximum of four members is expected to identify a topic of interest in consultation with Faculty-in-charge of mini project, review the literature and gather information pertaining to the chosen topic, state the objectives and develop a methodology to achieve the objectives. Execute experimental procedure, design/fabrication or develop codes/programs or conduct case studies to achieve the objectives. Demonstrate the novelty of the project through the results and outcomes.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is submitted by each student at the end of the semester.

**ASSESSMENT PATTERN**

The final evaluation will be conducted as an internal evaluation based on the level of objectives achieved, the report and a viva-voce examination, conducted by a 3-member committee appointed by Head of the Department offering minor. The committee members shall be HoD or a senior faculty member, Mini project coordinator and project supervisor. The Committee will evaluate the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement. The progress of the mini project is evaluated through a minimum of TWO reviews. At the time of the 1<sup>st</sup> review, students are expected to propose a methodology to achieve the objectives after completing a thorough literature study of the existing systems under their chosen area. In the 2<sup>nd</sup> review students are expected to highlight the implementation details of the proposed solution.

**Mark Distribution:**

Total: 100 marks (Minimum required to pass : 50 Marks).

- Project progress evaluation by guide : 20 Marks.
- Two interim evaluations by the Evaluation Committee : 30 Marks  
(15 marks for each evaluation).
- Final evaluation by the Final Evaluation committee : 30 Marks
- Quality of the report evaluated by the evaluation committee: 20 Marks

## HONOURS

### Honour Basket 1: SECURITY IN COMPUTING

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
23CSL4HA	Cyber Forensics	VAC	3	0	0	3	2023

#### i. COURSE OBJECTIVES:

The course will enable students to understand the fundamental concepts, developments, challenges, and future directions in Cyber Forensics. The course focuses on laws and legal frameworks related to computer crime investigations. The students will be able to study in depth the phases and procedures involved in the forensic investigation process.

#### ii. COURSE OUTCOMES:

After the completion of the course the student will be able to:

CO1	Explain the fundamental concepts, tools, and techniques involved in digital and cyber forensics	Understand
CO2	Understand the laws and legal frameworks related to computer crime investigations.	Understand
CO3	Apply appropriate forensic tools and techniques to collect and preserve digital evidence	Apply
CO4	Apply standard investigation procedures to analyze storage media, networks, and operating systems for forensic evidence.	Apply
CO5	Understand the process of preparing forensic reports and the ethical responsibilities of a forensic investigator.	Understand

#### iii. SYLLABUS

Introduction Computer Investigations, Requirements for forensic lab certification, Data Acquisition, Working with windows and DOS systems, Recovering Graphics Files, Email Investigations, Report writing for high tech investigations.

#### iv. REFERENCES

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christofer Stuart , “Computer Forensics and Investigations”, Second Indian Reprint , Cengage Learning India Private Limited,2009.
2. Eoghan Casey , “Digital Evidence and Computer Crime “, Edition 3, Academic Press, 2011.

**v. COURSE PLAN**

<b>Module</b>	<b>Contents</b>	<b>No. of hours</b>
I	Introduction to Digital Forensics, Developing Digital Forensics Resources, Understanding Case Law, Understanding Law Enforcement Agency Investigations, Procedures for Private-Sector High-Tech Investigations, Understanding Data Recovery Workstations and Software, Determining the Physical Requirements for a Digital Forensics Lab	9
II	Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions	9
III	Working with NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding Virtual Machines, Digital Forensics Software and Hardware Tools, Validating and Testing Forensics Software, Examining Linux File Structures, Understanding Macintosh File Structures	9
IV	Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, recognizing a Graphics File, Understanding Data Compression, Identifying Unknown File Formats, Understanding Copyright Issues with Graphics	9
V	Role of E-mail in Investigations, Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Mobile Device Forensics, Acquisition Procedures for Mobile Devices, Cloud Forensics, Report Writing for High-Tech Investigations, Guidelines for Writing Reports	9
Total Hours		45

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks

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<b>Total Continuous Assessment</b>	<b>:</b>	<b>40 marks</b>
<b>End Semester Examination</b>	<b>:</b>	<b>60 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

### Honour Basket II: COMPUTATIONAL BIOLOGY

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
	Computational Health Informatics	PCC	2	1	0	0	3	2025

#### i. COURSE OVERVIEW

The course introduces the integration of computer science, information science, and healthcare. It focuses on the use of data and algorithms to improve patient health and healthcare delivery.

#### ii. COURSE OUTCOMES

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

CO1	Explain fundamental concepts of Health Informatics, including its evolution, scope, challenges, and the role of healthcare information systems such as HIS, EMR, and EHR.	Understand
CO2	Apply healthcare data standards, medical coding systems, interoperability frameworks, and privacy, security, and ethical issues in health information exchange.	Apply
CO3	Develop an understanding of medical data processing techniques, including clinical data management, biomedical signal processing, imaging informatics, and clinical text analysis using NLP.	Understand
CO4	Apply machine learning and decision support techniques for disease prediction, clinical decision support, precision medicine, and personalized healthcare solutions.	Apply
CO5	Outline the applications in public health informatics, telemedicine, digital health technologies, and national digital health initiatives with special emphasis on the Indian healthcare context.	Understand

#### iii. SYLLABUS

This course provides an introduction to Health Informatics, covering its evolution, scope, challenges, and core healthcare systems such as HIS, EMR, and EHR, along with Health IT architecture models. It explores healthcare standards and interoperability, including medical coding systems (ICD-10/ICD-11, SNOMED CT, LOINC), data exchange standards (HL7, FHIR, DICOM), and issues related to privacy, security, and ethics. The syllabus also addresses medical data processing, clinical and biomedical signals, imaging informatics, and natural language processing of clinical text. Applications of machine learning in healthcare such as predictive modeling, clinical decision support systems, precision medicine, genomics, and personalized care are discussed. Finally, the course highlights public health informatics and digital health initiatives, including telemedicine, mHealth, disease surveillance, population health management, and major Indian programs like NDHM, ABDM, and National Health Authority policies.

## iv. a) TEXTBOOKS

1. Biomedical Informatics: Computer Applications in Health Care and Biomedicine" by Edward H. Shortliffe and James J. Cimino.
2. Health Informatics: A Practical Guide" by Robert E. Hoyt and William R. Hersh."Introduction to Healthcare Information Technology" by Mark Ciampa and Mark Revels.

## v. COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Health Informatics Concepts: Evolution of Health Informatics, scope, and challenges. Healthcare Systems: Hospital Information Systems (HIS), Electronic Medical Records (EMR), Electronic Health Records (EHR). Architecture: Health IT architecture models, service-oriented structures in healthcare.	8
II	Standards and Interoperability Medical Coding: ICD-10/ICD-11 (International Classification of Diseases), SNOMED CT, LOINC. Data Exchange Standards: HL7 (Health Level Seven), FHIR (Fast Healthcare Interoperability Resources), DICOM (for medical imaging). Privacy & Security: HIPAA regulations, ethical issues in data exchange, and patient confidentiality.	10
III	Medical Data Processing Clinical Data: Types of clinical data (structured vs. unstructured), data acquisition, and signal processing (ECG, EEG). Imaging Informatics: Basics of medical imaging (X-ray, CT, MRI), image archival (PACS), and analysis. Natural Language Processing (NLP): Extracting information from clinical notes and narrative reports	10
IV	Machine Learning in Healthcare Predictive Modeling: Disease risk prediction, patient readmission analysis. Decision Support Systems: Clinical Decision Support Systems (CDSS), expert systems in diagnosis. Applications: Precision medicine, genomics data analysis, and personalized treatment plans.	10
V	Public Health & Digital Initiatives Telemedicine: Architecture, mobile health (mHealth), and remote monitoring. Public Health Informatics: Disease surveillance, outbreak tracking, and population health management. Indian Context: National Digital Health Mission (NDHM), Ayushman Bharat Digital Mission (ABDM), and National Health Authority (NHA) policies. Recommended	7
	Total	45

## vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks

<b>Total Continuous Assessment</b>	<b>:</b>	<b>40 marks</b>
<b>End Semester Examination</b>	<b>:</b>	<b>60 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

**Honour Basket III: COMPUTER VISION**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTL4HC	SURVEILLANCE VIDEO ANALYTICS		3	0	0	0	3	2023

**PRE-REQUISITE:** NIL

**i) COURSE OVERVIEW**

This course aims to introduce students to basics of image processing, object detection, face recognition and video analytics

**ii) COURSE OUTCOMES**

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

CO 1	Explain the basics of image processing techniques for computer vision and video analysis.	Understand
CO 2	Explain the techniques used for image pre-processing.	Understand
CO 3	Make use of various deep learning techniques for object detection.	Apply
CO 4	Explain the various face recognition mechanisms.	Understand
CO 5	Illustrate the different deep learning methods for video analytics.	Understand

**iii) SYLLABUS**

Computer Vision – Image representation and image analysis tasks-Local pre-processing – Image smoothing- Object detection–Object detection methods-Face Recognition-Introduction Applications of Face Recognition-Video Processing – use cases of video analytics

**iv) (a) TEXTBOOKS**

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4th edition, Thomson Learning, 2013
2. Vaibhav Verdhhan, 2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress 2021(UNIT-III,IV and V)

**(b) REFERENCES**

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited,2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.

3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.

#### v) COURSE PLAN

Module	Contents	No. of hours
1	Computer Vision – Image representation and image analysis tasks – Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.	9
2	Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection- Parametric edge models - Edges in multispectral images - Local pre-processing in the frequency domain - Line detection by local preprocessing operators - Image restoration.	9
3	Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach- Intersection over Union (IoU) – Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures	9
4	Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition- DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNetGesture Recognition.	9
5	Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem - RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture Improvement in Inception v2-Video analytics-RestNet and Inception v3.	9
Total Hours		45

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

##### Continuous Assessment

Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>

<b>End Semester Examination</b>	<b>:</b>	<b>60 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

# S8 SYLLABUS

**Programme Elective IV**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CSL44A	VIRTUALIZATION	PEC	2	1	0	0	3	2023

**PRE-REQUISITE: Operating Systems(23CSL20D)**

**i. COURSE OVERVIEW**

This course introduces the fundamental concepts and technologies of virtualization that enable efficient utilization of computing resources in modern IT infrastructures. It covers hardware, server, desktop, network, and storage virtualization, along with hypervisors and virtualization architectures. The course also familiarizes students with industry-standard virtualization tools and platforms through practical use cases, preparing them to understand and deploy virtualized environments in data centers and cloud systems.

**ii. COURSE OUTCOMES**

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

Course Outcomes	Description	Level
CO 1	Explain the concept of virtualization and cloud computing, the need for virtualization, its benefits and limitations, and the types of hardware virtualization and hypervisors.	Understand
CO 2	Describe virtual machine basics, server and desktop virtualization approaches, their types, and considerations for selecting virtualization platforms.	Understand
CO 3	Explain the concepts, advantages, functions, and tools of network virtualization, including VLANs and WAN virtualization architectures.	Understand
CO 4	Describe storage virtualization techniques and underlying storage architectures used in virtualized environments.	Understand
CO5	Use industry-standard virtualization tools to configure virtual machines and analyze virtualization solutions through case studies.	Apply

**iii. SYLLABUS**

Introduction to virtualization and cloud computing, including hardware, server, desktop, network, and storage virtualization concepts. Study of hypervisors, virtualization architectures, SAN/NAS/RAID, and enterprise virtualization tools such as VMware, AWS, Hyper-V, VirtualBox, and Google platforms with case studies.

**iv a TEXTBOOKS**

1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter -Cloud computing a practical approach , TATA McGraw- Hill , New Delhi – 2010
2. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach

**b REFERENCES**

1. *Chris Wolf and Erick M. Halter ,Virtualization: From the Desktop to the Enterprise, APress, 2005.*
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski-Cloud Computing (Principles and Paradigms), John Wiley & Sons, Inc. 2011
3. Dan C. Marinescu, *Cloud Computing: Theory and Practice*, Morgan Kaufmann (relevant virtualization foundations).
4. IBM Redbooks, *IBM PowerVM Virtualization*, IBM Corporation.
5. VMware Inc., VMware vSphere Documentation, Official VMware Publications.

Corresponding MOOC course: [https://onlinecourses.nptel.ac.in/noc21\\_cs15/](https://onlinecourses.nptel.ac.in/noc21_cs15/)

**v. COURSE PLAN**

Module	Contents	Hours
I	<b>Introduction to Virtualization:</b> Virtualization and cloud computing – Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization – partial virtualization – Paravirtualization-Types of Hypervisors	8
II	<b>Server and Desktop Virtualization:</b> Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization	10
III	<b>Network Virtualization:</b> Introduction to Network Virtualization- Advantages-Functions-Tools forNetwork Virtualization-VLAN-WAN Architecture-WAN Virtualization	10
IV	<b>Storage Virtualization:</b> Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID	9

<b>V</b>	<b>Virtualization Tools:</b> VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box – IBM PowerVM- Google Virtualization- Case study.	<b>8</b>
Total Hours		<b>45</b>

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

#### vii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

#### viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL44A	REINFORCEMENT LEARNING	PEC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

Artificial intelligence techniques face challenges in learning from dynamic environment with minimal data. This course deals with various algorithms to learn such an environment. Elements of Reinforcement Learning, Model Based Learning, Temporal Difference Learning and Policy Search are the main focus topics of this course. It also enables learners to apply reinforcement learning algorithms on real world applications.

### ii. COURSE OUTCOMES

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

CO1	Explain the basics of Reinforcement Learning	Understand
CO2	Explain the working of Monte Carlo Reinforcement Learning Algorithms	Understand
CO3	Explain the differences of the On policy and Off policy Reinforcement Learning algorithms	Understand
CO4	Explain the working of TD( $\lambda$ ), Actor-Critic, Proximal Policy Optimization (PPO) algorithms	Understand
CO5	Develop Case study implementation of Reinforcement Learning algorithms	Apply

### iii. SYLLABUS

Introduction to Machine Learning and its various types, Motivation and Introduction to Reinforcement Learning, Multi arm Bandits, Markov Decision Process, Value functions, Dynamic programming, Monte Carlo Methods-MonteCarlo Prediction, Monte Carlo Estimation of Action values, Temporal Difference Learning, Eligibility Traces, Policy Approximation-Actor Critic Methods, PPO Algorithm.

#### iv. a TEXTBOOKS

- Richard S. Sutton, Andrew G. Barto, Francis Bach, Reinforcement Learning: An Introduction, 2nd Edition, MIT Press; 2018.
- Laura Graesser, Wah Loon Keng, Foundations of Deep Reinforcement Learning: Theory and Practice in Python, Addison-Wesley; 2022.

#### b) REFERENCES

3. Phil Winder, Reinforcement Learning: Industrial Applications of Intelligent Agents (Grayscale Indian Edition), O'Reilly Media; 2020.
4. Csaba szepesvari, Algorithms for Reinforcement Learning, Morgan & Claypool, 2010, First Edition.

#### v. COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Machine Learning and its various types, Motivation and Introduction to Reinforcement Learning, Multi arm Bandits, Markov Decision Process, Value functions. Dynamic programming: Policy evaluation and improvement, Value iteration and Policy iteration algorithms, Efficiency of Dynamic Programming.	9
II	Monte Carlo Methods-MonteCarlo Prediction, Monte Carlo Estimation of Action values, Monte Carlo Control ,Monte Carlo control without Exploring Starts, Monte Carlo with Exploring Starts Case Study implementation of Monte Carlo algorithms.	8
III	Temporal Difference Learning- TD prediction, Advantages of TD prediction Methods, SARSA, QLearning, Optimality of TD(0). Case study Implementation of Temporal Difference Algorithms	9
IV	Eligibility Traces- The forward view of TD( $\lambda$ ), The Backward View of TD( $\lambda$ ), Equivalences of Forward and Backward Views, Sarsa( $\lambda$ ). Case study implementation of TD( $\lambda$ ) algorithms	9
V	Policy Approximation-Actor Critic Methods, The Advantage Function-Learning the Advantage Function- A2C Algorithm- Implementing A2C. Proximal Policy Optimization (PPO): Surrogate Objective-Proximal Policy Optimization (PPO) – PPO Algorithm Case study implementation of PPO algorithms	10
	Total	45

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

##### Continuous Assessment

Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit
23CTL44B	TIME SERIES ANALYSIS & FORECASTING	PEC	2	1	0	0	3

### i. COURSE OVERVIEW

This course introduces the principles and techniques of time series analysis and forecasting. It covers trend, seasonal, and cyclical components, along with regression-based and smoothing methods. Students learn to model data using ARIMA, VAR, and GARCH processes. Emphasis is placed on practical applications in economics, finance, and engineering for effective decision-making.

### ii. COURSE OUTCOMES

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

CO 1	Explain the fundamental concepts, characteristics, and components of time series data and distinguish them from cross-sectional data.	Understand
CO 2	Use various methods such as moving averages and curve fitting to estimate and analyze trend and seasonal patterns in time series data.	Apply
CO 3	Implement exponential smoothing and linear time series models (AR, MA, ARMA) and evaluate their forecasting performance.	Apply
CO 4	Apply stationarity, perform unit root tests, and apply ARIMA and related models for effective forecasting of real-world data.	Apply
CO 5	Develop multivariate and volatility models (VAR, ARCH, GARCH) to analyze interrelated time series and model dynamic relationships.	Apply

### iii. SYLLABUS

Introduction to Time Series, Difference between cross-sectional and time series data. Basic Concepts of Matrix Algebra and Regression, Simple and multiple regression analysis, Decomposition of Time Series, Methods for Trend Estimation, Visualization and Plotting, Cyclical and Irregular Variations.

Exponential Smoothing Methods, Forecast Error Analysis, Introduction to Stochastic and Time Series Processes, Descriptive Measures, Stationarity and Ergodicity.

Wold Decomposition and General Linear Process, Moving Average (MA) and Autoregressive (AR) Processes, ARMA Models, Parameter Estimation.

ARIMA Models, Unit Root and Stationarity, Fractionally Integrated Models, Frequency Domain Analysis, Spectral density function and its estimation using periodogram.

Seasonal and Multivariate Models, Spectral Analysis for Bivariate and Multivariate Processes, Vector Time Series Models, Causality and Cointegration, Volatility Modelling.

**iv. a) TEXTBOOKS**

1. *Time Series Analysis: Forecasting and Control*, George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, and Greta M. Ljung, **Publisher:** Wiley **Edition:** 5th Edition, 2015.
2. *Applied Econometric Time Series*, Walter Enders, **Publisher:** Wiley, **Edition:** 4th Edition, 2014.

**b) REFERENCES**

1. *Introduction to Time Series and Forecasting*, Peter J. Brockwell and Richard A. Davis, **Publisher:** Springer, **Edition:** 3rd Edition, 2016.
2. *Time Series Analysis and Its Applications: With R Examples*, **Authors:** Robert H., Shumway and David S. Stoffer, **Publisher:** Springer, **Edition:** 4th Edition, 2017.
3. *The Analysis of Time Series: An Introduction*, **Author:** Chris Chatfield, **Publisher:** Chapman & Hall/CRC, **Edition:** 6th Edition, 2016.

**v. COURSE PLAN**

Module	Contents	No. of hours
1	Introduction to Time Series, Difference between cross-sectional and time series data. Basic Concepts of Matrix Algebra and Regression, Simple and Multiple Regression Analysis, Decomposition of Time Series, Methods for Trend Estimation, Visualization and Plotting, Cyclical and Irregular Variations.	10
2	Exponential Smoothing Methods, Forecast Error Analysis, Introduction to Stochastic and Time Series Processes, Descriptive Measures, Stationarity and Ergodicity.	10
3	Wold Decomposition and General Linear Process, Moving Average (MA) and Autoregressive (AR) Processes, ARMA Models, Parameter Estimation.	10
4	ARIMA Models, Unit Root and Stationarity, Fractionally Integrated Models, Frequency Domain Analysis, Spectral density function and its estimation using periodogram.	8
5	Seasonal Time Series Models, Multivariate & Vector Time Series Models, Spectral Analysis for Bivariate & Multivariate Processes, Causality and Cointegration, Volatility Modelling.	7
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment

Attendance : 5 marks

Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
23CTL44C	Cyber Crimes and Digital Forensics	PEC	2	1	0	3	2023

### i. COURSE OBJECTIVES

This course contains fundamental concepts, developments, challenges, and future directions in Cyber Forensics and studies in depth the phases and procedures involved in the forensic investigation process.

### ii. COURSE OUTCOMES

After the completion of the course the student will be able to:

CO1	Explain the fundamental concepts, processes, protocols in cyber forensics	Understand
CO2	Explain appropriate techniques in Disk Forensics	Understand
CO3	Apply appropriate tools and techniques to collect and preserve digital evidence	Apply
CO4	Apply standard investigation procedures to analyse storage media networks for forensic evidence	Apply
CO5	Explain the process of preparing forensic reports and the ethical responsibilities of a forensic investigator.	Understand

### iii. SYLLABUS

Introduction Computer Forensics and Cyber Crimes, Digital Evidence and Data Acquisition, Windows Forensics, Mobile Forensics, Network Forensics, Email Forensics, Malware Forensics, Antiforensics , Report writing for high tech investigations.

#### iv. a TEXT BOOKS

- i. Niranjana Reddy, "Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations", Apress, First Edition 2019.
- ii. Bill Nelson, Amelia Phillips, Frank Enfinger, Christofer Steuart, "Computer Forensics and Investigations", Second Indian Reprint, Cengage Learning India Private Limited, 2009.

#### b REFERENCES

- i. Leighton Johnson, "Computer Incident Response and Forensics Team Management. Conducting a Successful Incident Response", Syngress, First Edition, 2019
- ii. Bill Nelson, Amelia Phillips, Frank Enfinger, Christofer Steuart , "Computer Forensics and Investigations", Second Indian Reprint , Cengage Learning India Private Limited, 2009.
- iii. Eoghan Casey , "Digital Evidence and Computer Crime ", Edition 3, Academic Press, 2011.

**v. COURSE PLAN**

<b>Module</b>	<b>Contents</b>	<b>No. of hours</b>
I	<p>Cyber Forensics - Cyber Crimes, Types of Cyber Crimes, Forensics Investigation Process, Forensic Protocol for Evidence Acquisition, Digital Forensics standards and Guidelines, Digital Evidence – Write blockers, Forensic Triage, Chain of Custody, Challenges in Cyber Forensics</p> <p>Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions</p>	9
II	<p>Windows Forensics – Digital Evidence-Volatile, Nonvolatile Artifacts – MFT, MBR, Registry, Event logs, Configuration files, Application files, Temporary files, Swap files, Data files, Unallocated space Filesystem- FAT32, NTFS, Challenges, Timeline Analysis, Tools</p> <p>Linux File system, Forensic artifacts, Challenges, Differences between Windows and linux from a forensic perspective</p> <p>MacOs-File system, Forensic Process, Forensic Artifacts, Challenges</p>	9
III	<p>Digital Forensics Tools- Software and Hardware Tools, Validating and Testing Forensics Software</p> <p>Mobile Forensics – Acquisition Protocol, Android OS, Rooting an Android device, Android Debug Bridge, Manual Extraction, Physical Acquisition, JTAG, Chip off, Microread, Challenges</p> <p>iOS Operating System- device boot process, Jail break, iOS File system and architecture</p> <p>Familiarization with AI-Powered Tools for Case Analysis</p>	9
IV	<p>Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques</p> <p>Network Forensics: Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools</p> <p>Email Forensics: Protocols used in email communication: SMTP, POP3, IMAP, Email Crimes: Phishing, Spam, Email Harvesting, Email Bombing, Email Forensics- Recovering emails, Email header</p>	9

	analysis	
V	Malware Forensics- Types of malwares, Malware analysis, Tools, Challenges  Antiforensics practices, Data wiping and shredding-Data Remnance, Degaussing, Trial obfuscation – spoofing, data modification, Encryption, Data hiding – steganography, cryptography, Anti-forensics detection techniques  Report Writing for High-Tech Investigations, Guidelines for Writing Reports	9
Total Hours		45

#### vi. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

#### vii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

#### viii. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTL44D	Social network Analysis	PEC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

This course explores the evolution, structure, and applications of social networks in the context of the Semantic Web. It covers fundamental concepts such as social network analysis, ontology-based knowledge representation, and community detection and mining methods. The course also delves into understanding human behavior in social communities, trust and privacy issues in online networks, and various graph-theoretic approaches for analyzing and visualizing social networks. Through theoretical foundations and practical applications, students will gain insights into how social networks function and evolve in a digital environment.

### ii. COURSE OUTCOMES

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

Course Outcomes	Course Outcomes	Level
CO1	Explain the concept of semantic web and related applications.	Understand
CO2	Demonstrate knowledge representation using ontology.	Understand
CO3	Explain the evolution, detection, and characterization of communities in social networks using various methods and tools.	Understand
CO4	Explain human behavior in the social web and related communities.	Understand
CO5	Apply graph theory for visualization of social networks.	Apply

### iii. SYLLABUS

Introduction to the Semantic Web, fundamentals of social network analysis, key measures, electronic discussion networks, blogs, and web-based networks. Role of ontologies in the Semantic Web, ontology-based knowledge representation, ontology languages (RDF, OWL). Web community evolution, detecting and evaluating social network communities, methods and tools for community detection, decentralized online social networks, and multi-relational community characterization. Human behaviour in social communities, Graph theory

concepts, hybrid visualizations, and applications in social and collaboration networks.

#### iv. a TEXTBOOKS

- i) Peter Mika, —Social Networks and the Semantic Web, First Edition, Springer 2007.
- ii) Borko Furht, —Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.

#### b REFERENCES

1. Guandong Xu, Yanchun Zhang, and Lin Li,-Web Mining and Social Networking – Techniques and Applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo,-Social Information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant, and Stefan Decker, -The Social Semantic Web, Springer, 2009.

#### v. COURSE PLAN

Module	Contents	Hours
I	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 – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.	9
II	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 individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.	10
III	Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating	9

	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 – Multi-Relational characterization of dynamic social network communities.	
<b>IV</b>	Understanding and predicting human behavior 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 – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.	<b>8</b>
<b>V</b>	Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	<b>9</b>
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

**PROGRAMME ELECTIVE V**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL45A	Agentic AI and Multi agent Systems	PCC	2	1	0	0	3	2023

**i. COURSE OVERVIEW**

The course covers autonomous agent architectures, multi-agent interaction, and essential knowledge representation methods, including ontologies, actions and events, mental states, and reasoning techniques. The course also explores decision-making under uncertainty using probabilistic models and Bayesian networks, along with foundational learning methods including statistical and reinforcement learning. Overall, it integrates both theoretical understanding and practical applications to develop intelligent, adaptive systems.

**ii. COURSE OUTCOMES**

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

<b>CO1</b>	Explain the principles of agentic systems, architectures, and multi-agent interactions for building intelligent and autonomous systems.	Understand
<b>CO2</b>	Explain ontological, event-based, and category-based reasoning methods used in effective knowledge representation.	Understand
<b>CO3</b>	Apply the concepts of state-space, partial-order, and multi-agent planning in different environments.	Apply
<b>CO4</b>	Apply the principles of uncertainty in intelligent systems, probabilistic reasoning and Bayesian networks for decision-making.	Apply
<b>CO5</b>	Summarise statistical and reinforcement learning methods, communication mechanisms, and formal grammars in the development of intelligent agents.	Understand

**iii. SYLLABUS**

Intelligent agent architectures, fundamentals of multi-agent systems, and core knowledge representation methods, including ontologies, categories, actions and events, mental states, and reasoning techniques such as semantic networks, description logics, and default reasoning. Planning agents are examined through state-space search, partial-order planning, and multi-agent planning in non-deterministic and continuous domains. Decision-making under uncertainty is handled using probability theory, Bayesian networks, temporal models, utility theory, and decision networks. It also explores higher-level agents, statistical and reinforcement learning, communication protocols, formal grammars, and emerging AI trends, integrating theoretical foundations with practical applications.

**iv. a TEXT BOOKS**

1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, Prentice Hall, 2002.
2. Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002.
3. Biswas, Anjanava, and Wrick Talukdar. *Building Agentic AI Systems: Create intelligent, autonomous AI agents that can reason, plan, and adapt*. Packt Publishing Ltd, 2025.

#### b) REFERENCES

1. Patrick Henry Winston, Artificial Intelligence, III Edition, AW, 1999.
2. Nils.J. Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

#### iii SYLLABUS

Intelligent agent architectures, fundamentals of multi-agent systems, and core knowledge representation methods, including ontologies, categories, actions and events, mental states, and reasoning techniques such as semantic networks, description logics, and default reasoning. Planning agents are examined through state-space search, partial-order planning, and multi-agent planning in non-deterministic and continuous domains. Decision-making, probability theory, Bayesian networks, temporal models, utility theory, and decision networks. Higher-level agents, statistical and reinforcement learning, communication protocols, formal grammars, and emerging AI trends, integrating theoretical foundations with practical applications.

#### iv a) TEXTBOOKS

Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, Prentice Hall, 2002.

Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002.

Biswas, Anjanava, and Wrick Talukdar. *Building Agentic AI Systems: Create intelligent, autonomous AI agents that can reason, plan, and adapt*. Packt Publishing Ltd, 2025.

#### b) REFERENCES

Patrick Henry Winston, Artificial Intelligence, III Edition, AW, 1999.

Nils.J. Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992

#### v. COURSE PLAN

Module	Contents	No. of hours
I	<b>Principles of Agentic Systems</b> Understanding self-governance, agency, and autonomy, intelligent agents and their characteristics, architecture of agentic systems- Deliberative architectures, Reactive architectures, Hybrid architectures. Multi-agent systems- Definitions and characteristics, Interaction mechanisms in MASs.	9
II	<b>Knowledge Representation</b> Ontological engineering, Categories and Objects, Actions, Situations. and Events, Mental Events and Mental Objects, Reasoning Systems for Categories- Semantic networks, Description logics, Reasoning with Default Information.	9

III	<b>Planning Agents</b> State Space Search – Forward State Space Research, Backward State Space Research, Heuristics for state-space search. Partial Order Planning – Partial-order planning with unbound variables, Heuristics for partial-order planning. Planning Graphs- The GRAPHPLAN algorithm, Termination of GRAPHPLAN. Planning and Acting in Nondeterministic Domains– Conditional Planning – Continuous Planning – Multi-Agent Planning.	9
IV	<b>Agents and Uncertainty</b> Agents and Uncertainty – Acting Under Uncertainty – Probability Notation – Bayes Rule, Bayesian Networks, Time and Uncertainty – Temporal Models. Utility Theory – Decision Network, Complex Decisions- Decision with Theoretic Agents, Decisions with Multiple Agents.	9
V	<b>Higher-Level Agents</b> Knowledge in Learning – Relevance Information, Statistical Learning Methods- Learning with Hidden Variables: The EM Algorithm, Reinforcement Learning- Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning. Communication – Formal Grammar – Augmented Grammars – Future of AI.	9
	<b>Total</b>	<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTL45B	PRIVACY AND SECURITY IN IOT	PEC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

This course provides an overview of security, privacy, and trust challenges in Internet of Things systems. It examines IoT threat models, attack surfaces, and security mechanisms across devices, networks, and back-end infrastructures. The course also introduces privacy-preserving techniques and trust frameworks, enabling learners to comprehend secure and trustworthy IoT system design in real-world environments.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the phases of IoT systems and major security threats	Understand
CO 2	Apply security mechanisms to mitigate attacks on IoT sensors, RFID, networks, back-end systems, and cyber-physical objects while ensuring data access control and privacy.	Apply
CO 3	Apply light weight cryptography on IoT security problems using	Apply
CO 4	Explain trust, authentication, and privacy frameworks used in Internet of Things systems to support secure access, data protection, and informed consent.	Understand
CO5	Explain IoT security challenges and mechanisms across networking layers, communication links, back-end systems, resource management, databases, and existing security products.	Understand

### iii. SYLLABUS

Phases of IoT systems and interconnected threat models. Security threats in IoT environments including Sybil attacks, malware propagation, and smart home attack vectors. Attack models targeting sensors, RFID, networks, back-end systems, and cyber-physical objects, with emphasis on access control, hardware security, and privacy protection. Privacy preservation techniques for IoT data dissemination, location privacy in Internet of Vehicles, and lightweight privacy schemes for personal IoT applications. Trust models and authentication mechanisms in IoT, computational security, secure routing, access network protocols, informed consent frameworks, and layered IoT security including networking, communication, back-end systems, databases, testbeds, and commercial security products.

### iv(a)TEXTBOOKS

1. Hu Fei., Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1st edition, CRC Press, 2016.
2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1st edition, Packt Publishing Ltd, 2016.

**(b) REFERENCES**

1. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1st edition, NCC Group, 2014
2. DaCosta, Francis, and Byron Henderson, Rethinking the Internet of Things: a scalable approach to connecting everything, 1st edition, Springer Nature, 2013.
3. Giancarlo Fortino and Carlos E. Palau, Interoperability, Safety and Security in IoT, Springer Publications 2017.

<b>v) COURSE PLAN</b>		
<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>I</b>	Phases of IoT System, Internet of Things as Interconnections of Threats (IoT vs. IoT), Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems.	<b>8</b>
<b>II</b>	<b>Attack Models:</b> Attacks to Sensors in IoTs, Attacks to RFIDs in IoTs, Attacks to Network Functions in IoTs, Attacks to Back-end Systems, Security in Front-end Sensors and Equipment, Prevent Unauthorized Access to Sensor Data, M2M Security, RFID Security, Cyber-Physical Object Security, Hardware Security, Front-end System Privacy Protection.	<b>9</b>
<b>III</b>	<b>Privacy Preservation for IoT:</b> Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing	<b>10</b>
<b>IV</b>	<b>Trust Models for IoT:</b> Authentication in IoT- Computational Security for the IoT- Privacy-Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things.	<b>9</b>
<b>V</b>	<b>IoT Security:</b> Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function Security-IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products-Existing Test bed on Security and Privacy of IoTs, Commercialized Products.	<b>9</b>
<b>Total Hours</b>		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

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<b>Continuous Assessment</b>		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
23CTL45C	BIG DATA AND SCALABLE AI SYSTEMS	PEC	3	0	0	3	2023

### i. COURSE OBJECTIVES

This course provides an overview of storage, retrieval and processing of big data by implementing Map Reduce programs for processing big data. Realize storage and processing of big data using MongoDB, Pig, Hive and Spark and analyze big data using machine learning techniques.

### ii.COURSE OUTCOMES

After the completion of the course the student will be able to:

CO1	Explain the principles of big data and distributed systems, including the characteristics of large datasets and the fundamentals of building and maintaining reliable, scalable, distributed systems.	Understand
CO2	Explain the overview of the Hadoop framework, focusing on the Hadoop Distributed File System (HDFS) and MapReduce.	Understand
CO3	Apply the fundamental features and components of Hive, Pig, and Spark for data processing.	Apply
CO4	Apply R programming features to resolve problems associated with big data.	Apply
CO5	Explain the techniques used for handling massive datasets and optimization methods through relevant case studies.	Understand

### iii.SYLLABUS

Classification of data, What is big data, Why Big data, Hadoop Ecosystem and Core Components, Introduction to Map Reduce Programming ,Pig,Hive,Spark, Introduction to R – Overview of modern data analytic tools, Scalable algorithms, applications and case studies.

### iv.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.

### b. REFERENCES

- 1) Adam Shook and Donald Mine, “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems” - O'Reilly 2012 2
- 2) Tom White, “Hadoop: The Definitive Guide” 4th Edition, O'reilly Media, 2015.
- 3) Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016
- 4) 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

**v. COURSE PLAN**

<b>Module</b>	<b>Contents</b>	<b>No. of hours</b>
I	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: What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools.	9
II	<b>Hadoop Distributed File System:</b> History of Hadoop, Hadoop Ecosystem and Core Components, HDFS Architecture: Blocks, Name nodes and Data nodes, Using HDFS Files - Basic File system Operations, Hadoop Specific File Types. Anatomy of a file read and write. <b>Introduction to Map Reduce Programming:</b> Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression	9
III	<b>Introduction to Hive, Pig, Spark:</b> Hive: Features, Data types and file formats, primitive and collection data types, HiveQL-Creating tables, Dropping Tables, Alter table. Pig: Data Model, Pig Latin: Structure, Functions. Spark: Storage layers for spark, Core spark concepts, RDD basics, RDD Operations.	9
IV	<b>Introduction to R :</b> Overview of modern data analytic tools, Introduction to R, R Graphical User Interfaces - Features of R Language, Vectors, Filtering, Creating Matrices , Applying Functions to Matrix Rows and Columns, Lists , Creating List , General List Operations, Data Frames , Creating Data Frames , Matrix like Operations in Frames , Applying Functions to Data Frames ,Reading and Writing Files.	9
V	<b>Scalable Algorithms:</b> Analysis of algorithm complexity, techniques for dealing with massive datasets, dimensionality reduction, and optimization methods. <b>Applications and Case Studies:</b> Real-time sentiment analysis, stock market predictions, and various applications in different domains.	9
Total Hours		45

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

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<b>Continuous Assessment</b>		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

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**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CSL45E	QUANTUM COMPUTING AND PROGRAMMING	PEC	2	1	0	0	3	2026

### i. COURSE OVERVIEW

This course provides a comprehensive introduction to the quantum mechanical principles, mathematics, and practical implementations of quantum computing. It also covers the core concepts in quantum information processing to write quantum computer codes in *qiskit* framework. The practical applications of quantum computing are demonstrated through Grover's Search algorithm, Variational quantum eigensolver and quantum random number generators.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the physical and mathematical principles underlying quantum computing such as entanglement, quantum logic gates	Understand
CO 2	Explain the concepts of matrix representations of gates, quantum Fourier transform, and its standard implementations.	Understand
CO 3	Apply quantum circuits with X, H, CNOT gates to evaluate and interpret quantum computational processes.	Apply
CO 4	Apply qiskit for Grover search and Variational Quantum Eigensolver (VQE) problems	Apply
CO5	Explain the applications of quantum computing in cryptography and machine learning.	Understand

**iii. SYLLABUS**

Basics of Quantum mechanics for information processing; basic terminologies; classical vs. quantum computing; Mathematical tools in quantum computing; quantum gates, representations and applications in searching and factoring problems; Qiskit programming environment and debugging; New trends in quantum computing research.

**iv(a)TEXTBOOKS**

1. Quantum Mechanics for Scientists and Engineers, D. Miller, Cambridge University Press; 2008 (ISBN 978-0-521-89783-9).
2. Quantum Computing - a gentle introduction, E. Rieffel, W. Polak, The MIT Press, Cambridge, Massachusetts, 2014 (ISBN-13: 978-0262526678).
3. Quantum Computing for Programmers, R. Hundt, Cambridge University Press, 2022 (ISBN 978-1-009-09817-5).
4. Introduction to Classical and Quantum computing, T Wong, Rooted Grove Publication, 2022; (ISBN-13 : 979-8985593105).
5. Quantum Programming in Depth: Solving Problems With Q# and Qiskit, M. Mykhailova, Manning Publications, 2025; (ISBN-13: 978-1-63343-690-9).
6. Learn Quantum Computing with Python and IBM Quantum, R. Loredó, Packt Publications, 2025 (ISBN: 978-1-80324-480-8).
7. Programming Quantum Computers: Essential Algorithms and Code Samples, E. R. Johnston, N. Harrigan, M. Gimeno-Segovia, O'Reilly, 2021 (ISBN:9781492039631).

**(b) REFERENCES**

1. Quantum Computing - Progress and Prospects, E. Grumbling and M. Horowitz, Editors, The National Academies Press (ISBN 978-981-96-5645-5).

2. Essentials for Deeper Understanding of Quantum Computing, R. Maezono, Springer, 2025 (ISBN: 9789819656462).
3. Introduction to Quantum Computing, R. LaPierre, Springer, 2021 (ISBN 978-3-030-69317-6).

<b>v) COURSE PLAN</b>		
<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>I</b>	Quantum mechanics for quantum information processing; Classical and quantum computing; key components of quantum computer; Schrodinger equation and its solutions (eg. SHO); bra-ket notations; Postulates; operators (unitary and Hermitian), observable and probabilities; Principles of superposition, entanglement, decoherence, interference. Quantum bits, types of qubits; gates and qudits; Bloch's sphere.	<b>9</b>
<b>II</b>	Mathematics for Quantum Computing; Church-Turing Thesis and its variants; Hilbert space; Linearity; Matrix representation of gates; No-Cloning theorem; Bell's inequality; Hadamard operator; Deutsch-Jozsa algorithm; quantum Fourier Transform; Grover's search algorithm; Shor's factoring algorithm; Variational quantum eigensolver. classical and quantum random number generators;	<b>9</b>
<b>III</b>	Quantum information processing; Quantum circuit model and its diagrammatic representations (qubit register, measurements operations etc.); teleportation; examples (unitary transformation gate; I, X operators) transpilation; single- and multi- qubit gates (eg. Pauli-X,Y,Z and and CNOT); Hadamard and T qugate; analysis of measuring with X $ 0\rangle$ , H $ 0\rangle$ , HH $ 0\rangle$ , and CNOT gates; Measuring multiple qubits; Noise and error mitigation techniques;	<b>9</b>
<b>IV</b>	Programming Quantum Computer with Qiskit environment; IBM Quantum Composer; Qiskit; <i>QuantumCircuit, Statevector, Operator</i> classes; Defining Quantum and Classical Registers. Implementing gates and circuits (single-qubit gates (H, T, Pauli-X, Y, Z) and multi-qubit gates (CNOT, SWAP, Toffoli); Visualizing circuits; Statevector to inspect quantum states. Visualizing results; Simulation-based debugging;	<b>10</b>
<b>V</b>	Advanced concepts in quantum computing; introduction to Q# and quantum development kit, PennyLane and Cirq framework and its applications in cryptography and machine learning. Quantum key distribution in secure communications;Hybrid approaches and scalability challenges; Fault-tolerant quantum computing.	<b>8</b>

Total Hours	<b>45</b>
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**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

**viii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**ix. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

**PROGRAMME ELECTIVE VI**

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CSL46D	VIBE CODING	PEC	3	0	0	0	3	2023

**ii. COURSE OVERVIEW**

This course focuses on intuitive, creative, and AI-assisted programming practices that emphasize problem-solving, rapid prototyping, code readability, collaboration, and developer experience. The course blends foundational coding concepts with modern tools, including AI pair programming, low-code platforms, and human-centric software design.

**iii. COURSE OUTCOMES**

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

Course Outcomes	Description	Level
CO1	Explain the concept, philosophy, and significance of Vibe Coding.	Understand
CO2	Interpret clean coding principles and human-centric programming practices.	Understand
CO3	Apply AI-assisted and low-code tools for basic program development.	Apply
CO4	Apply creative and rapid application development techniques to solve simple problems.	Apply
CO5	Apply collaborative coding practices and basic testing techniques in project development.	Apply

**iv. SYLLABUS**

**Introduction to Vibe Coding:** Traditional coding vs Vibe Coding, Developer mindset and creative problem-solving, Programming paradigms overview, Code readability, writability, and maintainability, Ethical and responsible coding practices.

**Human-Centric Programming & Developer Experience (DX):** Clean code principles and coding standards, Code aesthetics, Self-documenting code and comments, Debugging strategies and

intuitive error handling, Version control fundamentals using Git, Collaborative workflows using GitHub, Inclusive and accessible software design.

**AI-Assisted and Low-Code Programming:** Fundamentals of prompt engineering, Pair programming with AI, Low-code / no-code platforms overview, Integrating low-code tools with traditional development, Evaluating AI-generated code for correctness and security.

**Creative Coding and Rapid Application Development:** Concepts and experimentation, Building small applications, Rapid prototyping workflows, UI/UX basics for programmers, Event-driven and interactive programming, Performance vs creativity trade-offs, Case studies of innovative software solutions.

**From Prototype to Product:** MVP thinking and iterative development, Feature prioritization and scope management, Managing technical debt in creative projects, Importance of testing in modern development, Secure coding fundamentals, Performance Optimization & Maintainability.

**Capstone Project.**

#### v (a) TEXTBOOKS

1. Martin, Robert C. Clean Code: A Handbook of Agile Software Craftsmanship. *Pearson Education*, 2008.
2. Noring, C., et al. AI-Assisted Programming for Web and Machine Learning. *Packt Publishing*, 2024.
3. Taulli, Tom. AI-Assisted Programming: Better Planning, Coding, Testing, and Deployment. 1st ed., *O'Reilly Media*, 2024.

#### (b) REFERENCES

1. Jeremy Morgan, Coding with AI. Manning, 2025.
2. Vootukuri, Naga Santhosh Reddy. Vibe Coding with GitHub Copilot: Enhancing Productivity by Leveraging GitHub Copilot Inside Visual Studio. Apress, 2025.
3. Kernighan, Brian W., and Rob Pike. The Practice of Programming. Addison-Wesley, 1999.

vi) COURSE PLAN		
Module	Contents	Hours
I	<b>Introduction to Vibe Coding:</b> concept, philosophy, and evolution, Traditional coding vs Vibe Coding, Creativity, intuition, empathy, and flow in programming, Developer mindset and creative problem-solving, Programming paradigms overview (procedural, object-oriented, functional and Event-driven), Selecting paradigms based on problem	9

	context, Hybrid and multi-paradigm programming, Code readability, writability, and maintainability, Industry-standard coding styles and conventions, Ethical and responsible coding practices, Sustainable and socially responsible software.	
II	<b>Human-Centric Programming &amp; Developer Experience (DX):</b> Understanding user needs and developer needs, Defining problems from a human perspective, Clean code principles and coding standards, Code aesthetics: naming, structure, and documentation, Self-documenting code and comments, Documentation using Markdown and README standards, Debugging strategies and intuitive error handling, Version control fundamentals using Git, Collaborative workflows using GitHub, Branching strategies, pull requests, and code reviews, Open-source contribution models and licensing basics, Inclusive and accessible software design.	9
III	<b>AI-Assisted and Low-Code Programming:</b> Introduction to AI-assisted coding tools, Strengths and limitations of AI coding tools, Fundamentals of prompt engineering, Context, constraints, roles, and examples in prompts, Iterative prompting and refinement techniques, Debugging prompts and improving outputs, Pair programming with AI, Human–AI collaboration models (use cases and limitations), Low-code / no-code platforms overview, Building simple applications and workflows using Bubble and Glide, Designing web interfaces and frontend experiences using Webflow, Creating automated workflows and integrations using Zapier, Integrating low-code tools with traditional development, Evaluating AI-generated code for correctness and security.	9
IV	<b>Creative Coding and Rapid Application Development:</b> Creative coding concepts and experimentation, Creative problem-solving strategies, Building small applications (scripts, tools, web apps), Rapid prototyping workflows, Introduction to frontend–backend interaction, UI/UX basics for programmers, Visual hierarchy, layouts, and interaction design, Wireframing and interface ideation using Figma, Familiarization of Visual Studio Code, Event-driven and interactive programming, Performance vs creativity trade-offs, Case studies of innovative software solutions.	9
V	<b>From Prototype to Product:</b> MVP thinking and iterative development, Feature prioritization and scope management, Managing technical debt in creative projects, Agile development basics and team workflows, Vibe Coding in startups vs enterprise environments, Importance of testing in modern development, Unit testing concepts and basic automation, API	9

	testing and backend validation using Postman, Secure coding fundamentals, Common vulnerabilities and safe coding practices, Privacy-aware and responsible application design, Ethical considerations in AI-assisted systems, Performance Optimization & Maintainability, Code maintainability and long-term scalability, Environment consistency and deployment basics using Docker.  <b>Capstone Project:</b> Team-based micro-project using Vibe Coding principles.	
Total Hours		<b>45</b>

### vii. ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	<b>:</b>	<b>40 marks</b>
<b>End Semester Examination</b>	<b>:</b>	<b>60 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

### viii. CONTINUOUS ASSESSMENT TEST

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

### ix. END SEMESTER EXAMINATION

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTL46A	AI for Healthcare	PCC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

The objective of this course is to help the learners to understand how AI and machine learning techniques are transforming healthcare delivery, clinical decision-making, and biomedical research. The course will cover topics such as machine learning algorithms, deep learning architectures, natural language processing, and computer vision, with a focus on their applications in medical imaging, diagnostics, patient management, and personalized medicine. This course enables the learners to explore the opportunities and challenges of integrating AI into healthcare systems.

### ii. COURSE OUTCOMES

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

CO1	Explain the principles of AI, machine learning, and deep learning in the context of healthcare applications.	Understand
CO2	Apply Machine Learning in developing AI models for Medical Data Analysis and Predictions	Apply
CO3	Apply Deep Learning for medical image analysis.	Apply
CO4	Explain natural language processing (NLP) techniques to extract insights from electronic health records (EHRs), clinical notes, and research papers.	Apply
CO5	Explain emerging AI technologies in healthcare, their ethical implications, regulatory challenges, and future trends.	Understand

### iii. SYLLABUS

The AI in Healthcare course provides a comprehensive understanding of how Artificial Intelligence, Machine Learning, Deep Learning, and Natural Language Processing (NLP) are applied in the medical field. It covers fundamental AI concepts, predictive modelling for disease diagnosis, deep learning for medical imaging, and NLP techniques for analysing electronic health records (EHRs) and clinical notes. The course also explores emerging AI technologies, including AI-driven personalized medicine, robotic surgeries, and blockchain for secure medical data management. Ethical considerations, regulatory frameworks (HIPAA, GDPR, FDA), and future trends are discussed to ensure responsible AI implementation. Through hands-on projects, students gain practical experience in developing AI solutions for real-world healthcare challenges.

#### iv a TEXTBOOKS

1. Artificial Intelligence in Healthcare – Adam Bohr, Kaveh Memarzadeh (Academic Press, 2020)
2. Machine Learning for Healthcare – John W. McGinnis (MIT Press, 2021)

3. Deep Learning for Medical Image Analysis – S. Kevin Zhou, Hayit Greenspan, Dinggang Shen (Academic Press, 2017)
4. Natural Language Processing for Healthcare – Zhiyong Lu, Hua Xu (Springer, 2021).

#### b REFERENCES

1. Analytics: From Data to Knowledge to Healthcare Improvement – Hui Yang, Eva Lee (Wiley, 2016)
2. "The Role of Artificial Intelligence in Healthcare: A Comprehensive Overview" – Research Paper (Nature Medicine, 2019)
3. "The Role of Artificial Intelligence in Healthcare: A Comprehensive Overview" – Research Paper (Nature Medicine, 2019)
4. "Predictive Analytics in Healthcare" – Research Paper (IEEE Transactions on Biomedical Engineering, 2020)
5. "Deep Learning in Medical Imaging: Overview and Future Trends" – Journal Article (IEEE Transactions on Medical Imaging, 2019)
6. "AI-driven NLP for Medical Text Processing" – Research Paper (Journal of Biomedical Informatics, 2021)
7. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again – Eric Topol (Basic Books, 2019).

#### v. COURSE PLAN

Module	Contents	No. of hours
I	<b>Introduction to AI in Healthcare-</b> Fundamentals of Machine Learning (Supervised, Unsupervised, Reinforcement Learning), Deep Learning Basics: Neural Networks, CNNs, RNNs, Key AI Techniques in Healthcare: Predictive Analytics, Decision Support Systems, Challenges and Opportunities of AI in Healthcare.	7
II	<b>Machine Learning for Medical Data Analysis and Predictions-</b> Data Collection & Preprocessing in Healthcare, Feature Engineering & Selection for Medical Data, Supervised Learning Algorithms: Decision Trees, SVM, Random Forest, XGBoost, Unsupervised Learning for Clustering & Anomaly Detection, Predictive Modeling for Disease Diagnosis (Diabetes, Heart Disease, Cancer)	10
III	<b>Introduction to Deep Learning in Medical Imaging-</b> Convolutional Neural Networks (CNNs) for Image Recognition, AI in Radiology: X-rays, MRI, and CT Scan Interpretation, Transfer Learning & Pretrained Models (ResNet, VGG, Efficient Net)	10
IV	<b>Fundamentals of NLP in Medical Text Processing-</b> AI for Electronic Health Records (EHRs) and Clinical Documentation, Named Entity Recognition (NER) for Medical Terms, AI Chatbots & Virtual Assistants in Healthcare, NLP in Drug Discovery and Biomedical Research, Case study: AI-powered Medical Text Analysis System.	10
V	<b>Ethical Considerations and Future Trends-</b> AI-driven Personalized Medicine & Genomics, AI in Robotics and Surgical Assistance, Blockchain for Secure AI-driven Medical Data Management, Regulatory Frameworks (HIPAA, GDPR,	8

	FDA Guidelines), Bias, Explainability, and Ethical Challenges in AI Healthcare, Future Trends and Career Opportunities in AI & Healthcare.	
	<b>Total</b>	<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
<b>Total Continuous Assessment</b>	:	<b>40 marks</b>
<b>End Semester Examination</b>	:	<b>60 marks</b>
<b>TOTAL</b>	:	<b>100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CSL46C	Blockchain and Crypto Currencies	PEC	2	1	0	0	3	2023

### i. COURSE OVERVIEW

This course introduces the fundamental concepts of blockchain technology and cryptocurrencies, covering distributed ledger systems, cryptographic foundations, Bitcoin architecture, and Ethereum platform. It provides an understanding of smart contracts and Solidity programming, including the process of developing and deploying simple decentralized applications. The course also explores blockchain applications, security challenges, and emerging trends such as Layer 2 solutions and Web3, with emphasis on conceptual clarity and practical exposure suitable for undergraduate students.

### ii. COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the fundamentals of distributed systems and the need for blockchain technology.	Understand
CO 2	Describe the cryptographic principles underlying blockchain technology.	Understand
CO 3	Explain the working of Bitcoin including transaction processing and consensus mechanisms.	Understand
CO 4	Develop and deploy simple smart contracts using Solidity on the Ethereum platform.	Apply
CO5	Explain blockchain applications and security challenges in decentralized systems.	Understand

### iii. SYLLABUS

Introduction to distributed ledger technology, blockchain structure, consensus mechanisms, and types of blockchains. Cryptographic primitives including hash functions, digital signatures, and Merkle trees. Working of Bitcoin and Ethereum, fundamentals of smart contracts and Solidity, decentralized applications, blockchain applications across industries, and basic security challenges including 51% attacks and double spending.

### iv. a TEXTBOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*, Princeton University Press, 2016.
2. Imran Bashir, *Mastering Blockchain: A Deep Dive into Distributed Ledgers, Consensus Protocols, Smart Contracts, DApps, Cryptocurrencies, Ethereum, and More*, 3rd Edition, Packt Publishing, 2020.
3. Chris Dannen, *Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners*, Apress, 2017.
4. Andreas M. Antonopoulos, *Mastering Bitcoin: Programming the Open Blockchain*, 3rd Edition, O'Reilly Media, 2024.

#### **b REFERENCES**

1. Antony Lewis, *The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them*, Mango Publishing, 2018.
2. Shaoen Wu, Song Guo, Junhao Hu, and Yi-Zhe Cheng (Eds.), *Blockchain for Cybersecurity and Privacy: Architectures, Challenges, and Applications*, CRC Press, 2020.
3. Henning Diedrich, *Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations*, Wildfire Publishing, 2016.
4. Elad Elrom, *The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects*, Apress, 2019.

#### **v. COURSE PLAN**

<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>I</b>	<b>Introduction to Blockchain</b> - Introduction to distributed systems and the need for distributed record keeping. Centralized versus decentralized systems, peer-to-peer networks, characteristics of blockchain technology, types of blockchains (public, private, and consortium), basic concepts of consensus mechanisms, overview of cryptocurrencies, and structure of a blockchain including blocks, hash, previous hash, and nonce.	<b>9</b>
<b>II</b>	<b>Cryptographic Foundations</b> - Fundamentals of cryptography used in blockchain including hash functions and their properties, digital signatures, public key cryptography, basics of elliptic curve cryptography (concept level), Merkle trees and Merkle proofs, Proof of Work concept, and basic transaction verification process in blockchain systems.	<b>9</b>

<b>III</b>	<b>Bitcoin Technology</b> - Introduction to Bitcoin and its architecture, components of the Bitcoin network, mining process, Proof of Work mechanism, block creation and validation, Bitcoin transactions, UTXO model, wallets and keys, advantages and limitations of Bitcoin, and overview of alternative consensus mechanisms such as Proof of Stake (concept level)	<b>9</b>
<b>IV</b>	<b>Ethereum and Smart Contract Development</b> - Introduction to Ethereum architecture, Ethereum Virtual Machine (EVM), and account-based model. Concepts of smart contracts and basics of Solidity programming including data types, functions, modifiers, events, mappings, and structs. Writing, compiling, testing, and deploying smart contracts using Remix IDE. Gas mechanism and transaction fees. Interaction with deployed contracts and overview of decentralized applications (DApps). Comparison between Bitcoin scripting and Ethereum smart contracts.	<b>9</b>
<b>V</b>	<b>Blockchain Applications and Security</b> - Applications of blockchain in healthcare, banking, supply chain management, digital identity, and voting systems. Basic security issues in blockchain including 51% attack, double spending, and Sybil attack. Introduction to Layer 2 scaling solutions, basic concept of blockchain interoperability, regulatory considerations, and overview of Web3 concepts.	<b>9</b>
Total Hours		<b>45</b>

**vi. ASSESSMENT PATTERN**

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment	
Attendance	: 5 marks
Assignments	: 15 marks
Assessment through Tests	: 20 marks
<b>Total Continuous Assessment</b>	<b>: 40 marks</b>
<b>End Semester Examination</b>	<b>: 60 marks</b>
<b>TOTAL</b>	<b>: 100 marks</b>

**vii. CONTINUOUS ASSESSMENT TEST**

- No. of Tests: 02
- Maximum Marks: 30
- Test Duration: 1 ½ hours
- Topics: 2 ½ modules

**viii. END SEMESTER EXAMINATION**

- Maximum Marks: 60
- Exam Duration: 3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CTJ48B	PROJECT	PWS	0	0	10	0	5	2023

**i. COURSE OVERVIEW** The aim of this course is to apply engineering knowledge in solving practical problems, to foster innovation in design of products, processes or systems, and to develop creative thinking in finding viable solutions to engineering problems. The course is mainly intended to evoke the innovation and invention skills of a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation.

**Desirable:** The project outcome should be published in a peer-reviewed journal or presented at a conference, or a patent application should be filed.

It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

**ii. COURSE OUTCOMES** After the completion of the course, the student will be able to:

Course Outcomes	Description	Level
CO 1	Apply multidisciplinary knowledge to model and solve real world problems.	Apply
CO 2	Apply innovative and creative problem-solving to develop sustainable and socially relevant products, processes, or technologies.	Create
CO 3	Exhibit effective teamwork and leadership skills in diverse environments, with the ability to comprehend and carry out designated responsibilities.	Apply
CO 4	Execute tasks by planning effectively and utilizing available resources to meet deadlines, while adhering to ethical and professional standards.	Apply
CO 5	Effectively document, present, and communicate technical and scientific outcomes in professional written and verbal formats.	Apply

### **iii. Evaluation Guidelines**

Total: 100 marks (Minimum required to pass: **50** Marks).

- Project progress evaluation by guide: **20** Marks.
- Two interim evaluations by the Evaluation Committee: **30** Marks (15 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: **30** Marks
- Quality of the report evaluated by the evaluation committee: **20** Marks

#### **Interim Evaluation:**

The Evaluation committee comprises of HoD or a senior faculty member, Project coordinator and Project supervisor.

#### **Final Evaluation:**

The final evaluation committee comprises of Project coordinator, domain expert from the Department and expert from Industry/research/academic Institute / senior faculty from a sister department

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23CTI48A	INTERNSHIP	PWS	0	0	-	0	5	2023

### i **COURSE OBJECTIVES**

The internship is an integral component of the undergraduate programme aimed at providing students with immersive learning through practical exposure in industry, research organizations, or academic institutions.

#### **BENEFITS OF INTERNSHIP**

##### **Benefits to Students**

- Provides practical exposure to real-world industrial and organizational environments, enabling the application of theoretical knowledge gained in classrooms.
- Enhances professional competencies such as communication, teamwork, time management, interpersonal skills, and workplace ethics.
- Facilitates the development of technical and domain-specific skills, thereby strengthening overall professional readiness.
- Assists students in assessing their career interests and determining the suitability of a particular industry or profession.
- Improves employability by strengthening profiles for placements, higher education, and potential recruitment by the host organization.
- Encourages professional networking and relationship - building with industry experts and peers.
- Offers an opportunity to evaluate the organization and work culture before committing to full-time employment.

##### **Benefits to the Institute**

- Strengthens industry - academia collaboration.
- Facilitates smoother and more effective placement processes.
- Enhances institutional credibility and brand value.
- Supports student engagement and retention.
- Enables curriculum updates based on industry and student feedback.
- Improves the overall teaching - learning process through industry relevance.

##### **Benefits to the Industry**

- Provides access to a pool of motivated, job-ready students who can contribute immediately.
- Offers a cost-effective mechanism to evaluate and recruit potential employees.
- Enables the availability of a flexible workforce for temporary, project-based, or seasonal requirements.
- Brings fresh perspectives and innovative approaches to problem-solving.
- Enhances organizational visibility and employer branding within academic institutions.
- Strengthens corporate image by contributing to education and skill development.

**TYPES OF INTERNSHIPS**

- Industry Internship with/without Stipend
- Government / PSU Internship (BARC/Railway/ISRO etc.)
- Internship with prominent education/ Research Institutes
- Internship with Incubation centres /Start-ups

**ii COURSE OVERVIEW**

Students can undertake an internship at an industry, research organization, or a reputed academic institution with prior approval of the respective Head of the Department.

The internship is designed to promote meaningful skill development through structured, outcome-driven experiential learning. It shall focus on clearly defined technical competencies, such as domain-specific skills, software proficiency, exposure to industry-standard tools, and structured engineering problem-solving tasks. The learning objectives of the internship, along with the expectations of the host organization and the academic requirements of the institution, shall be clearly defined in consultation with the host organization and mutually agreed upon prior to the approval of the internship.

Each student shall be assigned a faculty guide/supervisor for monitoring and evaluation. The internship shall be relevant to the student's stream of study and can be carried out in Semester **VII** or Semester **VIII**, as specified by the Department, for a minimum duration of **three months**.

A student shall be permitted to undertake the internship only after the respective semester registration. During the internship period, any other courses or academic activities shall be pursued in online mode or as specified by the Department, to ensure timely fulfilment of all academic requirements.

On successful completion of the internship, students are expected to demonstrate improved technical competence, professional conduct, and the ability to address practical problems in their chosen field.

**iii COURSE OUTCOMES**

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

CO1	Apply theoretical knowledge and engineering principles to practical problems encountered in professional practice.	Apply
CO2	Demonstrate technical competence and understanding of tools, techniques, and processes relevant to the chosen field of specialization.	Apply
CO3	Analyse social, environmental, economic, safety, and administrative factors influencing industrial operations and decision-making processes.	Analyze
CO4	Communicate effectively through technical reports, presentations, and professional interactions in an industrial or research environment.	Apply
CO5	Apply professional ethics, teamwork, and adaptability while performing assigned tasks in a multidisciplinary work setting.	Apply

**iv GUIDELINES FOR STUDENTS**

- Duration of internship is three to six months (One semester).
- Students may undertake mini projects, case studies, or related technical tasks during the internship with the prior approval of the competent authority at the host organisation.
- Students shall strictly adhere to the rules, regulations, code of conduct, and working hours prescribed by the host organisation.
- Prior permission shall be obtained from the host organisation before using or reproducing any data, documents, drawings, photographs, or proprietary information for academic purposes.
- Students shall follow all ethical practices, confidentiality requirements, and Standard Operating Procedures (SOPs) of the host organisation.
- Students shall comply with all health, safety, and environmental guidelines prescribed by the host organisation during the internship period.
- Students shall maintain regular contact with the assigned faculty guide/supervisor and submit weekly progress updates on the work carried out.
- Each student shall maintain a diary/logbook recording daily activities, learning outcomes, and progress throughout the internship period.
- On completion of the internship, students shall submit the following documents to the Department:
  - ✓ Internship report detailing the work carried out and learning outcomes
  - ✓ Internship Completion Certificate issued by the host organisation
  - ✓ Feedback from the employer
  - ✓ Proof of stipend received, if applicable

#### v) **ASSESSMENT PATTERN**

The marks awarded for the Internship will be based on the following:

- (v) Evaluation done by the industry,
- (vi) Student's diary,
- (vii) Internship report, and
- (viii) Internship viva voce.

<b>Continuous Assessment</b>		
Student's diary/ Daily Log	:	25 marks
Evaluation done by the industry	:	25 marks
<b>Total Continuous Assessment</b>	<b>:</b>	<b>50 marks</b>
<b>Final Assessment</b>		
Internship Report	:	25 Marks
Internship Viva Voce	:	25 marks
<b>Total Final Assessment</b>	<b>:</b>	<b>50 marks</b>
<b>TOTAL</b>	<b>:</b>	<b>100 marks</b>

### **Student's Diary/ Daily Log**

The purpose of maintaining a daily diary is to cultivate systematic documentation habits and to encourage students to record observations, impressions, information gathered and suggestions, if any, during the internship period. The diary shall contain a day-to-day record of activities, learning experiences, technical details, and relevant sketches or drawings related to the work carried out. The daily diary shall be signed regularly by the industry supervisor and shall be verified and ratified by the faculty guide during the interim review.

The interim review shall be conducted midway through the internship by the Internship Review Committee, comprising the internship coordinator, faculty supervisor, and a senior faculty member of the Department. The review may be conducted in online or offline mode, based on the feasibility of the student's physical presence on campus.

### **Internship Report**

On completion of the internship, each student shall prepare and submit a comprehensive internship report to the faculty supervisor. The report shall present a systematic account of the activities undertaken, observations made and knowledge gained during the training period. Students may consult the industry supervisor during the preparation of the final report, subject to compliance with the confidentiality policies and norms of the host organisation. The completed report shall be duly certified and signed by the Industry Supervisor, Faculty guide and the Head of the Department.

The internship report shall be evaluated based on the following criteria:

- Originality and technical content
- Adequacy, clarity and relevance of the written presentation
- Organization, format, use of drawings, sketches, language and overall style
- Variety and relevance of learning experiences documented
- Demonstration of practical applications and linkage with theoretical concepts covered in the curriculum

### **Evaluation done by the industry**

The performance of the student during the internship shall be evaluated by the industry supervisor or the person-in-charge using a prescribed evaluation format provided by the institution. The evaluation shall cover key parameters such as professional behaviour, technical competence, learning ability, initiative, quality of work, communication skills, teamwork, discipline, time management, and overall professional attitude.

The faculty guide shall share the evaluation format with the host organisation and coordinate the assessment process. The completed evaluation form shall be duly signed and sealed by the industry supervisor and submitted to the Department as part of the internship assessment records.

### **Internship Viva Voce**

The viva voce examination shall be conducted by the Internship Review Committee. The committee shall assess the student's understanding of the internship work, technical competence, learning outcomes, and professional orientation.

23CSJ4H (B,D,F)	MINI PROJECT	Category	L	T	P	J	Credit	Year of Introduction
		VAC	0	0	6	0	3	2023

### i. Course Overview

The main objective of this course is to apply fundamental concepts learned in the respective Honour streams of Engineering through practical implementation. The course provides students with exposure to the development of application-oriented software, hardware solutions, or software simulations in their chosen field. Working in small teams under faculty supervision, students identify a relevant problem, perform literature review, plan and execute the project, and present the outcomes through a working model or prototype. The mini project enhances problem-solving ability, teamwork, project planning, and technical communication skills, and serves as a foundation for future research or major project work.

### ii. Course Outcomes

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

CO1	Identify engineering problems that are socially relevant, technically feasible, and economically viable.	Apply
CO2	Make use of relevant literature and existing engineering principles to explore and analyze potential solutions.	Apply
CO3	Develop a suitable design or methodology using modern tools while adhering to professional ethics.	Apply
CO4	Evaluate the performance or feasibility of the proposed solution using theoretical or experimental validation.	Evaluate
CO5	Apply effective communication techniques to prepare technical reports, presentations, and demonstrations.	Apply
CO 6	Plan and execute project activities and coordinate effectively within a team to meet objectives and deadlines.	Apply

### iii. Course plan/Guidelines

In this course, each group consisting of a maximum of 4 members is expected to design and develop a moderately complex software/hardware system relevant to their domain with practical applications. The basic concept of product design may be taken into consideration. Students should identify a topic of interest in consultation with the Project guide assigned and Project coordinator in charge of the course. They should review the literature from latest journals, relevant conferences and gather information pertaining to the chosen topic. Later the group should state the objectives and develop a methodology to achieve the objectives and then carry out the design/fabrication or develop codes/programs to achieve the objectives. Finally the team should demonstrate the novelty of the project through the working results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department/Project Coordinator in charge. A project report is required at the end of the semester which will be evaluated and approved by the department. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due considerations. A zeroth review may be conducted to finalize the topic and plan in the beginning. Two continuous reviews will assess progress and implementation.

### iv. Evaluation Scheme

The Mini Project shall be evaluated through a comprehensive assessment framework designed to monitor continuous progress, technical competence, and quality of documentation. The evaluation carries a total of 100 marks, with a minimum pass requirement of 50 marks, and is conducted through multiple stages involving the project guide and an evaluation committee. Continuous assessment includes project progress evaluation by the guide, two interim evaluations by the Evaluation Committee to assess problem formulation, design, and implementation progress, and a final evaluation to judge the level of completion, functionality, demonstration, technical understanding, and viva-voce performance. In addition, the quality of the project report is assessed for technical depth, clarity, organization, and adherence to prescribed standards. The Evaluation Committee comprises the Head of the Department or a senior faculty member, the Mini Project Coordinator, and the Project Supervisor, ensuring a fair and holistic evaluation of the mini project.

### v. Evaluation Pattern and Mark Distribution

Project progress evaluation by Guide	: 20 marks
Interim Evaluation – I	: 15 marks
Interim Evaluation – II	: 15 marks

Final Evaluation by Evaluation Committee	: 30 marks
Quality of Project Report	: 20 marks
<b>Total</b>	<b>: 100 marks</b>