

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)
Kattankulathur, Chengalpattu District 603203,
Tamil Nadu, India



ACADEMIC CURRICULA POST GRADUATE DEGREE PROGRAMMES

MASTER OF COMPUTER APPLICATIONS
GENERATIVE ARTIFICAL INTELLIGENCE

(Detailed Syllabus for Two Years Courses)
Learning Outcomes based Curriculum Framework (LOCF)
National Credit Framework (NCrF)

Regulations 2025
Faculty of Science and Humanities

Office of the Registrar, SRM IST

Control Copy

Approved in:

70th Executive Council Meeting 29.03.2025

58th Academic Council Meeting 22.02.2025

REGISTRAR

FACULTY OF SCIENCE AND HUMANITIES

ACADEMIC CURRICULA

**POSTGRADUATE DEGREE PROGRAMME
(REGULATIONS - 2025)**

**MASTER OF COMPUTER APPLICATIONS
GENERATIVE ARTIFICIAL INTELLIGENCE**

Two Years (Full-Time)

National Education Policy

**Learning Outcomes based Curriculum Framework
(LOCF)**

National Credit Framework

**Academic Year
2025 - 2026**



SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

| 1. Department Vision Statement | | | | | |
|---|--|-------------------|-------------------|-------------------|-------------------|
| Stmnt - 1 | Creating the most conducive environment for imparting quality education in Computer Applications | | | | |
| Stmnt - 2 | Contributing effectively to produce globally competent quality professionals in the field of IT | | | | |
| Stmnt - 3 | Contributing towards preparing young minds to serve community | | | | |
| 2. Department Mission Statement | | | | | |
| Stmnt - 1 | Impart student's essential knowledge and skills required for a successful career in Information Technology | | | | |
| Stmnt - 2 | Instill confidence in the students to take up new challenges by grooming them appropriately | | | | |
| Stmnt - 3 | Inculcate in the students a sense of commitment to professional ethics, moral values with emphasis on team work and leadership qualities | | | | |
| Stmnt - 4 | Instill the students with a clear awareness of environmental issues and their relevance to their profession | | | | |
| Stmnt - 5 | Impress upon the students the impact of their work on the nation's economic and social progress | | | | |
| 3. Program Education Objectives (PEO) | | | | | |
| PEO - 1 | Offer the students those skill sets and domain knowledge based on needs of IT and dynamic business environment | | | | |
| PEO - 2 | Provide the students with the capabilities in the areas of analysis, design, development and testing | | | | |
| PEO - 3 | Kindle the minds of students to take up research and development in Computer Applications with missionary zeal | | | | |
| PEO - 4 | Train the students to become effective communicators in professional as well as general aspects of life | | | | |
| PEO - 5 | Prepare the students into balanced individuals who are keen to leave a mark by excelling in their profession | | | | |
| 4. Consistency of PEO's with Mission of the Department | | | | | |
| | Mission Stmt. - 1 | Mission Stmt. - 2 | Mission Stmt. - 3 | Mission Stmt. - 4 | Mission Stmt. - 5 |
| PEO - 1 | 3 | 3 | 2 | 3 | 2 |
| PEO - 2 | 3 | 2 | 3 | 3 | 3 |
| PEO - 3 | 2 | 3 | 2 | 3 | 3 |
| PEO - 4 | 3 | 3 | 3 | 1 | 2 |
| PEO - 5 | 1 | 3 | 2 | 3 | 3 |
| 3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation | | | | | |

| 5. Consistency of PEO's with Program Learning Outcomes (PO) | | | | | | | | | | | | |
|---|--------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|
| | Program Learning Outcomes (PO) | | | | | | | | | | | |
| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. |
| | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| PEO - 1 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 2 | 3 | 3 |
| PEO - 2 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 1 | 2 | 3 | 2 | 2 |
| PEO - 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 3 |
| PEO - 4 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 |
| PEO - 5 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 2 |
| 3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation | | | | | | | | | | | | |

6. Programme Structure (Total Credits: 80 Credits)

| 1. Professional Core Courses (C) (10 Courses) | | | | | |
|---|--|------------|---|---|-----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PCA25C01J | Object Oriented Programming using Java | 3 | 0 | 2 | 4 |
| PCA25C02T | Data Structures and Algorithms | 4 | 0 | 0 | 4 |
| PCA25C03J | Database Technology | 3 | 0 | 2 | 4 |
| PCA25C04J | Data Analysis using Python Programming | 3 | 0 | 2 | 4 |
| PCA25C05T | Optimization Techniques | 4 | 0 | 0 | 4 |
| PCA25C06J | Advanced Operating System | 3 | 0 | 2 | 4 |
| PCA25C07J | Artificial Intelligence and Machine Learning | 3 | 0 | 2 | 4 |
| PCA25C08J | Data Communication Networks | 3 | 0 | 2 | 4 |
| PCA25C09T | Cloud and Quantum Computing | 4 | 0 | 0 | 4 |
| PCA25C10L | Capstone Project | 0 | 0 | 8 | 4 |
| Total Learning Credits | | | | | 40 |

| 2. Discipline Elective Courses (D) (3 Courses) | | | | | |
|--|--|-------------------------------|---|---|-----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PGI25D01J | Introduction to Computer Vision | 3 | 0 | 2 | 4 |
| PGI25D02J | Intelligent Language Processing | | | | |
| PGI25D03J | Intelligent Internet of Things (IIoT) | 3 | 0 | 2 | 4 |
| PGI25D04J | Augmented Reality and Virtual Reality | | | | |
| PGI25D05J | Generative AI and Large Language Models | 3 | 0 | 2 | 4 |
| PGI25D06J | IoT Cloud Infrastructure and Protocols | | | | |
| PGI25D07J | Computer Vision in Smart Robotics | 3 | 0 | 2 | 4 |
| PGI25D08J | Building Conversational AI for Human Resources | | | | |
| PGI25D09J | IoT Devices with Computer Vision Technologies | Total Learning Credits | | | 12 |

| 3. Generic Elective Courses (G) (2 Courses) | | | | | |
|--|--|-------------------------------|---|---|----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PGI25G01T | Deep Neural Networks | 2 | 0 | 0 | 2 |
| PGI25G02T | Building GPT Powered Business Applications | | | | |
| PGI25G03T | Cloud Infrastructure for Generative AI | 2 | 0 | 0 | 2 |
| PGI25G04T | Data Engineering and Analytics | | | | |
| PGI25G05T | Distributed Data Processing Systems | Total Learning Credits | | | 4 |
| PGI25G06T | Quantum Machine Learning | | | | |

| 4. Skill Enhancement Courses (S) (2 Courses) | | | | | |
|--|-------------------------------------|------------|---|---|----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PGI25S01J | Generative AI and Open AI | 2 | 0 | 3 | 4 |
| PGI25S02J | Prompt Engineering in Generative AI | 2 | 0 | 3 | 4 |
| Total Learning Credits | | | | | 8 |

| 5. Project Work, Internship in Industry/Higher Technical Institutions (P) (2 Courses) | | | | | |
|--|--------------|------------|---|----|-----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PGI25P01L | Internship | 0 | 0 | 0 | 2 |
| PGI25P02L | Project Work | 0 | 0 | 20 | 10 |
| Total Learning Credits | | | | | 12 |

| 6. Ability Enhancement Courses (AE) (2 Courses) | | | | | |
|--|--|------------|---|---|----------|
| Course Code | Course Title | Hours/Week | | | C |
| | | L | T | P | |
| PCD25AE1T | Comprehensive Skills in Quantitative and Logical Reasoning | 2 | 0 | 0 | 2 |
| PCD25AE2T | Soft Skills and Verbal Mastery | 2 | 0 | 0 | 2 |
| Total Learning Credits | | | | | 4 |

7. Implementation Plan

| Semester – I | | | | | | |
|--------------|--|-------------|---|---|----|--|
| Code | Course Title | Hours/ Week | | | C | |
| | | L | T | P | | |
| PCA25C01J | Object Oriented Programming using Java | 3 | 0 | 2 | 4 | |
| PCA25C02T | Data Structures and Algorithms | 4 | 0 | 0 | 4 | |
| PCA25C03J | Database Technology | 3 | 0 | 2 | 4 | |
| PGI25D01J | Introduction to Computer Vision | 3 | 0 | 2 | 4 | |
| PGI25D02J | Intelligent Language Processing | 3 | 0 | 2 | | |
| PGI25D03J | Intelligent Internet of Things (IIoT) | 3 | 0 | 2 | | |
| PGI25G01T | Deep Neural Networks | 2 | 0 | 0 | 2 | |
| PGI25G02T | Building GPT Powered Business Applications | | | | | |
| PGI25G03T | Cloud Infrastructure for Generative AI | | | | | |
| PGI25S01J | Generative AI and Open AI | 2 | 0 | 3 | 4 | |
| PCD25AE1T | Comprehensive Skills in Quantitative and Logical Reasoning | 2 | 0 | 0 | 2 | |
| Total | | 28 | | | 24 | |

| Semester - II | | | | | | |
|---------------|--|-------------|---|---|----|--|
| Code | Course Title | Hours/ Week | | | C | |
| | | L | T | P | | |
| PCA25C04J | Data Analysis using Python Programming | 3 | 0 | 2 | 4 | |
| PCA25C05T | Optimization Techniques | 4 | 0 | 0 | 4 | |
| PCA25C06J | Advanced Operating System | 3 | 0 | 2 | 4 | |
| PCA25C07J | Artificial Intelligence and Machine Learning | 3 | 0 | 2 | 4 | |
| PGI25D04J | Augmented Reality and Virtual Reality | 3 | 0 | 2 | 4 | |
| PGI25D05J | Generative AI and Large Language Models | 3 | 0 | 2 | | |
| PGI25D06J | IoT Cloud Infrastructure and Protocols | 3 | 0 | 2 | | |
| PGI25S02J | Prompt Engineering in Generative AI | 2 | 0 | 3 | 4 | |
| PCD25AE2T | Soft Skills and Verbal Mastery | 2 | 0 | 0 | 2 | |
| Total | | 31 | | | 26 | |

| Semester - III | | | | | | |
|----------------|--|-------------|---|---|----|--|
| Code | Course Title | Hours/ Week | | | C | |
| | | L | T | P | | |
| PCA25C08J | Data Communication Networks | 3 | 0 | 2 | 4 | |
| PCA25C09T | Cloud and Quantum Computing | 4 | 0 | 0 | 4 | |
| PCA25C10L | Capstone Project | 0 | 0 | 8 | 4 | |
| PGI25D07J | Computer Vision in Smart Robotics | 3 | 0 | 2 | 4 | |
| PGI25D08J | Building Conversational AI for Human Resources | 3 | 0 | 2 | | |
| PGI25D09J | IoT Devices with Computer Vision Technologies | 3 | 0 | 2 | | |
| PGI25G04T | Data Engineering and Analytics | 2 | 0 | 0 | 2 | |
| PGI25G05T | Distributed Data Processing Systems | | | | | |
| PGI25G06T | Quantum Machine Learning | | | | | |
| PGI25P01L | Internship | 0 | 0 | 0 | 2 | |
| Total | | 24 | | | 20 | |

| Semester - IV | | | | | | |
|---------------|--------------|-------------|---|----|----|--|
| Code | Course Title | Hours/ Week | | | C | |
| | | L | T | P | | |
| PGI25P02L | Project Work | 0 | 0 | 20 | 10 | |
| Total | | 20 | | | 10 | |

Total Number of Subjects: 21
Total Number of Credits: 80

8. Program Articulation Matrix

| Course Code | Course Title | Programme Learning Outcomes (PO) | | | | | | | | | | | |
|-------------|--|----------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|
| | | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| PCA25C01J | Object Oriented Programming using Java | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C02T | Data Structures and Algorithms | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C03J | Database Technology | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 2 |
| PCA25C04J | Data Analysis using Python Programming | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C05T | Optimization Techniques | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C06J | Advanced Operating System | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | - | 2 | - | - |
| PCA25C07J | Artificial Intelligence and Machine Learning | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C08J | Data Communication Networks | 3 | - | 2 | 3 | 3 | - | - | - | 3 | - | - | 3 |
| PCA25C09T | Cloud and Quantum Computing | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25C10L | Capstone Project | 3 | - | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| PGI25D01J | Introduction to Computer Vision | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D02J | Intelligent Language Processing | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D03J | Intelligent Internet of Things (IIoT) | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D04J | Augmented Reality and Virtual Reality | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D05J | Generative AI and Large Language Models | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D06J | IoT Cloud Infrastructure and Protocols | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25D07J | Computer Vision in Smart Robotics | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 |
| PGI25D08J | Building Conversational AI for Human Resources | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| PGI25D09J | IoT Devices with Computer Vision Technologies | 3 | 3 | 2 | 2 | 2 | 2 | 2 | - | 2 | - | - | 2 |
| PGI25G01T | Deep Neural Networks | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25G02T | Building GPT Powered Business Applications | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25G03T | Cloud Infrastructure for Generative AI | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25G04T | Data Engineering and Analytics | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25G05T | Distributed Data Processing Systems | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25G06T | Quantum Machine Learning | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25S01J | Generative AI and Open AI | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PGI25S02J | Prompt Engineering in Generative AI | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25P01L | Internship | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| PCA25P02L | Project Work | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| PCD25AE1T | Comprehensive Skills in Quantitative and Logical Reasoning | - | 3 | 1 | 3 | 1 | - | - | - | 2 | - | - | - |
| PCD25AE2T | Soft Skills and Verbal Mastery | 1 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 2 | 3 |
| | Program Average | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

SEMESTER- I

| Code | PCA25C01J | Title | Object Oriented Programming using Java | | | | Category | C | Professional Core Course | L | T | P | C |
|------|-----------|-------|---|--|--|--|----------|---|--------------------------|---|---|---|---|
| | | | | | | | | 3 | 0 | 2 | 4 | | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|----------------|--|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|-----------------------|---|---|---|---|---|---|---|---|----|----|----|
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CR-1 | An overview of Java and Buzz words and OO features in Java | | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-2 | Understand the concept of Classes and Constructor | | | | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-3 | Create and understand the various kind of packages and interface | | | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CR-4 | Understand the Thread and Utility Classes | | | | | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-5 | Understand Event handling and JDBC | | | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |
| CO-1 | Understand the difference between C++ and Java | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CO-2 | Develop Java program using JVM | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-3 | Use the various kinds of packages and interfaces | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CO-4 | Apply the Exception handling methods in Java program. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-5 | Understand the Java I/O classes and collections interfaces. | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |

| Title & Session Outcomes | Introduction to Java | Classes and Constructors | Inheritance and Exception Handling | Thread and Utility Classes | Event Handling and JDBC |
|--------------------------|--------------------------|----------------------------|------------------------------------|-----------------------------|----------------------------------|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | The Genesis of Java, How | Introducing classes- Class | Inheritance Basics, | Introduction to Java Thread | Introduction to Event Handling - |

| | | | | | |
|----------------|--|--|---|---|---|
| | java changed the internet- Java's magic: Byte Code, Java Buzzword | fundamentals- Declaring Objects, Assigning object Reference variables- Method | Understanding Types of Inheritance: Single, Multilevel, Hierarchical Inheritance | model, Creating a Thread by Extending Thread Class | Understanding ActionEvent, ItemEvent, KeyEvent, MouseEvent, TextEvent, WindowEvent and ComponentEvent |
| SO-2 | Features of Java, Evolution of Java, Difference between C++ and Java | Constructors - Characteristics of constructors - Types of Constructors, this Keyword | How does java support multiple inheritance? - using Super keyword, Method Overriding | Creating a Thread by implementing Runnable Interface, Thread Class | Introduction to Event Listener Interfaces, Working with ActionListener & AdjustmentListener |
| SO-3 | Object Oriented Concepts of Java, Lexical Issues of Java | Introduction to Garbage Collection, Using Finalize() method | Understanding Dynamic method dispatch - Introduction to Abstract keyword, Working with Abstract class and Method & Using final with inheritance | Creating multiple threads, Assigning Thread priorities | Working with ContainerListener, ItemListener, ComponentListener, KeyListener & MouseListener |
| SO 4-5 | Practice 1: Learning to work with Java IDE and Writing Simple Conversion Programs | Practice 4: Program to implement the Queue operations using Classes and Objects | Practice 7: Program to Implement Inheritance, Method Overriding, Abstract classes and methods, | Practice 10: Implement Multithreading Program Program to Implement Binary Search Tree | Practice 13: Program to implement Event Handling concepts Program to implement Graph |
| SO-6 | Data types, Variables, dynamic initialization of variables, Scope and lifetime of variables, Operators | Overloading methods- Overloading constructors, Using objects as parameters- Argument Passing | Introduction to Package - Creating a Package, Understanding Access Protection- Importing packages | Applying Synchronization- Inter-thread communication, Introduction to Legacy Classes- Working with Vector class | Introduction AWT Controls - Working with Label controls, Buttons controls, CheckBoxes and CheckBoxGroup |
| SO-7 | Arrays, Conditional Statements, | Returning Objects- Recursion | Introduction to Interfaces- Defining an interface, Implementing Interfaces, How Interfaces are extended? | Examples using Vector class, 0Understanding Stack class | Working with Choice controls, Lists controls and TextField controls |
| SO-8 | Iterative Statement, Jump Statements- break, continue | Introducing Access Control, Understanding Static variables and methods | Exception, Understanding, Exception Types | Examples using Stack class , Introduction to Legacy Interfaces, Understanding Enumeration Interface- Examples using Enumeration interface | Introduction to Layout Manager- Understanding Flow Layout, Border Layout and Grid Layout |
| SO 9-10 | Practice 2: Program to implement the Sorting Operation using Control Statements | Practice 5: Implement Overloading Methods, Constructors program. Implement Tower of Hanoi program using Recursion | Practice 8: Program to implement the concept Packages, Interfaces | Practice 11: Program to implement the concept Legacy Classes and Binary Tree Traversal | Practice 14: AWT Controls, Layout Managers |
| SO-11 | Introduction to I/O Streams, Byte Streams classes | Understanding Final variables and methods, | Introduction to Exception handling, Working with try and | Introduction to Utility classes, Working with String Tokenizer | Introduction to JDBC, JDBC Drivers & Architecture |

| | | | | | |
|-----------------|--|---|--|---|---|
| | | Working with Nested Class | catch | | |
| SO-12 | Character Streams classes, Examples using Byte and Character Streams | Understanding Inner Class, Introduction to String Class | Using multiple catch clauses, Working with Finally, Throw and throws | Working with Date class, Calendar, GregorianCalendar-Random Class | Establishing JDBC connections, Types of Statements in JDBC |
| SO-13 | Command Line arguments | Working with String Handling Methods | Understanding Built-in Exceptions, Creating user defined Exceptions | Working with Scanner Class, Examples using utility classes | Working with JDBC Connections and CRUD operations |
| SO 14-15 | Practice 3: Program to implement the Stack operations using Array | Practice 6: Program to implement Linked List Concept Program to implement String Class | Practice 9: Implement Exception Handling program | Practice 12: Using Utility Classes implement the program | Practice 15: Implement the program using JDBC Connection |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| | | | | | | | | | | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|---|------------------------|----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | Clean Water & Sanitation |
| | | Mind Map | Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | |
| | | Problem Based Learning | |

| Resources | |
|-----------|--|
| 1. | Herbert Schildt, Java: The Complete Reference, 12th Edition, McGraw-Hill Education, 2021 |
| 2. | Cay S. Horstmann, Core Java Volume I – Fundamentals, 11th Edition, Prentice Hall, 2020 |
| 3. | Java Programming and Object-Oriented Application Development" by Daniel Liang, Comprehensive Version 9 th edition, Pearson 2012 |

| Designers | | | |
|----------------------|---|------------------|---|
| Professional Experts | Higher Institution Experts | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd |
| | | 1 | Dr.V.Nisha, SRMIST |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|---------------------------------------|-----------------------------|-----|----------------------------|-----------------|----------|---------------------------------|----------|----------|----------|----------|
| Code | PCA25C02T | Title | Data Structures and Algorithms | | | | Category | C | Professional Core Course | L | T | P | C |
| | | | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | | | 4 | 0 | 0 | 4 |

| | | | | | | | | | |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|-----------------------|--|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Learn the different data types; Gain Knowledge in linked list | | | | | | | | | | | | | | | | | | | | | | |
| CR-2 | Learn stack and queues in processing data for real-time applications | | | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Gain Knowledge in tree data storage structure for real-time applications | | | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Learn Graph and sorting techniques | | | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Utilize algorithms to find shortest data search in graphs for real-time application development | | | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | |
| CO-1 | Identify linear and non-linear data structures. Apply linked list in real-time applications | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | | | |
| CO-2 | Construct stack and queue data structures and evaluate its operations | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | |
| CO-3 | Create tree data structures and evaluate its types and operations | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | | | |
| CO-4 | Create graph data structure, evaluate its operations and apply sorting technique in real-time applications | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | |
| CO-5 | Understand the searching algorithm and various algorithm techniques | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | |

| Title & Session Outcomes | Introduction | Stack, Queue and Tree | Categories of Tree | Graph and Sorting | Algorithms |
|-------------------------------------|---|---|---|--------------------------------------|--|
| Duration (hour) | 12 | 12 | 12 | 12 | 12 |
| SO-1 | Overview and importance of algorithms Algorithm specification, Performance analysis | Introduction to stack, Representation of Stacks | Threaded Binary Tree, Application of Tree | Overview of Graph, Graph Terminology | Divide and Conquer: General method, applications |
| SO-2 | Asymptotic Notation, The Big-O, | Stack as ADT ,Stack Operations, | Introduction to Binary Search | Representation of Graph, Types of | Implementation of Min-Max |

| | | | | | |
|-------|--|--|--|--|---|
| | Omega and Theta notation, Programming Style, Refinement of Coding | | Tree(BST) | Graph, | Problem |
| SO-3 | Introduction to Data structures, Abstract Data type, Data representation | Applications of Stacks – Recursion, Towers of Hanoi, | Binary Search Tree: Construction, | Operation of Graph, Graph Traversal – BFS | Introduction to dynamic Programming, General method, applications |
| SO-4 | Complexity of Algorithms, Operations | Arithmetic Expressions, Polish notations | Operation of Binary Search tree, Introduction to AVL Tree | DFS | Multistage Graph Basics |
| SO-5 | Types of Data structures – Linear and Non Linear | Queue, Linked Representation of Queues | Operation of AVL, AVL Tree Rotations | Overview of Shortest Path Algorithm, Topological Sorting | Implementation of Multistage Graph problem |
| SO-6 | Arrays, Representation of Arrays, Types of Arrays | Queue as ADT, Operations on Queue | Applications of AVL tree, Introduction to Heap | Spanning Trees , Dijkstra Algorithm | Greedy Algorithm: General method, applications |
| SO-7 | Arrays operations | Types of Queue ; Priority Queue, Circular Queue, | Types of Heap, Application of Heap | Warshalls’s algorithm | Knapsack Problem Basics |
| SO-8 | Application of Arrays | Double ended Queue, Tree terminologies | Introduction of Search, Types of Search - Linear Search, Binary Search | Prims and Kruskals Algorithms | Implementation of Knapsack Problem |
| SO-9 | Introduction to lists, Representation of Linked list , Operations | Implementation of Tree, Function of Tree | Sorting, Types of Sorting: Internal and External Sort | Define Hashing | Backtracking: General method, applications |
| SO-10 | Types of Linked List, Header Linked List | Binary Tree, Representation of Binary Tree | Bubble Sort, Insertion Sort | Hash functions | Implementation of Sum of Subset Problem |
| SO-11 | Circularly Linked List | Properties of Binary tree, Tree Traversals–In order, | Radix sort, Merge Sort | Hashing: Collision avoidance | Branch and Bound: General method, applications |
| SO-12 | Doubly Linked List | Preorder Post order. | Quick Sort, Heap Sort | Hashing: Separate chaining, Open addressing, Advantages of Hashing, Extensible Hashing | Implementation of Travelling Salesman Problem |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|---|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | 20% | - | 20% | - | 20% | - | 20% | - | 20% | - |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | |
|--|--|
| 1. R.F.Gilberg,B.A.Forouzan,“Data Structures”,ThomsonIndi,2ndEdition, 2005 | 2. A.V.Aho,J.EHopcroft,J.D.Ullman,(2003),“Data structures and Algorithms”,1stEdition,Pearson Education |

| Designers | | |
|---|--|--|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R,Professor,National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements,GUVI Geek Networks Pvt Ltd | 1 Dr.S.Usha,SRMIST,Kattankulathur |
| 2 | 2 | 2 Dr.S.Sivakumar, SRMIST, Kattankulathur |

| | | | | | | | | | | | | | | | | |
|-------------|------------------|--------------|----------------------------|--|--|--|-----------------|---|---------------------------------|--|--|--|---|---|---|---|
| Code | PCA25C03J | Title | Database Technology | | | | Category | C | Professional Core Course | | | | L | T | P | C |
| | | | | | | | | | | | | | 3 | 0 | 2 | 4 |

| | | | | | | | | | |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | |
|-----------------------|---|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| CR-1 | To understand the basic concepts and terminology related to DBMS and Relational Database Design | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | |
| CR-2 | To design and implement Structured Query Language | | | | | | | | | | | | | | | | | | | | |
| CR-3 | To understand PL/SQL (Procedural Language/Structured Query Language) | | | | | | | | | | | | | | | | | | | | |
| CR-4 | To understand the architecture and Normalization Techniques | | | | | | | | | | | | | | | | | | | | |
| CR-5 | To understand Transaction management- Database Administration & Database Recovery | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Understand the fundamental concepts of database management systems (DBMS). | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | |
| CO-2 | Gain proficiency in Structured Query Language | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-3 | Acquire the skills to apply to PL/SQL (Procedural Language/Structured Query Language) | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | |
| CO-4 | Encouraging the learner to understand the various Normalization Techniques | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-5 | Impart working methodology of Transaction Management, Concurrency Control and Recovery Management | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | |

| Title & Session Outcomes | Introduction to Database concepts | Structured Query Language, DDL and DML commands | Concepts of PL/SQL | Decomposition & Normalization Techniques | Database Administration & Database Recovery |
|-------------------------------------|--|---|---------------------------|---|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Introduction to Database systems –File systems Vs DBMS- Advantages of DBMS | The Form of A Basic SQL Query- SQL Syntax, SQL Data Types | PL/SQL Overview | Single Tier –Three Tier Application Architecture | Transaction Management |
| SO-2 | Architecture of DBMS | Set Operations, SQL Expression | PL/SQL blocks | Client-Server Architectures | ACID Property |

| | | | | | |
|----------|---|--|---|---|---|
| SO-3 | Data Models, Structure of Relational Databases | Data Definition Language Commands- Data Manipulation Language Commands | PL/SQL: Variables, Constants | Advantages of the Three-Tier Architecture | Transaction States- Transaction Isolation & Isolation Levels |
| SO 4-5 | Practice 1- Create a Database Schema for University Database | Practice 4 : Implement DDL, DML commands | Practice 7: PL/SQL: Case, Loop | Practice 10: Implement Integrity Constraints | Practice 13: Implement the functions/procedures to begin, commit, and rollback transactions. |
| SO-6 | Database Schema - Schema Diagrams | Transaction Control Language Commands- Data Control Language Commands | PL/SQL Data Types | Properties of Decompositions- Preserving Decomposition | Concurrency Control: Types of locks |
| SO-7 | Relational Query Languages- Relationships And Relationship Sets | Aggregate Functions- SQL functions | PL/SQL: Conditional Statements | Normalization-Functional Dependency | File Organization: Indexing: Primary index – Secondary indices |
| SO-8 | Keys- Primary Key Constraint: | SQL Clauses - SQL Indexes | PL/SQL: Case, Loop | First, Second, Third Normal Forms | B tree Index, B+ tree Index |
| SO 9-10 | Practice 2: SQL queries for employee database with key constraints | Practice 5: Implement DCL,TCL Commands | Practice 8: Implementing PL/SQL Conditional Statements, Looping Statements | Practice 11: Implement First, Second and Third normalization techniques | Practice 14: Analyze the structure and properties of B-tree index and its variants |
| SO-11 | Unique Constraint- Foreign Key Constraint | SQL Queries- SQL Subqueries | PL/SQL: Procedure- PL/SQL: Function | Boyce Code Normal Form | Backup and Recovery Considerations & Recovery Control |
| SO-12 | Database Design and ER Diagrams | SQL Joins- SQL Views | PL/SQL: Cursor | Multi-valued Dependencies and Fourth Normal Form | Components for Backup and Recovery- Performing Offline backups |
| SO-13 | Entities, Attributes, And Entity Sets | SQL Triggers- SQL Procedures | PL/SQL: Exception | Join Dependencies and Fifth Normal Form | Types of Failures |
| SO 14-15 | Practice 3: Create ER Model University Database | Practice 6: Implement SQL sub queries, Joins and Clauses | Practice 9: : Sample programs for Cursors and Exceptions | Practice 12: Implement Fourth and Fifth form of normalization techniques | Practice 15: Case Study: Analyze different types of failures such as transaction failures, system crashes, and disk failures |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|--|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | | | |
|-----------|--|----|---|--|--|
| 1. | R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004 | 2. | A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008 | | |
| 3 | Kevin Loney , Oracle Database 10G: The Complete Reference, McGraw Hill, New Delhi.(Fifth RePrint-2007) | | | | |

| Designers | | | | | |
|----------------------|---|----------------------------|---|------------------|---|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.S.Belina V J Sara, SRMIST, Kattankulatur |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|--|--|--|--|-----------------|----------|-----------------------------------|----------|----------|----------|----------|
| Code | PGI25D01J | Title | Introduction to Computer Vision | | | | Category | D | Discipline Elective Course | L | T | P | C |
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| | | | | | | | | | |
|----------------------------|------------------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|------------------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|-----------------------|--|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CR-1 | Understand the basics of Computer vision including image formation and image processing techniques | | | | | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| CR-2 | Understand the image compression and feature detection techniques | | | | | | | | | | | | | | | | | | | |
| CR-3 | Conceive the Multiview geometry and 3D reconstruction techniques | | | | | | | | | | | | | | | | | | | |
| CR-4 | Understand the segmentation techniques including object detection | | | | | | | | | | | | | | | | | | | |
| CR-5 | Understand the Machine learning model for Computer Vision | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| CO-1 | Learn the basics of Computer vision including image formation and image processing techniques | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CO-2 | Apply the image compression and feature detection techniques | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-3 | Implement the Multiview geometry and 3D reconstruction techniques | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CO-4 | Learn the segmentation techniques including object detection | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-5 | Apply Machine learning techniques for Computer Vision | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |

| Title & Session Outcomes | Computer Vision Introduction | Image Compression & Restoration | 3D Construction | Segmentation & Detection | Computer vision for Machine learning |
|-------------------------------------|-------------------------------------|--|--|-------------------------------------|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Introduction to computer vision | Image compression Techniques | Multiview geometry and 3D construction | Introduction to Segmentation | Introduction to Machine Learning for computer vision |

| | | | | | |
|----------|---|---|---|--|--|
| SO-2 | Image formations - 2D, 3D transformations | Gaussian, Laplacian pyramids | Epipolar geometry | Active contours | Supervised and unsupervised learning for vision |
| SO-3 | 3D transformation to 2D projections | Wavelets and its applications | Fundamental of essential matrix | Split and merge techniques for segmentations | Evaluation metrics |
| SO 4-5 | Practice 1: Implement 2D and 3D transformations using OpenCV | Practice 4: Implement image compression techniques | Practice 7: Implement epipolar lines | Practice 10: Write a code to find active contours | Practice 13: Implement K-Nearest neighbor classifier |
| SO-6 | 3D to 2D projections, 3D Rotations, Lens Distortion | Geometric Transformations | Stereo Vision | Watershed | Various classification techniques |
| SO-7 | Photometric Image formation | Types of transformations | Structure from stereo and Motion | Region splitting and merging | Computer Vision in Real world problems |
| SO-8 | Lighting, Reflectance and shading | Image restoration techniques | Various techniques | Graph based segmentation | Image classification using KNN |
| SO 9-10 | Practice 2: Implement camera calibration | Practice 5: Implement geometric transformations | Practice 8: Write a code to find pixel level disparity | Practice 11: Implement watershed segmentation | Practice 14: Implement KNN for health care dataset |
| SO-11 | Introduction to Image Processing | Feature detection and descriptors | 3D reconstruction | Introduction to Object detection | Image classification using SVM |
| SO-12 | Point Operators, Linear Filters | Feature matching and tracking techniques | Shape from X, Active range finding. | Face detection | Image Classification using Decision Trees |
| SO-13 | Fourier transform, Wiener filtering | Edge detection and linking | Surface representation, point based representations | Instance recognition | Comparison of classifiers, advantages and disadvantages |
| SO 14-15 | Practice 3: Implement filters | Practice 6: Implement SHIFT, HOG technique | Practice 9: Implement any 3D reconstruction technique | Practice 12: Implement object detection technique | Practice 15: Implement SVM classifiers for any real world problem |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|-----------------|----------|-----------------|----------|-----------------|----------|-------------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | |
|-----------|---|----|--|
| 1. | Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011. | 2. | Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2 nd Edition, Cambridge University Press, March 2004 |
| 3. | R. Bishop; Pattern Recognition and Machine Learning, Springer, 2006 | 4. | R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992. |
| 5. | K. Fukunaga; Introduction to Statistical Pat- tern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990 | | |

| Designers | | |
|--|---|---|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R., Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 Dr. Vanitha, SRMIST, Kattankulathur |

| Code | PGI25D02J | Title | Intelligent Language Processing | | | | Category | D | Discipline Elective Course | L | T | P | C |
|------|-----------|-------|---------------------------------|--|--|--|----------|---|----------------------------|---|---|---|---|
| | | | | | | | | | | 3 | 0 | 2 | 4 |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Understand fundamentals of Natural Language Processing | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | |
| CR-2 | Understand Named Entity Recognition and Parsing techniques in NLP | | | | | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-3 | Understand NLP algorithms for parsing and topic modeling | | | | | | | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-4 | Explore advanced text processing techniques in NLP | | | | | | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CR-5 | Develop practical skills in implementing NLP based Applications | | | | | | | | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-1 | Demonstrate a comprehensive understanding of NLP Pipeline | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | | | | |
| CO-2 | Demonstrate a comprehensive understanding of the principles and different approaches in NLP | | | | | | | | | | | | | | | | | | | | | | |
| CO-3 | Develop practical skills in implementing NLP based pipeline | | | | | | | | | | | | | | | | | | | | | | |
| CO-4 | Apply NLP concepts to solve variety of real-world problems in text processing | | | | | | | | | | | | | | | | | | | | | | |
| CO-5 | Critically evaluate the performance and ethical implications of different NLP Real world applications | | | | | | | | | | | | | | | | | | | | | | |

| Title & Session Outcomes | Introduction to NLP | Text Analysis and Information Extraction | Semantic Approach | Semantic Representations and Information Retrieval in NLP | Intelligent Text Understanding and Generation |
|--------------------------|--|--|---|---|---|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Overview of NLP, Definition and Scope of NLP, Why ILP is | Introduction to Named Entity Recognition (NER), Types of | Probabilistic Context-Free Grammar (PCFG), Applications | Introduction to Word Vectors, Role and applications of word | Information Extraction and its |

| | Important. | Named Entities | of PCFG | vector | approaches |
|---------|---|---|--|---|---|
| SO-2 | Uses of NLP, Challenges of NLP, Natural Language Understanding (NLU), Natural Language Generation (NLG). | NER Approaches and Algorithms | Chunking and Segmentation, Chunking techniques and approaches | Word2Vec Model-CBOW and Skip Gram | Introduction to Text Summarization. |
| SO-3 | Retrieval based and Conversation based NLU and NLG | NER Applications, Challenges in NER | Hidden Markov Models | GloVe (Global Vectors for Word Representation);, FastText: | Extractive vs. Abstractive Summarization |
| SO 4-5 | Practice 1: Exploration of NLP Library - NLTK, SpaCy, CoreNLP and others | Practice 4: Building a Named Entity Recognition System | Practice 7: Implement a simple rule-based chunker that identifies noun phrases (NP) in a given sentence | Lab 9: Implementation of Word Similarity Exploration with Word Vectors | Lab 11: Case Study: Analyzing Twitter Data for Sentiment Analysis |
| SO-6 | Linguistics for NLP- Morphology, Syntax, Semantics, Pragmatics, Corpus and Corpus Linguistics | Introduction to Stopwords, Common Stopword Lists in Various NLP Applications | Conditional Random Field and its implementation. | ELMo (Embeddings from Language Models): BERT (Bidirectional Encoder Representations from Transformers): | Summarization in Real-world Applications. |
| SO-7 | Tokenization, Lemmatization, Stemming, stemming Algorithm | Introduction to Regular Expression, Splitting text into tokens based on regex pattern | Introduction to Topic Modeling , Generative vs. Discriminative Models in NLP, | Introduction to Information Retrieval, Information Retrieval Models-Vector space model and other models | Ethical and Social Implications of Summarization. |
| SO-8 | Introduction to Text encoding, Various text encoding techniques | Regex libraries and functions for text processing tasks, Regular expression Applications in NLP | Latent Dirichlet Allocation (LDA) | Query Processing and Evaluation, Semantic Search and Knowledge Graphs: | Introduction to Chatbots, Types of Chatbots |
| SO 9-10 | Practice 2: Perform tokenization, stemming, and lemmatization on a text dataset | Practice 5: Perform stop word removal from text | Practice 8: Implement a basic Latent Dirichlet Allocation (LDA) topic model using Python's Gensim library and apply it to a small text corpus | Lab 9: Implement a simple information retrieval system using a vector space model to retrieve relevant documents for user queries. | Lab 12: Case Study: Designing a Chatbot for Customer Service Queries |
| SO-11 | Introduction to POS tagging, POS tagging in NLP applications | Introduction to Syntax analysis in NLP, Syntax tree | Latent Semantic Analysis (LSA), implementation | Multimodal Information Retrieval, Challenges in Information Retrieval | Machine Translation, Rule-based Machine Translation (RBMT) |
| SO-12 | POS Tagging Algorithm and Techniques | Context Free Grammars, Syntax rules and productions in CFGs | Applications in Topic modeling, Challenges in Topic modeling | Information Fusion, Methods of Information Fusion-cross model information fusion | Statistical Machine Translation (SMT), Neural Machine Translation (NMT) |
| SO-13 | POS Tagging Libraries and Tools, Challenges in POS | Parsing in NLP, Dependency | Sentiment Analysis, Types of | Applications of Information Fusion in NLP:, Challenges in | Challenges in Machine Translation, Question Answering |

| | tagging | Parsing | Sentiment Analysis | Information Fusion | Systems |
|-------------|---|--|--|--|--|
| SO 14-15 | Practice 3: Apply Part-of-Speech (POS) tagging on sample sentences using various NLP tools and algorithms. | Practice 6: Develop a Python script to validate password strength based on specific criteria using regular expressions, and extract the username from an email address using regex. | Practice 9: Implement of sentiment analysis | Lab 10: Implement a basic system to perform sentiment analysis by fusing textual and visual features from social media posts. | Lab 13: Case Study: Building a Question Answering System for Wikipedia Articles |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|----------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|------------------|--|----|--|
| 1. | "Speech and Language Processing" by Daniel Jurafsky and James H. Martin: | 2. | Natural Language Processing with Python Quick Start Guide, NirantKasliwal, November 2018 |
| 3. | Practical Natural Language Processing, By Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta and Harshit Surana, June 2020 | 4 | YoavGoldberg, Neural Network Methods for Natural Language Processing |
| 5 | . Natural Language Processing with Python and spacy, Vasiliev, April 2020. | 6 | C.Manning and H.Schutze, —Foundations of Statistical Natural Language Processingl, MIT Press. Cambridge,MA:,1999 |

| Designers | | | | |
|-----------------------------|---|-----------------------------------|--|-------------------------|
| Professional Experts | | Higher Institution Experts | | Internal Experts |
| 1 | Dr. Gangadharan G.R,Professor,National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements,GUVI Geek Networks Pvt Ltd | Dr.S.Sivakumar, SRMIST |

| Code | PGI25D03J | Title | Intelligent Internet of Things (IIoT) | | | | Category | D | Discipline Elective Course | L | T | P | C |
|------|-----------|-------|---------------------------------------|--|--|--|----------|---|----------------------------|---|---|---|---|
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|----------------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|----|----|----|--|--|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | |
| CR-1 | Demonstrate the design, communication model and enabling technologies for IoT. | | | | | | | | Disciplinary Knowledge | | | | | | | | | | | | | | | | |
| CR-2 | Gain expertise in IoT protocols, wireless tech, and data analytics for edge AI. | | | | | | | | Problem Solving | | | | | | | | | | | | | | | | |
| CR-3 | Analyze microcontrollers, sensors, and interfaces in intelligent IoT systems. | | | | | | | | Design & Development | | | | | | | | | | | | | | | | |
| CR-4 | Learn how AI and IoT integrate for advanced data processing and ML. | | | | | | | | Analysis, Design, Research | | | | | | | | | | | | | | | | |
| CR-5 | Develop intelligent IoT solutions using generative models, microcontrollers, and cloud integration. | | | | | | | | Modern Tool Usage | | | | | | | | | | | | | | | | |
| | | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | | | | | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Understand IoT architecture, security, and real-world applications. | ✓ | | | | 5 | 85 | 75 | | | | | | | | | | | | | | | | | |
| CO-2 | Understand IoT protocols, wireless technologies, and data analytics | ✓ | ✓ | ✓ | | 4 | 85 | 75 | | | | | | | | | | | | | | | | | |
| CO-3 | Enhance IoT skills for Devices, Cloud, and Smart Systems. | | ✓ | | | 6 | 85 | 75 | | | | | | | | | | | | | | | | | |
| CO-4 | Apply IoT and AI concepts for data processing, ML, and smart automation. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | | | | | | | | | | | | | | | | | |
| CO-5 | Develop IoT solutions with AI, microcontrollers, cloud, and automation. | ✓ | ✓ | | | 2 | 85 | 75 | | | | | | | | | | | | | | | | | |

| Title & Session Outcomes | Fundamentals and Applications | Protocols, Analytics, and Edge Computing | IoT Systems, AI Integration, and Cloud Computing | IoT and AI: Foundations and Applications | IoT and AI: Smart Systems & Cloud |
|-------------------------------------|--|---|--|---|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | IoT Fundamentals: Definitions, Architectures, Challenges, and Promises, Impact | IoT Protocols and Software: MQTT, UDP, HTTP, AMQP, CoAP - XMPP and Gateway Protocols | The Smart “Things” in IoT: Definition and Architecture of Smart Things | Principles and Foundations of IoT and AI: IoT Reference Model, IoT Platforms. Big Data and IoT | Generative Models for IoT: Generating Images using VAEs |
| SO-2 | Benefits of Adopting IoT in Healthcare - IoT Cyber Security | IoT point to point communication technologies: IoT Communication Pattern - IoT protocol Architecture | Sensors, Actuators and Electrical Motors | Cross-Industry Standard Process for Data Mining, AI platforms and IoT platforms - TensorFlow, Keras, Datasets | GANs - Personal and Home IoT |
| SO-3 | Architectures and Reference Models of IoT: IoTWF Reference Model of IoT - Simplified Reference Model of IoT | Selection of Wireless Technologies: 6LoWPAN, Zigbee, WIFI | Processing Unit: Microcontroller, Classifications of Microcontrollers - Three Main Types of Microcontrollers | Data Access and Distributed Processing for IoT: TXT format | IoT and Smart Homes - Smart Lighting |
| SO 4-5 | Practice 1: Arduino Installation and Blink LED using Node MCU Esp8266 | Practice 4: Interfacing Temperature Humidity Sensor with Node MCU Esp8266 | Practice 7: Create a an Access point and a Webserver using Node MCU Esp8266 | Practice 10: Create a Voice Controlled Switch Using Arduino IoT Cloud | Practice 13: Integrating IR sensor with Raspberry pi and control an LED using python |
| SO-6 | IoT Applications in Vertical Market: Smart Agriculture, Logistics and Transportation - Smart Grid, Smart Building, Smart Factory, Smart City | Data Analytics for IoT: Data; IoT Data Analytics Overview and Challenges - Machine Learning: Supervised Learning and Unsupervised Learning, Neural Networks - Machine Learning and Getting Intelligence from Big Data | ARM Microcontrollers - Architecture | CSV format, XLSX format - Working with the JSON format, HDF5 format | Microcontrollers for IoT: Introduction to Arduino, ESP8266 Node MCU, Arduino IDE, Raspberry pico |
| SO-7 | Standards: “Traditional” Internet Review - Physical/Link Layer | Predictive Analytics - Big Data Analytics Tools and Technology, Massively Parallel Processing Databases - NoSQL Databases, Hadoop, YARN - The Hadoop Ecosystem, Apache Kafka, Lambda Architecture | GPIOs and Interfaces: General-Purpose Input/Output (GPIO), Analog Inputs, Analog Outputs | Machine Learning for IoT: ML and IoT - Prediction using Linear Regression, Logistic Regression for Classification | Getting Started with the ESP8266 , Installing the Arduino IDE for the ESP8266 - Connecting your module to your Wi-Fi Network |
| SO-8 | Network Layer - Transport Layer , Application Layer | Edge Streaming Analytics - Comparing Big Data and Edge Analytics, Edge Analytics Core | Parallel Interfaces vs Serial Interfaces, Universal Asynchronous, | Classification using Support Vector Machines - Naive Bayes, Decision Trees | Reading data from a GPIO pin Grabbing the content from a web page - Reading Data from a |

| | | | | | |
|----------|--|---|---|--|---|
| | | Functions - Distributed Analytics Systems - Network Analytics - Flexible NetFlow Architecture | Receiver/Transmitter (UART) - Serial Peripheral Interface (SPI), I2C (Inter-integrated Circuit) - Universal Synchronous Asynchronous Receiver Transmitter | | Digital Sensor |
| SO 9-10 | Practice 2: Interfacing Light Sensor with ESP8266 NODE MCU WiFi Board | Practice 5: Interfacing MQ 4 GAS Sensor with Node MCU Esp8266 | Practice 8: Interfacing Temperature Humidity Sensor and Visualize data in Cloud Server with Node MCU Esp8266 | Practice 11: ESP8266 NodeMCU Data Logging to Firebase Realtime Database | Practice 14: Raspberry Pi: Send an Email using Python |
| SO-11 | The Internet of Things: Designing the Architecture of an IP-based Internet of Things - Physical / Link Layer | Open source IoT platforms, Cloud Dashboards | IoT Frameworks and Platforms: FIWARE, SmartThings, AWS IoT - Microsoft Azure IoT | Deep Learning for IoT - Artificial Neuron, Modelling Single Neuron in TensorFlow - Convolutional Neural Networks | Cloud Data Logging with the ESP8266 - Hardware and Software requirements - |
| SO-12 | Network Layer and Transport Layer - Application Layer: Constrained Application Protocol (CoAP) | Fog Computing: Need for Fog Computation - Fog Applications | Azure IoT Edge, Azure Stream Analytics, | Different layers of CNN - Some popular CNN models | Configuration and Testing the sensor, Logging data to Cloud server, Displaying data using Cloud Application |
| SO-13 | CoSIP Protocol Specification - Related work on Session Initiation | Edge computing: Need for Edge Computation - Edge Applications | Azure Machine Learning, Azure Logic Apps | LeNet to recognize handwritten digits on IoT Device - Recurrent Neural Networks | Controlling an LED from a cloud dashboard; Controlling the Lamp from anywhere in the World |
| SO 14-15 | Practice 3: Lab 3: Interfacing Infrared (IR) Sensor with Node MCU Esp8266 | Practice 6: Interfacing Relay and Control LIGHT with Node MCU Esp8266 | Practice 9: Create a Smart Switch to Control Light from Internet | Practice 12: Install OS and Configure Raspberry pi | Practice 15: Install Mosquitto MQTT Broker on Raspberry Pi |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------|----------|--------|----------|--------|----------|-----------------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | | | |
| | | (10 %) | | (10%) | | (20%) | | (10%) | | (50% Weightage) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | | | |
|-----------|--|--|--|----|---|
| 1 | Internet of Things: Architectures, Protocols and Standards, Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, 2019 Wiley. | | | 2. | Intelligent Internet of Things From Device to Fog and Cloud, Farshad Firouzi, Krishnendu Chakrabarty Sani Nassif, Springer. |
| 3. | IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" – By David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry, Cisco Press. | | | 4 | Kamal, R., "Internet of Things – Architecture and Design Principles," 1st Edition, Mcgraw Hill, 2017. |
| 5 | Hands-On Artificial Intelligence for IoT, Amita Kapoor, 2019, Packt Publishing Ltd. | | | 6. | Internet of Things with ESP8266, Marco Schwartz, 2019, Packt Publishing Ltd. |

| Designers | | |
|----------------------|----------------------------|------------------|
| Professional Experts | Higher Institution Experts | Internal Experts |
| | | |

| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.S.Balamurugan, SRMIST | | | | | |
|------|---|-------|---|---|--------------------------|---|-------------------------|---|---|---|
| Code | PGI25G01T | Title | Deep Neural Networks | | Category | G | Generic Elective Course | | | |
| | | | | | | | L | T | P | C |
| | | | | | | | 2 | 0 | 0 | 2 |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | |
| CR-1 | Understanding the fundamental concepts of deep learning | | | | | | | | | | | | | | | | | | | | | | | |
| CR-2 | Understand the principles and algorithms of deep neural networks | | | | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Understand the optimization techniques and training procedures | | | | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Explore advanced architectures of deep neural networks | | | | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Develop practical skills in implementing deep neural networks | | | | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | | |
| CO-1 | Demonstrate the basic concepts of deep neural networks. | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | | | | |
| CO-2 | Demonstrate a comprehensive understanding of the principles and algorithms of deep neural networks. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | |
| CO-3 | Develop practical skills in implementing, training, and evaluating deep learning models | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | | | | |
| CO-4 | Implement advanced architectures of deep neural networks | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|------|---|---|---|--|--|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-5 | Evaluate the performance and ethical implications of deep learning models | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |
|------|---|---|---|--|--|---|----|----|---|---|---|---|---|---|---|---|---|---|---|---|

| Title & Session Outcomes | Concepts of Deep Learning | Principles of Deep Neural Networks | Deep learning models Implementation | Advanced architectures of DNNs | Ethical implications of DNN |
|--------------------------|---|---|---|--|--|
| Duration (hour) | 6 | 6 | 6 | 6 | 6 |
| SO-1 | Overview of Machine Learning and Deep Learning | Artificial neural network Deep Neural Network | Convolutional Neural Network | Recurrent Neural Networks (RNNs) | Autoencoders, Architecture, Types of Autoencoder |
| SO-2 | Evolution of Neural Network | Feed Forward Neural network, Training Deep neural network, Vanishing /Exploding Gradient Problems, Avoiding Overfitting through Regularization | Building Blocks of CNNs, Convolutional Layers, Pooling Layer, Activation Functions, Fully Connected Layer | Architecture of RNN, Types of RNN | Variational Autoencoders Basics Encoder Network, Decoder Network |
| SO-3 | Deep learning Libraries Tensorflow Keras | Training a Neural Network with Backpropagation | CNN Architecture LeNet, AlexNet, VGGNet, ResNet,DenseNet | Long Short Term Memory (LSTM), Architecture of LSTM, Training LSTM, Hyperparameter tuning, -Gated Recurrent Units (GRUs) Basics, GRU Architecture, Training GRU, Hyperparameter tuning | Generative Adversarial network What is GAN?, Generator Discriminator, Loss Functions Training ,Optimization Evaluation, Applications of GAN |
| SO-4 | Applications of Deep Neural Network: Computer Vision, Natural Language Processin, Healthcare & Medical AI Speech Recognition and Synthesis | Activation functions, Straight-line functions Step Functions Piecewise Linear Functions, Smooth Functions Softmax | Transfer Learning, Using Pretrained models (VGG, ResNet,), Fine-tuning on new Datasets | Bidirectional RNNs, Basic structure, Training Bidirectional RNNs, Implementing Bidirectional RNNs | Attention Mechanism : Self – Attention Multi-Head Attention |
| SO-5 | Biological Neurons to Artificial Neurons, Logical Computations with Neurons, Perceptron | Forward and Backward Propagation Forward propagation (Forward pass) Input layer processing, Weighted sum computation, Activation function, Output layer computation- Backward propagation (Backward pass), Computing Loss Computing Gradients Updating Weights | Optimization Techniques, Stochastic Gradient Descent, Adam Adagrad RMSProp, Adadelata | Attention Mechanism: Seq2Seq models with Attention | Vision Transformers, Image Patching and Embedding, Positional Encoding Training Vision Transformers, Advantages and Challenges of ViTs |

| | | | | | |
|------|--|---|-----------------------------------|--------------------------------------|---|
| SO-6 | Multi-layer perceptron, Hidden Layers, Activation Functions, Implementation of Multilayer Perceptron, Initializing Model Parameters, Activation Function, Model Loss Function Training | Loss Functions, Types of Loss functions, Regression Loss Functions: MSE, MAE, Classification Loss Functions: Binary Cross-Entropy, Categorical Cross Entropy, Sparse Categorical Cross Entropy, KL Divergence | Application: Image Classification | Application: Text Sentiment Analysis | Application: Image Generation using GAN |
|------|--|---|-----------------------------------|--------------------------------------|---|

| Assessment | | | | | | | | | |
|-------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|---|------------------------|----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | ✓ Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | Clean Water & Sanitation |
| | | Mind Map | Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | |
| | | Problem Based Learning | |

| Resources | | | |
|-----------|--|----|---|
| 1. | Ian Goodfellow, Yoshua Bengio, Aaron Courviller, Deep Learning , edition, Determination Press,2015 | 2. | Michael A.Nielsen,Neural Networks and Deep Learning, edition, Determination Press, 2015 |
| 3. | Aurelien Geronr, Hands-on Machine Learning with Scikit-Learn,Keras & Tensorflow,concepts,tools and Techniques to build Intelligent Systems, 2019 | 4. | Aston Zhang,Zahary C.Lipton, Mu Li and Alexander J.Smola , Dive-intoDeep_Learning, 2021 |
| 5. | Andrew Glassner, Deep Learning A Visual Approach, edition, no starch press, 2021 | 4. | |

| Designers |
|-----------|
| |

| Professional Experts | | Higher Institution Experts | | Internal Experts | |
|----------------------|---|----------------------------|---|--------------------------------------|--|
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | Dr.S.Lakshmi, SRMIST, Kattankulathur | |

| Code | PGI25G02T | Title | Building GPT Powered Business Applications | | | | Category | G | Generic Elective | L | T | P | C |
|------|-----------|-------|--|--|--|--|----------|---|------------------|---|---|---|---|
| | | | | | | | | | 2 | 0 | 0 | 2 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|----------------|--|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|
| | | 1 | 2 | 3 | 4 | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Rationale (CR) | The purpose of learning this course is to: | | | | | | | | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| CR-1 | Learn the aspects related to ChatGPT, Capabilities, advancements and future of ChatGPT. | | | | | | | | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-2 | Familiarize the Natural Language Processing functionalities, Part of Speech, NLP Tools and Techniques. | | | | | | | | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-3 | Conceive the concept of Prompt Engineering, LLM and advanced techniques for text generation, | | | | | | | | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CR-4 | Identify and acquire knowledge in AI Chatbot, Copilot and Role of AI in Image Generation | | | | | | | | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |
| CO-1 | Acquire the basics of ChatGPT, Capabilities, advancements and future of ChatGPT | ✓ | | | | 5 | 85 | 75 | 2 | 85 | 75 | | | | | | | | | |
| CO-2 | Enhance knowledge in Natural Language Processing functionalities, its tools and techniques. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | | | | | | | | | | | | |
| CO-3 | Design and implement techniques in Prompt Engineering | | ✓ | | | 6 | 85 | 75 | | | | | | | | | | | | |
| CO-4 | To gain knowledge in AI Chatbot, Copilot and AI in Image Generation | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | | | | | | | | | | | | |
| CO-5 | Apply knowledge in developing GPT Powered Applications | ✓ | ✓ | | | 2 | 85 | 75 | | | | | | | | | | | | |

| Title & Session Outcomes | Introduction to ChatGPT | NLP Techniques | Prompt Engineering | AI Chatbot, Copilot | Building GPT Powered Applications |
|-------------------------------------|---|---|---|--|--|
| Duration (hour) | 6 | 6 | 6 | 6 | 6 |
| SO-1 | Introduction to ChatGPT | Named entity recognition (NER) techniques | Introduction to Prompt Engineering – The Five Principles of Prompting | Introduction to AI Chatbot | Building GPT Powered Applications |
| SO-2 | Advancements and future of GPT Models | Markov chains and Hidden Markov Models | Standard Practices for Text Generation with ChatGPT | Working of AI Chatbots | AI Blog Writing |
| SO-3 | Introduction to OpenAI | Smoothing techniques for language models | Advanced Techniques for Text Generation with LangChain | Copilot by Github, Working of copilot | Topic Research, Expert Interview |
| SO-4 | Large Language Models(LLM) | Text Classification and Sentiment Analysis | Introduction to Diffusion Models for Image Generation | Creating an application with copilot | Text Generation, Writing Style |
| SO-5 | Introduction to Natural Language Processing (NLP) - Overview of NLP | Lexicon-based and machine learning approaches | Define GPT in academic perspective | Comparison of ChatGPT, Bard, LLAMA, Claude | Title Optimization |
| SO-6 | Text preprocessing techniques, Word Representations | Introduction to word embeddings (Word2Vec, GloVe) | Realtime Examples of GPT | AI Tools for Image Generation | AI Blog Images, User Interface |

| Assessment | | | | | | | | | |
|-------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | | |
|-----------|---|---|---|--|
| 1. | Lane, H., & Hapke, H. (2019). Natural Language Processing in Action: Understanding, Analyzing, and Generating Text with Python. Manning Publications. | 2 | James Phoenix & Mike Taylor, “Prompt Engineering for Generative AI”, O’REILLY Publication. | |
| 3. | Olivier Caelen & Marie-Alice Blete, “Developing APPS with GPT-4 and ChatGPT”, O’REILLY Publication. | 4 | . Steven Bird, Ewan Klein and Edward Loper.”Natural Language Processing with Python”, O’REILLY Publication. | |

| Designers | | | | | |
|----------------------|---|----------------------------|---|------------------|---|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.G.Mothilal Nehru, SRMIST, mothilag@srmist.edu.in |

| Code | PGI25G03T | Title | Cloud Infrastructure for Generative AI | | | | Category | G | Generic Elective Course | L | T | P | C |
|------|-----------|-------|--|--|--|--|----------|---|-------------------------|---|---|---|---|
| | | | | | | | | | 2 | 0 | 0 | 2 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | Depth | Attainment | Program Outcomes (PO) | | | | | | | | | | | | | | | | | |
|---|---|------------|-----------------------|---------|--------------------------|---|----|------------------------------|---|---|---|---|---|---|---|---|----|----|----|---|
| CR-1 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| <i>The purpose of learning this course is to:</i> | | | | | | | | | | | | | | | | | | | | |
| Introduces the foundational concepts of Generative AI and cloud computing, establishing the need for scalable infrastructure in AI workflows. | | | | | Level of Thinking | | | Disciplinary Knowledge | | | | | | | | | | | | |
| Equips students with knowledge of cloud-based compute, storage, and networking resources essential for training and managing large AI models. | | | | | Expected Proficiency (%) | | | Problem Solving | | | | | | | | | | | | |
| Enables learners to containerize and orchestrate generative AI workloads using modern DevOps and MLOps practices. | | | | | Expected Attainment (%) | | | Design & Development | | | | | | | | | | | | |
| Trains students to deploy, scale, and optimize generative AI models for real-time and batch inference in cloud environments. | | | | | | | | Analysis, Design, Research | | | | | | | | | | | | |
| Raises awareness of security, governance, and ethical challenges in deploying AI responsibly on cloud platforms. | | | | | | | | Modern Tool Usage | | | | | | | | | | | | |
| | Conceive | Design | Implement | Operate | | | | Society & Culture | | | | | | | | | | | | |
| | | | | | | | | Environment & Sustainability | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | | | | | | | | | | | | | | | | | | | |
| CO-1 | Explain the fundamentals of Generative AI models and the role of cloud infrastructure in supporting them. | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CO-2 | Identify and evaluate cloud-based compute, storage, and networking components required for training and deploying GenAI models. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-3 | Apply containerization and orchestration techniques to build scalable GenAI pipelines on cloud platforms. | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CO-4 | Design and implement inference and deployment strategies for real-time and batch GenAI applications using cloud-native tools. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-5 | Evaluate the security, ethical, and governance challenges in deploying generative AI in a cloud environment. | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |

| Title & Session Outcomes | Introduction to Generative AI & Cloud Computing | Overview of Cloud Computing | Storage, Networking & Security for AI Workloads | Generative AI Architecture and Model Building | Deployment and Management of GenAI Models |
|-------------------------------------|--|--|---|--|--|
| Duration (hour) | 06 | 06 | 06 | 06 | 06 |
| SO-1 | What is Generative AI? Definition of Generative AI, Difference between generative and discriminative AI models | Introduction to Cloud Computing- Definition of Cloud, Characteristics of Cloud Computing | Computer Services : VMs, Containers, Serverless | Architecture of Generative AI System – Data Pipeline, | Deployment Strategies for GenAI Models: Batch Inference vs Real-Time APIs, REST APIs with FastAPI, Flask, or Streamlit |
| SO-2 | Overview of Gen AI types, Application of Generative AI | History and Evolution of Cloud Computing | Storage Services : Block Storage, Object Storage, File Storage | Component of Model Training, Building Generative Models – Preprocessing and Tokenization | Model Serialization: ONNX, SavedModel, TorchScript |
| SO-3 | Basics of neural network basics, GANs - Architecture, Working process – Variants - applications | Cloud Architecture, Cloud Service Models: IaaS, PaaS, SaaS | Compute resource: GPU and TPU | Choosing a Base Model , Transfer Learning and Fine-Tuning | Model Hosting Options: cloud function, Container services, Model Gateways |
| SO-4 | VAEs- Concept of encoding and decoding, Latent space representation | Cloud deployment Model, Benefits of Cloud Computing and Challenges in Cloud Adoption | Data Lifecycle Management in AI Workflows | Model Training Pipelines: MLOps Tools: MLFlow, Weights & Biases | Monitoring and Logging Models in Production |
| SO-5 | Transformer – based Generative Models – attention mechanism – How transformers generated text and other modalities | Cloud Provider: AWS, Azure, Google, Cloud | Networking Essentials: VPC, Subnets, Load Balancers, API Gateways, Bandwidth, Latency, and Data Movement Challenge | Training Monitoring and Logging | Performance Tuning and Cost Optimization |
| SO-6 | Overview of training process – pre-training, fine-tuning | Virtualization Technology, Hypervisors | security Aspects: Identity and Access Management (IAM), Encryption (At Rest and In Transit), Network Firewalls and Secure Access (VPN, Bastion Hosts), Compliance Standards: GDPR, HIPAA, ISO | AI/ML Services: AWS Sagemaker, GCP Vertex AI, Azure ML Studio | Managing Model Drift, Feedback Loops, and Model Updating |

| Assessment | | | | | | | | | |
|-------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|-----------|---|---|---|
| 1. | Designing Cloud Data Platforms" Danil Zburivsky & Lynda Partner Publisher: O'Reilly Media | 2 | "Cloud Computing: Concepts, Technology & Architecture", Thomas Erl, Ricardo Puttini, Zaigham Mahmood, Pearson |
| 3. | Machine Learning Engineering with Python: Manage the Production Life Cycle of Machine Learning Models Using MLOps with Practical Examples", Andrew P. McMahon, Pack | | |

| Designers | | | | | |
|----------------------|---|----------------------------|---|------------------|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr. M.GRACY, SRMIST, gracym2@srmist.edu.in |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|----------------------------------|--|--|--|-----------------|----------|----------------------------------|----------|----------|----------|----------|
| Code | PGI25S01J | Title | Generative AI and Open AI | | | | Category | S | Skill Enhancement Courses | L | T | P | C |
| | | | | | | | | | 2 | 0 | 3 | 4 | |

| | | | | | | | | | |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|-----------------------|--|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Understand Generative AI | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | |
| CR-2 | Introduction to Generative models | | | | | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-3 | Understanding OpenAI Technology | | | | | | | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-4 | Generative Adversarial Networks | | | | | | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CR-5 | OpenAI tools | | | | | | | | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | | | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Understand the basic concepts of Generative AI | ✓ | | | | 5 | 85 | 75 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | |
| CO-2 | Design and implement VAE generative models. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | |
| CO-3 | Apply and understand appropriate data modeling techniques | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | | | |
| CO-4 | Perform appropriate modeling techniques to implement text generation | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | |
| CO-5 | Implement Image synthesis using OpenAI | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | |

| Title & Session Outcomes | Introduction to Generative AI | Introduction to Autoencoders | Introduction to GAN | Introduction to Text Generation | Introduction to DALL-E |
|-------------------------------------|--|--|---|---|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Introduction to AI, ML and DL, Real world applications of AI,ML,DL | Definition and intuition behind autoencoders.,Applications of autoencoders | Definition and motivation behind Generative Adversarial Networks (GANs)., Overview of Generative Adversarial Networks (GANs). | Introduction to Text Generation: Text generation tasks - language modeling, text completion, and dialogue generation. | Overview and core principle of DALL-E, DALL-E's architecture |

| | | | | | |
|----------|---|---|---|---|---|
| | | | | Applications of text generation | |
| SO-2 | Introduction to GEN AI, ML Vs Gen AI, Generative Models Overview : Types of Generative Models | Autoencoder – Architecture, Different activation functions and layer configurations. Training Autoencoders: Overview of the backpropagation algorithm for training autoencoders., Understanding techniques for optimizing reconstruction loss - gradient descent and stochastic gradient descent. | GANs Architecture: Generator and discriminator networks' architectures. Role of activation functions and normalization techniques in GAN architecture. Training GANs: Overview of the minimax game framework used for training GANs | Evolution of GPT Models: Overview of the key advancements and improvements from GPT-1 to GPT-3, including model size, training data, and performance metrics. Impact of each GPT model, GPT Architecture Overview: Transformer architecture and its components, Self-attention mechanisms and feed-forward neural networks. | Transformer-based design and attention mechanisms. Training Process of DALL-E: data collection, preprocessing, and model optimization. Understanding DALL-E's Capabilities |
| SO 3 - 5 | Practice 1: Simple programs on Open API | Practice 4: on implementing a basic autoencoder using TensorFlow or PyTorch. | Practice 7: GAN model using TensorFlow or PyTorch | Practice 10: Fine-tuning GPT for Text Generation. | Practice 13: generating images using DALL-E |
| SO-6 | Applications of generative models in image generation and NLP | VAEs and the role of the latent space. Comparison between traditional autoencoders and VAEs | Training Dynamics: Exploration of the iterative process of generator and discriminator updates during GAN training, Analysis of the Nash equilibrium and convergence properties in GAN training dynamics. | Pretraining Objectives: autoregressive language modeling, masked language modeling | Image Representation in DALL-E: interpretation and representation of textual descriptions, latent space representation used by DALL-E |
| SO-7 | Understanding OpenAI: History and evolution of OpenAI , OpenAI's Technologies: Overview of GPT models | Latent Space Representation- Techniques for visualizing and interpreting the latent representations, Loss Functions in VAEs: reconstruction loss and the KL divergence loss in VAEs. Trade-off between reconstruction fidelity and regularization in VAE training. | Loss Functions in GANs: Adversarial loss and the role of the generator and discriminator loss functions. Introduction to additional loss functions like feature matching and gradient penalty in GAN training. | Fine-tuning GPT Models: Hyperparameters and optimizing fine-tuning performance. Transfer Learning with GPT: Overview of transfer learning approaches such as feature extraction and fine-tuning, benefits and challenges of transfer learning with GPT | Text-to-Image Generation with DALL-E: Overview of the text-to-image synthesis process techniques and strategies for optimizing the generation process and improving image quality |
| SO 8 -10 | Practice 2 : Training a simple Autoencoder model on a dataset. | Practice 5: Implementing a Variational autoencoder using TensorFlow or PyTorch | Practice 8: Implementing a DCGAN for image generation | Practice 11:-conditioning GPT models for specific text generation tasks | Practice 14 conditioning DALL-E to generate images |
| SO-11 | Ethical Considerations in AI, Challenges related to interpretability and control in generative AI models. | Real-world examples of using autoencoders for image denoising and anomaly detection. Applications of VAEs in generating novel images and | Progressive Growing GANs (PGGANs): Overview of the progressive growing and benefits of progressive growing in generating realistic and diverse images. | Text Generation Techniques: Greedy decoding, beam search, and nucleus sampling used for text generation with GPT models. Evaluation Metrics for Text Generation | Conditioning DALL-E for Image Synthesis: DALL-E's image generation process, DALL-E's image synthesis using conditioning Ethical |

| | | | | | |
|----------|---|--|--|--|--|
| | | performing image-to-image translation tasks. | | | Considerations in Image Synthesis- Limitations and Challenges of DALL-E |
| SO-12 | Limitations of current generative models in capturing complex data distributions, Future Trends Exploration of reinforcement learning-based generative models | Comparison with Other Models Comparison of the training stability and sample quality between autoencoders, VAEs, and GANs., interpretability and controllability of generated samples in autoencoders versus GANs | Self-Attention GANs (SAGANs): Mechanisms and their integration into GAN architectures. Wasserstein GAN (WGAN) and WGAN-GP, Conditional GANs: class-conditional and image-to-image translation GANs. Applications of conditional GANs | Ethical Considerations in Text Generation: Real-world Applications of GPT: Case studies and examples demonstrating the use of GPT models. Advanced GPT Architectures :Overview of advanced transformer-based architectures - XLNet, T5, and BERT | Applications of DALL-E: design automation, content creation, and visual storytelling. Comparison with Other Image Synthesis Models: Comparative analysis of DALL-E GANs (Generative Adversarial Networks) and VAEs (Variational Autoencoders). |
| SO 13-15 | Practice 3: Implementing a basic GAN architecture for generating synthetic images using a pre-trained model. Top of Form | Practice 6: VAEs for anomaly detection in datasets | Practice 9: implementing a Progressive Growing GAN | Practice 12: interpreting and analyzing the output of GPT models for text generation tasks. | Practice 15: Preprocessing and formatting datasets for training and fine-tuning DALL-E models. |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | - | 40% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | | | | | | | | | | |
| 4 | Analyze | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | - | 40% |
| 5 | Evaluate | | | | | | | | | | |
| 6 | Create | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | - | 20% |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|---|------------------------|----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | Clean Water & Sanitation |
| | | Mind Map | Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | |
| | | Problem Based Learning | |

| Resources | | | |
|------------------|--|---|--|
| 1 | Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning (Chapter 20: Generative Models). 2016 | 2 | Stefano Van Der Walt, Benjamin Kallus, and Alex Lavin. "Hands-On Generative Adversarial Networks with PyTorch 1.x: Implement next-generation neural networks to build powerful GAN models using Python |
| 3 | Jakub Langr and Vladimir Bok, "GANs in Action: Deep learning with Generative Adversarial Networks" | | |

| Designers | | | | | |
|-----------------------------|---|-----------------------------------|---|-------------------------|---------------------------------|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.J.Anita Smiles , SRMIST, KTR |

| (hour) | | | | | |
|--------|---|---|-------------------------------------|--|--|
| SO-1 | Classification of Numbers & Tests of Divisibility | Problems on Averages and Percentage | Time and work - Problems | Clock - Problems | Number Puzzles - Problems |
| SO-2 | Unit Digit & Trailing Zeroes | Problems on Discount | Time, Speed and Distance Problems | Problems on Calendar | Logical Puzzles –Problems |
| SO-3 | Arithmetic Progression Geometric Progression | Problems on Simple Interest and Compound Interest | Boats and Streams - Problems | Direction Sense – Problems | Sequential Output Tracing – Problems |
| SO-4 | Highest Common Factor (HCF) Least Common Multiples (LCM) | Profit and Loss - Problems | Mixtures and Alligations – Problems | Blood relation-Problems | Inductive, Logical, Abstract and Diagrammatic Reasoning – Problems |
| SO-5 | Simplification - Problems | Permutation and Combination – Problems | Height and Distance - Problems | Data Interpretation – Table and Bar chart | Alphanumeric Series - Problems |
| SO-6 | Virnaculum - Problems | Problems on Probability | Problems based on Ages | Data Interpretation – Pie Chart and Line graph | Coding and Decoding - Problems |

| Assessment | | | | | | | | |
|-------------------|--|----------|-----------------|----------|-----------------|----------|------------------|----------|
| Level of Thinking | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | CLA– 1 (20%) | | CLA– 2 (20%) | | CLA– 3 (30%) | | CLA – 4 (30%) | |
| | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| | 1 Remember | | | | | | | |
| 2 Understand | 40% | - | 40% | - | 40% | - | 40% | - |
| 3 Apply | | | | | | | 40% | - |
| 4 Analyze | 40% | - | 40% | - | 40% | - | 40% | - |
| 5 Evaluate | | | | | | | | |
| 6 Create | 20% | - | 20% | - | 20% | - | 20% | - |
| Total | 100 % | | 100 % | | 100 % | | 100% | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | | No Poverty |
| Emulations | | Group Discussion | ✓ | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | ✓ | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | ✓ | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | ✓ | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | ✓ | |

| Resources | | | |
|------------------|---|----|--|
| 1. | Dr. Agarwal.R.S, Quantitative Aptitude for Competitive Examinations, S. Chand and Company Limited, 2018 Edition | 2. | Archana Ram, PlaceMentor: Tests of Aptitude for Placement Readiness, Oxford University Press, Oxford, 2018 |
| 3 | Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill, 5th Edition | 4 | Edgar Thrope, Test Of Reasoning for Competitive Examinations, Tata McGraw Hill, 6th Edition |

| Designers | | | | | |
|-----------------------------|--|-----------------------------------|---|-------------------------|---|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Mr. Varadha Rajan M (External Expert), Assistant Manager – Human Resources, Justdial Limited, Chennai – 600015 varadha1723@gmail.com | 1 | Dr. Premavathy M, Associate Professor , Department of English Center for Distance and Online Education, Bharathidasan University, Tiruchirappalli – 620024 drmpremavathy@bdu.ac.in | 1 | Dr. Deepalakshmi S, HoD, Department of Career Guidance Cell, FSH, SRMIST |
| | | | | 2 | Dr. Sathish K, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST |
| | | | | 3 | Dr. Aarthi S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST |

SEMESTER – II

| Code | PCA25C04J | Title | Data Analysis using Python Programming | Category | C | Professional Core | L | T | P | C |
|------|-----------|-------|--|----------|---|-------------------|---|---|---|---|
| | | | | | | | 3 | 0 | 2 | 4 |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|-----------------------|---|---|---|---|---|---|---|---|----|----|----|--|
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| CR-1 | Understand why Python is a useful scripting language for developers. | | | | | | | | | | | | | | | | | | | | |
| CR-2 | Learn Python data structures – lists, tuples, and dictionaries to represent complex data. | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Learn how to design object-oriented programs with Python classes. | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Learn Error and Exception handling in Python applications. | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Gain knowledge about Data Analysis, Database connectivity and Graphical User Interface Components | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Appreciate the basic and advanced features of core language-built ins | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | |
| CO-2 | Handle and control system/OS level features | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-3 | Implementing OOP Concepts in Python Applications | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | |
| CO-4 | Data Analysis Using NumPy and Pandas | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-5 | Design and implement basic applications with database connectivity. | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | |

| Title & Session Outcomes | Introduction | Object Oriented Programming | Modules & Threads | Data Analysis | GUI and SQL lite |
|-------------------------------------|---|--|---|--|---|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Python Interpreter | Classes, Objects | Creating and Importing Modules | Machine Learning Basics | Introduction to Tkinter |
| SO-2 | Python IDE-Interactive Mode | Methods, Constructors | Uses of Standard Modules in Python – OS | Array Operations | Dialogs, Message and Entry |
| SO-3 | Python Block Structure | Inheritance & its types | Random Module | Introduction to NumPy-Array Creation in NumPy | Menus |
| SO 4-5 | Practice 1: Simple programs | Practice 4: Implementing Inheritance | Practice 7: Implementing Modules | Practice 10: Descriptive Statistics Using NumPy | Practice 13: Building GUI Application with Tkinter |
| SO-6 | Data Types & Variables | Method Overloading & Overriding | Threads | Pandas | SQLite –Introduction |
| SO-7 | Operators & Expressions | Class Method | Threading Functions | Series Indexing | Database Creation |
| SO-8 | Tuples, Lists | Static Method | Binary Files | Data Frames with Pandas & Data Manipulation | CRUD Operations-Insert, Select, Update, Delete |
| SO 9-10 | Practice 2: Programs Using Tuples, List, Dictionary and Sets | Practice 5: Implementing Method Overloading | Practice 8: Implementing Threads | Practice 11: Illustrate Indexing Operations in data frame | Practice 14: Creating Tables Using SQLite |
| SO-11 | Decision Making and Branching | Errors and Exceptions | Command Line Arguments | Data Visualization Using Pandas | SQLite Aggregate Functions |
| SO-12 | Decision Making and Looping Statements | User Defined Exceptions | Parallel System Tools | Data Visualization Using Matplotlib | SQLite Keys |
| SO-13 | Functions | File Handling | Regular Expressions | Scikit-learn | Database Connectivity |
| SO 14-15 | Practice 3: Illustration on Lambda and Filters | Practice 6: Illustration on how to raise an Exception | Practice 9: Illustration on Command Line Arguments and Regular Expressions | Practice 12: Illustrate various Plots using Pandas and Matplotlib | Practice 15: Illustration on Database Connectivity |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|-----------------|----------|-----------------|----------|-----------------|----------|-------------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | | | |
|-----------|---|---|--|--|--|
| 1 | Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1 st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278. | 2 | Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021. | | |
| 3 | S.Sridhar , J..Indumathi,V.M . Hariharan “Python Programming “ 2023 ISBN-978-93-560-6933-6 | | | | |

| Designers | | | | | |
|----------------------|---|----------------------------|--|------------------|---|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R,Professor,National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements,GUVI Geek Networks Pvt Ltd | 1 | Dr. NITHYA S, SRMIST, KTR, nithyas7@srmist.edu.in |

| Code | PCA25C05T | Title | Optimization Techniques | | | | Category | C | Professional Core | L | T | P | C |
|------|-----------|-------|-------------------------|--|--|--|----------|---|-------------------|---|---|---|---|
| | | | | | | | | | | 4 | 0 | 0 | 4 |

| Offering Department | Mathematics and Statistics | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Graph sheet Need, Statistical table Need |
|---------------------|----------------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|--|
|---------------------|----------------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|--|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | |
| CR-1 | To impart the overall view of the subject of operations Research | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | | |
| CR-2 | To apply mathematical models for solving real life problems | | | | | | | | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | 3 | - | 3 | |
| CR-3 | To develop the student's ability and help to solve quantitative issues in information technology | | | | | | | | 4 | 85 | 75 | 3 | - | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-4 | This mathematical modelling, provides the knowledge in planning, controlling and scheduling to the network analysis | | | | | | | | 6 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CR-5 | To develop the decision-making knowledge. | | | | | | | | 3 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 |
| Outcomes (CO) | At the end of this course, learners will be able to: | ✓ | ✓ | ✓ | ✓ | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | |
| CO-1 | To understand the mathematical models and its limitations. | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | | | | |
| CO-2 | To have skill in analysis of data by Transportation and other methods. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | |
| CO-3 | To enable the student to apply the technique in solving problem by Game theory models | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | | | | |
| CO-4 | To provide the students with opportunity of using various software package for solving network problems | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | |
| CO-5 | To introduce the students to the use of basic methodology for the solution of Queuing theory models | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | |

| Title & Session Outcomes | Introduction to operations research | Transportation and Assignment Problems | Game Theory | Network Analysis | Queuing Theory and Inventory Control |
|-------------------------------------|--|--|---|--|---|
| Duration (hour) | 12 | 12 | 12 | 12 | 12 |
| SO-1 | Introduction to operations research, Meaning of Operations Research | Introduction of Transportation | Introduction of game theory, Basic definitions and Examples. | Introduction of Network Analysis | Introduction of Queuing theory, Basic Definitions |
| SO-2 | Advantages of Operations Research | Finding initial Solution by North-West Corner Method | Characteristics of Game theory and Uses of Game theory | Objectives of Network Analysis and Main function of Network | Uses of Queuing theory, Meaning of Queuing System |
| SO-3 | Uses and Nature of Operations Research | Finding initial Solution by Row-minima Method, Column-minima Method and matrix-minima | Pure Strategies: Maximin - Minimax Principle | Advantages and Limitations of Network Analysis | Elements of Queuing System, Kendal's Notation for representing Queuing models |
| SO-4 | Role of Operations Research in computer science and Information technology | Finding initial Solution by VAM Method | Mixed strategy: Finding value of the games without saddle points. (2X2) | Rules for constructing a project network, Constructing project network | The average number of units in the system |
| SO-5 | Formulating the LPP | Find the initial solution for unbalanced and Maximization transportation problem | Matrix oddment method for nxn games | Network computations by Critical path method | Finding probability of waiting time in the Queue |
| SO-6 | Some Basic Assumptions | Calculating Optimum Solutions by MODI method without Loop | Introduction of Dominance property, Rules of Dominance | Earliest start and completion time of a project network | . Problems on (M/M/1) |
| SO-7 | Standard form of LPP and Canonical form of LPP | Calculating Optimum Solutions by MODI method with Loop | Solving Games by Dominance property | Latest start and completion time of a project network | Introduction to Inventory, Types and Application of Inventory |
| SO-8 | Graphical solution of a LPP, Working Procedure for Graphical method | Introduction of Assignment problem, Hungarian procedure for solving Assignment Problem | Solving Games by Dominance property | Total float, Free float and Independent float | Cost involved in inventory problem |
| SO-9 | Solving LPP by Graphically (i) Feasible Solution | Balanced and Unbalanced Assignment Problem | solving game- Graphical method, | Network computations by PERT | Deterministic inventory models |
| SO-10 | Solving LPP by Graphically ii) Infeasible Solution iii) Unbounded Solution | Finding the optimum solution to Restriction and Maximization assignment method | Graphical Solutions of 2xM | Time estimates-Expected duration of each activity | Economic order quantity(E.O.Q) |
| SO-11 | Simplex Method | Solving the Travelling Salesmen Problem | Graphical Solutions of N x2 | Time estimates-Expected variance of each activity and variance of project length | Purchasing model with no shortages |

| | | | | | |
|-------|----------------|---|-----------------------------|---------------------------------------|---------------------------------------|
| SO-12 | Simplex Method | Difference between Transportation and Assignment Problems | .Limitations of Game Theory | Basic difference between PERT and CPM | Manufacturing model with no shortages |
|-------|----------------|---|-----------------------------|---------------------------------------|---------------------------------------|

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 30% | - | 30% | - | 30% | - | 30% | - | 30% | - |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 30% | - | 30% | - | 30% | - | 30% | - | 30% | - |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|--|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | |
| Emulations | ✓ | Group Discussion | | Zero Hunger | |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | |
|------------------|---|----|--|
| 1. | <i>C.R.Kothari, Quantitative Techniques, Third Revised Edition, S.Chand Ltd, New Delhi, 2013.</i> | 2. | <i>V.Sundaresan, K.S.Ganapathy Subramanian, K. Ganesan, Resource Management Techniques, Eleventh Edition, A.R Publication, 2017.</i> |
| 3. | <i>Kalavathy.S, Operations Research, Fourth Edition, Vikas publishing house, 2014.</i> | 4. | <i>Hamdy A. Taha, Operations Research: An Introduction, Tenth Edition, Pearson, 2021.</i> |

| Designers | | | | | |
|-----------------------------|---|-----------------------------------|---|-------------------------|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | <i>Dr. S. Lakshmi Priya, SRMIST, lakshmis3@srmist.edu.in</i> |
| 2 | | 2 | | 2 | <i>Dr. Suruthi S, SRMIST, suruthis3@srmist.edu.in</i> |

| Code | PCA25C06J | Title | Advanced Operating System | | | Category | C | Professional Core Course | L | T | P | C |
|------|-----------|-------|---------------------------|--|--|----------|---|--------------------------|---|---|---|---|
| | | | | | | | | 3 | 0 | 2 | 4 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Understand the design and implementation of advanced OS features | | | | | | | | | | | | | | | | | | | | | | |
| CR-2 | Gain hands-on experience with process scheduling | | | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Learn about process management and Memory management in OS | | | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Implement File management in OS | | | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Analyze and evaluate real-world operating systems like Linux, Windows, and Android | | | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | |
| CO-1 | Understand advanced OS concepts like scheduling, memory management, and synchronization | ✓ | | | | 3 | 80 | 70 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | - | 2 | - | - | | | |
| CO-2 | Implement modules for system-level operations in Unix/Linux | ✓ | ✓ | ✓ | | 3 | 85 | 75 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | - | 2 | - | - | | | |
| CO-3 | Analyze and compare different OS architectures | ✓ | ✓ | ✓ | ✓ | 3 | 75 | 70 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | - | 2 | - | - | | | |
| CO-4 | Understand distributed and real-time systems | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 80 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | - | 3 | - | - | | | |
| CO-5 | Apply concepts in virtualization, containers, and OS-level security | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | - | 3 | - | - | | | |

| Title & Session Outcomes | Introduction | Memory, Storage and Files | Distributed Operating Systems | Real time Operating Systems | Mobile Operating Systems: Android OS |
|--------------------------|-----------------------------|-----------------------------------|--------------------------------|-------------------------------|--------------------------------------|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Operating System- Functions | Memory Management: Logical | Distributed Operating Systems: | Real time Operating Systems : | Mobile Operating Systems: |

| | | | | | |
|----------|---|---|--|---|--|
| | of OS, Structures of OS – OS design issues | Vs. Physical address space, Swapping | System Architectures— Design issues, Communication models, | Introduction , Applications of Real Time Systems | Introduction, Architecture of Mobile operating system |
| SO-2 | Types, Understanding different types, Overview of Process scheduling | Virtual Memory – Basic concepts – age fault handling, Paged memory management, | Clock synchronization, Mutual exclusion, Election algorithms | Basic Model of Real Time System | ARM and Intel architectures, Kernel structure and native level programming |
| SO-3 | Understand the process concepts, Process states, | Understanding the concept of various paging techniques, Page replacement algorithms | Distributed Deadlock detection, Distributed scheduling | Characteristics of Real Time operating Systems | Runtime issues- Approaches to power management |
| SO-4 – 5 | Practice 1: Simulation of Process Scheduling | Practice 4: Implementation of Page replacement algorithm | Practice 7: Implementation of Distributed scheduling | Practice 10: Write a program using POSIX Real-Time Threads | Practice 13: Write a program using POSIX Real-Time Threads |
| SO-6 | System Calls, Process Synchronization: Background, Critical section Problem, Understanding the race conditions | Segmented memory management Various segmentation techniques, Thrashing, Causes of Thrashing | Distributed shared memory | Safety and Reliability, Types of Real-time tasks | Type of Mobile OS: Android OS , Bada ,BlackBerry OS (Research In Mo,iPhone OS / iOS (Apple),MeeGo OS, Palm OS ,Windows Mobile (Windows Phone 7) |
| SO-7 | Interprocess Communication and Synchronisation: Signals, message passing, Pipes and Named Pipes (FIFOs); Shared memory | Storage Management: Mass storage structure – Overview of Mass storage structure – Magnetic Disks | File placement – Caching | Timing constraints, Modeling timing constraints Some important concepts | Android Operating System, The Android Software Stack |
| SO-8 | Threats, Mutexes and Condition Variables, Semaphores | Scheduling Algorithms- Disk Scheduling algorithms | Database Operating Systems: Requirements of Database OS – | Real Time Task Scheduling | The Linux Kernel – its functions, essential hardware drivers. Libraries - Surface Manager |
| SO- 9-10 | Practice 2 : Implementation of System Calls | Practice 5: Implementation of Scheduling algorithm | Practice 8: Implementation of clock synchronization | Practice 11: Implementation of real time simulation | Practice 14:Study and simulate Power Management Approaches used in Android/iOS |
| SO-11 | CPU Scheduling; Various scheduling algorithms | File System Interface: File concept, File access methods, File sharing and Protection | Transaction process model | Scheduling in RTOS: Clock driven: cyclic | Media framework, SQLite, WebKit, OpenGL. Android Runtime - Dalvik Virtual Machine, Core Java Libraries |
| SO-12 | Deadlocks: Resource allocation, Deadlock prevention methods, | File system structure Directory Implementation - Understanding the various levels of directory structure | Synchronization primitives | Event driven: Earliest Deadline First (EDF) and rate monotonic scheduling | Application Framework - Activity Manager, Content Providers, Telephony Manager, Location Manager, Resource Manager. |

| | | | | | |
|-----------|--|---|--|--|--|
| SO-13 | Deadlock Avoidance, Deadlock detection, Recovery mechanisms, Killing the process and resource preemption | File System Implementation: Free space Management, Allocation methods, Understanding the pros and Cons of various disk allocation methods | Concurrency control algorithms | Hybrid schedulers | Android Application – Activities and Activity Lifecycle, applications such as SMS client app, Dialer, Web browser, Contact manager |
| SO-14 -15 | Practice 3: Implementation of Deadlocks | Practice 6: Implementation of File access methods | Practice 9 : Implementation of Concurrency control algorithms | Practice 12: Simulate a Hybrid Scheduler using combination of RMS and EDF | Practice 15: Implementation of Android Applications |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education ✓ |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|------------------|--|---|--|
| 1. | Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating systems, 9th ed., John Wiley & Sons, 2013 | 2 | William Stallings, Operating Systems-Internals and Design Principles, 7th ed., Prentice Hall, 2012 |
| 3. | Andrew S.Tanenbaum, Herbert Bos, Modern Operating systems, 4thed., Pearson, 2015 | 4 | Bryant O’Hallaxn, Computer systems- A Programmer’s Perspective,Pearson, 2015 |

| Designers | | | | | |
|-----------------------------|---|-----------------------------------|--|-------------------------|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R,Professor,National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements,GUVI Geek Networks Pvt Ltd | 1 | Dr.G.Elavarasi, SRMIST, elavarag4@srmist.edu.in |

| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
|-----------------|---|--|---|--|---|
| SO-1 | Definition of AI and Scope of AI | Architecture of expert systems | A* algorithm, Constraint satisfaction | PROLOG: Representation | Components of Machine Learning Models |
| SO-2 | Evolution of AI | Role of expert systems | AO* Algorithm | Structure, Backtracking | Learning Models, Geometric Models |
| SO-3 | The Turing Test, The Cognitive modeling approach | Types of Expert system: Rule Based, Frame Based | Constraint satisfaction | Unification | Types of Learning |
| SO 4-5 | Lab 1: Solving Problems using AI | Lab4: Experts System in Prolog | Lab 7: Working on Informed Search -I | Lab 10: Decision tree implementation | Lab 13: Bayesian Learning |
| SO-6 | Intelligent Agents and its Types | Case Based, Fuzzy Logic System, Hybrid Systems | Greedy Best-First Search | Learning with trees | Supervised, Unsupervised and Reinforcement Learning |
| SO-7 | Problem Solving Agents | Knowledge Acquisition | Beam | Decision Tree with Entropy Calculation | Linear Models for Regression, Logistic Regression, SVM, LDA |
| SO-8 | Knowledge based systems | Meta knowledge, Heuristics | Searching Game playing: Minimax | CART Algorithm | Bayesian Learning- Naive Bayes |
| SO 9-10 | Lab2: Solving Problems using AI | Lab 5: Working on Uninformed Search -I | Lab 8: Working on Informed Search-II | Lab 11: Implementation of Decision tree and K- Mean algorithm | Lab 14: Linear Models for Clustering |
| SO-11 | Propositional Logic: Representation, Inference | Search Algorithms: Uninformed Search: Breadth First Search | Search Alpha-Beta Cutoffs, | What is Machine Learning and Why should we care about it? | K-Means, Hierarchical Clustering |
| SO-12 | Forward and Backward Chaining | Depth First Search, Depth Limited Search | Waiting for Quiescence | Applications of Machine Learning | Gaussian Mixture Models, Logistic Regression Decision Tree Learning |
| SO-13 | Syntax and Semantics of First order Logic Representation. | Comparison of Uninformed search Strategies | Examples | Where ML is used in the Data Science Process | Random Forest, K-NN, Bagging: Random Forest Trees |
| SO 14-15 | Lab3: Propositional Logic and Reasoning | Lab 6: Working on Uninformed Search-II | Lab 9: Working with PROLOG | Lab 12: Supervised Learning | Lab 15: Reinforcement Learning |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|-----------------|----------|-----------------|----------|-----------------|----------|-------------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | | | | | | | | | | |
| 4 | Analyze | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 5 | Evaluate | | | | | | | | | | |
| 6 | Create | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|-----------|---|----|--|
| 1. | Stuart Russell & Peter Norvig: "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition | 2. | Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014 |
| 3. | Ivan Bratko, "Prolog Programming For Artificial Intelligence", 2 nd Edition Addison Wesley. | 4 | Ethem Al paydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014. |

| Designers | | |
|---|---|---|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 Dr. M. Gracy, SRMIST, gracym2@srmist.edu.in |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|--|--|--|--|-----------------|----------|---------------------------------|----------|----------|----------|----------|
| Code | PGI25D04J | Title | Augmented Reality and Virtual Reality | | | | Category | D | Discipline Elective Core | L | T | P | C |
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| | | | | | | | | | |
|----------------------------|------------------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|------------------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|-----------------------|---|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Gain introductory experience in Unity Programming with C# | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | |
| CR-2 | To provide a strong theoretical grip on AR technology | | | | | | | | 3 | 80 | 70 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-3 | Implement augmented reality apps from the developer's perception. | | | | | | | | 3 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-4 | Use Unity to efficiently create AR apps for Android, iOS, and Windows platforms | | | | | | | | 3 | 75 | 70 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CR-5 | Navigate the Unreal Engine interface and understand its key features. | | | | | | | | 3 | 85 | 80 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| | | 3 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | | | | |

| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> |
|----------------------|---|
| CO-1 | Discover the potential of immersive VR & AR |
| CO-2 | Understand the techniques, processes, applications in immersive AR |
| CO-3 | Gain the Practical Understanding of Unity software |
| CO-4 | Handle scripting and events using Unity |
| CO-5 | Gain a high-level understanding of game engine principles along with an overview of the Unreal's basic operation logic. |

| Title & Session Outcomes | Overview | Augmented Reality | 2D Game | Script | Unreal Engine |
|-------------------------------------|---|---------------------------|-----------------------------------|---|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Virtual Reality: An Overview Introduction | What is AR? Terminologies | Unity for AR & VR Unity Interface | Scripting in Unity Setting up the Scripting Environment | Overview of Unreal Engine, Installing and Setting up Unreal Engine |
| SO-2 | History and Tech Developments | Types of AR Current AR | Create Gameplay, Scenes, Game | Creating and Using Scripts | Working with Unreal projects |

| | Types of VR | Technologies | Objects | Instantiating Prefabs at runtime | and templates |
|----------|---|---|---|--|--|
| SO-3 | | Types of VR systems and hardware Tracking System for AR | Prefabs, Layers, Constraints Lights , Cameras, Publishing Builds | Order of Execution for event functions Event Functions | Unreal Editor Interface, Content Browser |
| SO-4-5 | Lab 1: Set up a VR development environment using Unity : Install VR development tools, import VR SDKs, Set up a new VR project | Lab 4: Set up AR Foundation & ARKit Package | Lab 7: Create a simple scene with a controllable character (e.g., a cube) that can move forward, backward, left, and right using keyboard input. | Lab 10: Develop a script that rotates an object (e.g., a sphere) around its axis when the player presses certain keys (e.g., Q and E). | Lab 13: Create your first unreal engine project |
| SO-6 | Components of VR systems VR Software and Tools | AR Displays Software | Assets Workflow-Importing Assets, Assets Database | Coroutines, Namespaces | Assets and Packages, Working with Assets, Migrating Assets |
| SO-7 | VR Tracking Systems Comparing Immersive and Non-immersive VR UI | AR Development tools Benefits | Asset Bundles Scripting with Assets | Attributes, UnityEvents | Actors and Geometry, Select, Place, Transform, Group, Snap and Merge Actors |
| SO-8 | Visual Perception of VR, Acoustic Perception of VR | Disadvantages Examples of AR applications | Introduction to 2D game development, 2D Sorting | Few important Classes in Unity Unity Architecture | Components of Unreal: AI, Audio, Camera, Light Components, Components of Unreal: Rendering, Shape, Mesh and Widget components |
| SO 9-10 | Lab 2: Create a simple VR scene. | Lab 5: Creating and Scripting a Placement Indicator in Unity | Lab 8: Implement a script that allows the player to interact with objects in the scene (e.g., picking up and dropping objects, triggering events). | Lab 11: Implement a timer script that counts down from a specified time (e.g., 60 seconds) and displays the remaining time on the screen. | Lab 14: Create a simple environment, author basic materials, explore the lighting system, and add basic Landscape and Foliage to bring the scene to life. |
| SO-11 | How AR & VR works together? | Gamification for Education5.0 AR games for Education | Working with Sprites, Tilemaps | Multiplayer, Audio Files, Mixers. Profilers | Levels-Work with Level Assets Managing Multiple Levels |
| SO-12 | Impact of VR on Human Lives, Gesture Interaction in VR | General Software Tools for Gamification AR Apps for Education | Tilemaps Workflow, World Building | Video Overview, Animation Clips | World Settings, Playing & Simulating |
| SO-13 | Enabling Technologies in VR, Applications of VR | Multidisciplinary use of AR, Future of AR in Education | Terrain & Tools, Tree Editor | Animation Controllers, Playables API | Building Virtual Worlds-Water, foliage , Fog Effects |
| SO 14-15 | Lab3: Experiment with different audio and visual effects for immersive experience | Lab 6: Create an AR game by importing 3D objects | Lab 9: Design a simple user interface (UI) with buttons, sliders, and text elements to display information or control aspects of the game (e.g., | Lab 12: Create a script that controls the playback of animations on a character or object (e.g., idle, walk, jump). | Lab 15: Create classes with Blueprints in Unreal Engine |

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|--|--|------------------------------------|--|
| | | health bar, score display). | |
|--|--|------------------------------------|--|

| Assessment | | | | | | | | | | | |
|--------------------------|------------|--|----------|--------------|----------|--------------|----------|--------------|----------|-----------------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 5 | Evaluate | | | | | | | | | | |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|-----------------------------|---|--------------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education ✓ |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | | |
|------------------|---|----|--|--|
| 1 | Alvin Albuero De Luna, " Introduction to Virtual Reality", Arcler Press, 2022 | 2. | Zeynep Tacgin, "Virtual and Augmented Reality", An Educational Handbook, Cambridge Scholars Publishing, 2020 | |
| 3. | P.Kaliraj, T.Devi, " Innovating with Augmented Reality, CRC Press, 2022 | 4 | Daniel Buckley, Morgan McKie, "AR Game Development for Beginners", Zenva Pvt Ltd 2020 | |
| 5 | https://docs.unrealengine.com/ | | | |

| Designers | | | | |
|-----------------------------|---|-----------------------------------|---|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 Dr. Leena Nesamani S, SRMIST, leenan@srmist.edu.in |

| | | | | | | | | | | | | | | | | |
|-------------|------------------|--------------|--|--|--|--|-----------------|----------|------------------------------------|--|--|---|----------|----------|----------|----------|
| Code | PGI25D05J | Title | Generative AI and Large Language Models | | | | Category | D | Discipline Elective Courses | | | | L | T | P | C |
| | | | | | | | | | | | | 3 | 0 | 2 | 4 | |

| | | | | | | | | | | | | | | | | |
|----------------------------|------------------------------|------------------------------|------------|-----------------------------|------------|----------------------------|------------|------------------------------------|------------|--|--|--|--|--|--|--|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil | | | | | | | |
|----------------------------|------------------------------|------------------------------|------------|-----------------------------|------------|----------------------------|------------|------------------------------------|------------|--|--|--|--|--|--|--|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | | | |
|-----------------------|---|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|-------------------|-------------------|-------------------|---------------|----------------------------|------------------------|---------------|----------------------|--------------------|--|--|--|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | | |
| CR-1 | Understand the Gen AI and LLMs | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-2 | To acquire the basic concept of LLM | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Gain foundational knowledge, practical skills and functional understanding of how generative AI works | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-4 | To build applications using LLMs | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-5 | To impart knowledge of LLM | | | | | | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, | Modern Tool Usage | Society & Culture | Environment & | Ethical Practices & Social | Individual & Team Work | Communication | Project Management & | Life Long Learning | | | | | | |
| CO-1 | Understand the basic concept of LLMs | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | | | | | | |
| CO-2 | To gain knowledge for developing LLM applications | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | | | |
| CO-3 | Implement and train a neural language model | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | | | | | | |
| CO-4 | Explore techniques for fine tuning pre-trained language models | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | | | | | | |
| CO-5 | Understand how to apply LLMs to a variety of applications | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | | | |

| Title & Session Outcomes | Define language models | Introduction to Transformer | Fine-tuning Methods | Applications of LLMs, | Ethics, Deployment, Security |
|-------------------------------------|--|--|---|--|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Introducing generative AI | Building a Chatbot like ChatGPT | Developing Software with Generative AI | Generative AI in Production | The Future of Generative Models |
| SO-2 | Why now? | Introduction of Chatbot | Software development and AI | LLM apps ready for production | The current state of generative AI |
| SO-3 | Understanding LLMs | Understanding retrieval and vectors | ode LLMs, Writing code with LLMs | Terminology, How to evaluate LLM apps | Challenges, Trends in model development |
| SO 4-5 | Practice 1- Python Programs for AI-Powered Content Creation | Practice 4: Python program to help you understand retrieval and vector-based search using LangChain | Practice 7: Python Program to write code and execute Using LLM | Practice 10: Implement LLM Terminology using Python Program | Practice 13: Python Program: Exploring the Current State of Generative AI |

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|----------|--|--|---|--|---|
| SO-6 | What is a GPT? Other LLMs | Embeddings, Vector storage, Table of Contents, Vector indexing, Vector libraries, Vector databases | CStarCoder, StarChat, Llama 2 Small local model | Comparing two outputs, Comparing against criteria | Big Tech vs. small enterprises, Artificial General Intelligence |
| SO-7 | How do GPT models work? | Document loaders, Retrievers in LangChain, | LLMs for Data Science | String and semantic comparisons, Running evaluations against datasets | Economic consequences, Creative industries and advertising |
| SO-8 | Pre-training, Tokenization, Scaling, Conditioning | kNN retriever, PubMed retriever, Custom retrievers | The impact of generative models on data science, Automated data science, | How to deploy LLM apps, FastAPI web server | Education, Law |
| SO 9-10 | Practice 2: Python program that demonstrates how to build a simple customer support system using Generative AI (OpenAI GPT model), | Practice 5: Demonstrates three types of retrievers using LangChain. | Practice 8: Python Program: Automated EDA with Generative AI | Practice 11: Python Program: Deploying LLM as an API with FastAPI | Practice 14: Python Program: Economic Consequences and Impact on Creative Industries & Advertising |
| SO-11 | LangChain for LLM Apps, limitations of LLMs, mitigate LLM limitations | Document loader, Vector storage, Memory, Conversation buffers | Data collection, Visualization and EDA | Ray, How to observe LLM apps | Manufacturing, Medicine |
| SO-12 | Exploring key components of LangChain | Remembering conversation summaries, Storing knowledge graphs | Preprocessing and feature extraction, | Tracking responses, Observability tools | Military, Societal implications, Misinformation and cybersecurity |
| SO-13 | What are chains? What are agents? What is memory? What are tools? | Combining several memory mechanisms, Long-term persistence | AutoML | LangSmith, PromptWatch | Regulations and implementation challenges |
| SO 14-15 | Practice 3. Python program that explores the key components of LangChain, a powerful framework for building applications with Large Language Models (LLMs). | Practice 6: Python Program: Combined Memory System | Practice 9: Python program that covers the core stages of a data science pipeline using a dataset: | Practice 12: Python program using LangSmith and PromptWatch | Practice 15: Python Program: Misinformation Detection and Cybersecurity |

| Assessment | | | | | | | | | | | |
|-------------------|---|----------|--------------|----------|--------------|----------|--------------|----------|-----|----------------------------|-----|
| Level of Thinking | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | | Final Exam (50% Weightage) | |
| | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | | |
| | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | | |
| | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|---|------------------------|----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | ✓ Zero Hunger |
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| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | Clean Water & Sanitation |
| | | Mind Map | Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | |
| | | Problem Based Learning | |

| Resources | | | |
|-----------|--|---|---|
| 1 | Ben Auffarth- Generative AI with LangChain, Build large language model (LLM) apps with Python, ChatGPT, and other LLMs, Packt Publishing, st Edition, 2023. | 2 | Utpal Chakraborty, Soumyadeep Roy, Sumit Kumar; Soumyadeep Roy; Sumit Kumar- Rise of Generative AI and ChatGPT: Understand how Generative AI and ChatGPT are transforming and reshaping the business world, BPB Online LLP, 2023. |
| 3 | Valentina Alto- <i>Modern Generative AI with ChatGPT and OpenAI Models: Leverage the capabilities of OpenAI's LLM for productivity and innovation with GPT3 and GPT4 [1 ed.]</i> , Packt Publishing, 2023. | 4 | Patrick Parra Pennefather-Creative Prototyping with Generative AI: Augmenting Creative Workflows with Generative AI (Design Thinking) [1 ed.], Apress, 2023. |

| Designers | | | | | |
|----------------------|---|----------------------------|---|------------------|-------------------------|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr. S.Sivakumar, SRMIST |

| Code | PGI25D06J | Title | IoT Cloud Infrastructure and Protocols | | | | Category | D | Discipline Elective Course | L | T | P | C |
|------|-----------|-------|--|--|--|--|----------|---|----------------------------|---|---|---|---|
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| CR-1 | Understanding the fundamentals of cloud computing is essential for effective IoT implementation. | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | |
| CR-2 | Knowledge of IoT protocols ensures efficient and reliable communication between devices. | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Security is a critical component in cloud-based IoT systems to protect data and maintain trust. | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Familiarity with cloud-based IoT platforms simplifies device integration and accelerates development. | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Staying informed about emerging IoT trends is crucial for future readiness and innovation. | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Explain the concept of cloud computing and its significance in the Internet of Things (IoT). | ✓ | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | |
| CO-2 | Compare various IoT communication protocols and select appropriate ones based on specific IoT application requirements. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-3 | Implement security measures to safeguard IoT data stored and transmitted through cloud platforms. | | ✓ | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | 3 | |
| CO-4 | Manage and integrate IoT devices effectively using leading cloud service platforms. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 | |
| CO-5 | Analyze emerging trends and current research areas in IoT cloud infrastructure and communication protocols. | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 | |

| Title & Session Outcomes | Introduction to IoT Cloud Infrastructure | Cloud Platforms for IoT | IoT Protocols | Security and Data Management in IoT Cloud | Innovations in IoT and Cloud Convergence |
|--------------------------|--|-------------------------|---------------|---|--|
| Duration | 15 | 15 | 15 | 15 | 15 |

| (hour) | | | | | |
|---------|--|--|--|--|---|
| SO-1 | Cloud Computing: Definition, Significance, and Key Characteristics of Cloud Services | Overview of AWS IoT Core and Key Features and Services Offered by AWS IoT | Introduction to IoT Communication Protocols, including MQTT (Message Queuing Telemetry Transport): Overview and Applications. | Security Challenges in Cloud-Based IoT Deployments and Data Encryption Techniques for IoT Communication. | Blockchain Technology for Secure IoT Transactions and IoT Standards for Interoperability. |
| SO-2 | Overview of Cloud Service Models (IaaS, PaaS, SaaS) and Leading Cloud Service Providers | Microsoft Azure IoT Suite: Introduction, Features, and Google Cloud IoT Core: Overview and Capabilities | CoAP (Constrained Application Protocol): Features, Benefits, and the Role of HTTP/HTTPS Protocols in IoT Applications. | Ensuring Data Integrity in Cloud-Based IoT Solutions and Role-Based Access Control (RBAC) in IoT Cloud Environments. | DevOps Practices and CI/CD in IoT Cloud Deployments. |
| SO-3 | Integration of IoT Applications with Cloud Computing and Their Architectural Framework | Comparison of Major Cloud IoT Platforms and Device Provisioning and Management on Cloud Platforms | AMQP (Advanced Message Queuing Protocol) in IoT and a Comparison of IoT Protocols: Performance, Scalability, and Security. | IoT Security Best Practices and Data Management Strategies for IoT Applications. | Case Studies of Innovative IoT Deployments and Ethical Considerations in IoT Cloud Deployment. |
| SO 4-5 | Practice 1: MQTT Publisher: Develop a program to publish sensor data (e.g., temperature, humidity) from Node MCU to an MQTT broker hosted on a cloud platform | Practice 4: OTA Updates: Set up Over-The-Air (OTA) firmware updates for Node MCU to enable remote updating of firmware from a cloud server without physical access. | Practice 7: Real-time Data Streaming: Develop a program to stream real-time sensor data from Node MCU to a cloud-based database (e.g., Firebase Real time Database, AWS Dynamo DB). | Practice 10 : Integration with IoT Platforms: Integrate Node MCU with popular cloud-based IoT platforms (e.g., AWS IoT, Google Cloud IoT Core) to leverage their services for IoT applications. | Practice 13: HTTP Server: Implement an HTTP server on Raspberry Pi to receive sensor data from Node MCU or other IoT devices and store it in a cloud-based database. |
| SO-6 | Challenges in Implementing IoT on Cloud Infrastructure: Edge Computing vs. Cloud Computing in IoT | Message Brokering and Routing in Cloud-Based IoT Solutions and IoT Analytics and Insights Using Cloud Services | Interoperability Challenges, and a Comparison of MQTT vs. CoAP for IoT Applications. | Data Storage Options (Databases, Data Lakes, Data Warehouses) and Real-Time Data Processing in IoT Cloud Environments. | Privacy Concerns in IoT Cloud Deployments and Future Directions in IoT Cloud Infrastructure and Protocols. |
| SO-7 | Fog Computing and Its Role in IoT: Scalability and Elasticity in Cloud-Based IoT Solutions | Integration of IoT Devices with Cloud Platforms and Security Measures in Cloud-Based IoT Deployments | Securing IoT Communication with TLS/SSL and Implementing Authentication and Authorization Mechanisms in IoT. | Data Visualization, Dashboards for IoT Applications, and the Role of Edge Computing in IoT. | IoT Ecosystem, Industry Trends, and Challenges & Opportunities in IoT Cloud Deployments. |
| SO-8 | Cost considerations for deploying IoT on cloud platforms | IoT Security Best Practices and Role-Based Access Control (RBAC) in IoT Cloud Environments | Ensuring Data Integrity and Exploring Data Storage Options in Cloud-Based IoT Solutions. | Serverless Computing for IoT Applications and Hybrid Cloud Architectures for IoT Deployments. | IoT Security Regulations, Compliance, and Sustainable IoT Cloud Solutions. |
| SO 9-10 | Practice 2: MQTT Subscriber: Create a program to subscribe to MQTT topics on Node MCU | Practice 5: Security Measures: Secure communication between Node MCU and cloud services using TLS/SSL encryption and implement | Practice 8: Data Visualization: Interface Node MCU with a cloud-based data visualization platform (e.g., Thing Speak, Grafana) to visualize sensor | Practice 11: MQTT Publisher: Develop a Python script on Raspberry Pi to publish data from sensors connected to GPIO pins to an MQTT | Practice 14: Data Logging to Cloud Storage: Write a Python script to log sensor data (e.g., temperature, humidity) from Raspberry Pi to a cloud-based |

| | | authentication mechanisms | data in real-time. | broker hosted on a cloud platform | storage service (e.g., Google Cloud Storage, AWS S3). |
|----------|---|--|---|---|---|
| SO-11 | Case Studies of Successful IoT Deployments on Cloud Infrastructure and Future Trends in Cloud-Based IoT | Real-time data processing, analytics, and encryption techniques for IoT communication in cloud environments. | Data Streaming, Event Processing, and Implementing Over-the-Air (OTA) Firmware Updates in IoT Applications. | Containerization, Microservices in IoT Cloud Solutions, and IoT Platforms for Rapid Development. | Emerging Technologies in IoT Cloud Infrastructure and Industry Partnerships in IoT Cloud Deployments. |
| SO-12 | Ethical Considerations and Regulatory Compliance in IoT Cloud Deployments | Data Visualization and Dashboards for IoT Applications with AWS IoT Greengrass | Implementing RESTful APIs for IoT Data Exchange and Message Queueing Protocol (MQP) in IoT Applications. | Machine Learning and AI in Cloud-Based IoT Solutions, and Compliance, Governance, and Risk Management. | Research Directions in IoT Cloud Infrastructure, Protocols, and Smart Cities & Urban IoT Deployments. |
| SO-13 | Cloud Service Deployment Models and IoT Edge Device Management | Azure IoT Edge and Google Cloud IoT Edge | Message Queueing Telemetry Transport (MQTT) and Extensible Messaging and Presence Protocol (XMPP) in IoT Applications. | Physical Security, Environmental Controls, and IoT Endpoint Security. | IoT for Environmental Monitoring, Sustainability, and Wearable Technology in Healthcare IoT Applications. |
| SO 14-15 | Practice 3: HTTP Client: Implement an HTTP client on NodeMCU to send sensor data to a cloud-based server | Practice 6: Cloud-triggered Actions: Create a program on NodeMCU to perform specific actions (e.g., turn on/off an LED) based on commands received from a cloud-based IoT platform. | Practice 9: Device Shadowing: Implement device shadowing functionality on NodeMCU to synchronize device states and configurations with a cloud-based IoT platform. | Practice 12: MQTT Subscriber: Create a Python script to subscribe to MQTT topics on Raspberry Pi and take actions based on messages received from a cloud-based MQTT broker. | Practice 15: Real-time Data Analytics: Develop a Python script to perform real-time analytics on sensor data received from NodeMCU or other devices and send alerts or notifications based on predefined thresholds. |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| | | | | | | | | | | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | | | |
|-----------|--|----|--|--|--|
| 1. | Arshdeep Bahga, Vijay Madiseti, <i>Internet of Things: A Hands-On Approach</i> , 1st Edition, VPT (Universities Press), 2014. | 2. | Michael J. Kavis, <i>Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)</i> , 1st Edition, Wiley, 2014. | | |
| 3. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, <i>IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things</i> , 1st Edition, Cisco Press, 2017. | 4. | Thomas Erl, Zaigham Mahmood, Ricardo Puttini, <i>Cloud Computing: Concepts, Technology & Architecture</i> , 1st Edition, Prentice Hall, 2013. | | |
| 5. | Houbing Song, Di Wu, Sabina Jeschke, Subhas Chandra Mukhopadhyay, <i>Security and Privacy in the Internet of Things (IoT)</i> , 1st Edition, Wiley, 2017. | 6. | Olivier Hersent, David Boswarthick, Omar Elloumi, <i>Internet of Things: From Research and Innovation to Market Deployment</i> , 1st Edition, Wiley, 2015. | | |

| Designers | | |
|----------------------|----------------------------|------------------|
| Professional Experts | Higher Institution Experts | Internal Experts |
| | | |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr. M. Pandiyan, SRMIST, pandiyam@srmist.edu.in |
|---|---|---|---|---|---|

| Code | PGI25S02J | Title | Prompt Engineering in Generative AI | Category | S | Skill Enhancement Courses | L | T | P | C |
|------|-----------|-------|-------------------------------------|----------|---|---------------------------|---|---|---|---|
| | | | | | | | 2 | 0 | 3 | 4 |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|----------------|--|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|---------------------------------------|--------------------|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | To generate new content based on variety of inputs | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Entrepreneurship | Life Long Learning | | | |
| CR-2 | To enhance the ability to use generative AI effectively | | | | | | | | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CR-3 | To apply various models in AI | | | | | | | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CR-4 | To know the various Prompts | | | | | | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | 3 | 3 | - | 3 | |
| CR-5 | To build variety of AI powered Applications | | | | | | | | 3 | 85 | 75 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-1 | To acquire the knowledge to get best output from the right question. | 2 | 85 | 75 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | | | | | |
| CO-2 | To work efficiently with ChatGPT, UM-GPT and DALL-E. | | | | | | | | | | | | | | | | | | | | | | |
| CO-3 | To able to craft the prompt for the various conditions. | | | | | | | | | | | | | | | | | | | | | | |
| CO-4 | To implement the encoding and Decoding of Text | | | | | | | | | | | | | | | | | | | | | | |
| CO-5 | To construct variations of AI Applications using Web Interface | | | | | | | | | | | | | | | | | | | | | | |

| Title & Session Outcomes | Foundations of Generative AI and Prompt Engineering | Designing Effective prompts and Text Generation Techniques | Advanced Prompting and Text Generation | Autonomous Agent with Memory and Tools: | Prompt Engineering for Image Generation using Diffusion Models |
|--------------------------|---|--|--|---|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |

| | | | | | |
|----------------------|--|---|--|---|---|
| SO-1 | Introduction to Prompt Engineering: Understand the role and importance of prompt. | Standard Practices for Text Generation with Chat GPT: Generating List and Hierarchical List Generation, Generating JSON | Introduction to LangChain and Chat Models | Chain of Thought Reasoning : Introduction to step-by step reasoning in LLMs, Applications | Introduction to diffusion models, Applications in generative image creation |
| SO-2 | Definition of Generative AI and difference between traditional AI and generative AI, Principles of Prompting | Generating diverse outputs formats, Chunking Strategies | Advanced Text generation Techniques LangChain Prompt Template | Understand Agents in LangChain: What are agents?, Role of agents, Integration of OpenAI functions into workflow, API-based prompt execution | OpenAI's DALL-E, Introduction to stable diffusion models |
| SO-3 -5 | Practice 1- Apply 5 Principles of prompting and Generate an Image Prompt | Practice 4- Build a simple chunking algorithm in Python to segment large text inputs | Practice 7- Create a custom text generator using LangChain | Practice 10- Implement a simple ReAct-based agent using LangChain | Practice 14- Generate AI images using format and art style modifiers |
| SO-6 | Evolution of AI: From Rule based to Generative Models | Encoding and Sentiment Analysis | LangChain Expression Language (LCEL) | Comparing Open AI functions vs ReAct framework, | Overview of text-to-image architecture |
| SO-7 | Text Generation Models: Overview of key models and comparison between Popular Generative A | Prompting Strategies: Least to most prompting, Role Prompting and instruction design | Vector Databases and Embeddings, Working principle and benefits of Retrieval Augmented Generation | Agent Toolkits and Customization, Memory in Agents: Introduction to agent memory | Prompt engineering for visual output: format modifier, art style modifier and refine output using negative prompts |
| SO-8 - 10 | Practice 2- Working with Chat GPT Prompt-I | Practice 5- Implement Encoding and Decoding of Text | Practice 8- Work with LangChain Prompt Templates and integrate with a vector database | Practice 11- Customize and build an agent with memory and integrated tools | Practice 14- Experiment with diverse prompt styles, including negative and reference-image prompts |
| SO-11 | Common use cases of Generative AI, Designing Effective Prompts | GPT Best Practices for prompting engineering | Loading document for context aware prompting | Understanding memory types in LangChain | Advanced Prompting Techniques: Reverse engineering image prompts Inpainting and outpainting concepts |
| SO-12 | Prompt for domain specific applications | Classification tasks, Mets Prompting : Introduction | Memory Retrieval with FAISS, Self-Querying | Advanced Agent Framework, Callbacks | Running Stable Diffusion, Automatic1111 Web User Interface |
| SO-13 SO 14-15 | Practice 3- Working with Chat GPT Prompt-II | Practice 6- Build a Classification Model | Practice 9- Implement FAISS-based memory retrieval, document loading, and self-querying retriever setup | Practice 12- Implement and test callbacks using constructors in an advanced agent setup | Practice 15- Build a simple AI-powered image generation application using Stable Diffusion and the Automatic1111 interface |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|-----------------|----------|-----------------|----------|-----------------|----------|-------------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| | | | | | | | | | | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | - | 40% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | | | | | | | | | | |
| 4 | Analyze | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | - | 40% |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | - | 20% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|---|------------------------|----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | Clean Water & Sanitation |
| | | Mind Map | Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | |
| | | Problem Based Learning | |

| Resources | | | | |
|-----------|--|--|----|---|
| 1. | Prompt Engineering for generative AI by James Phoenix and Mike Taylor, O'Reilly Media, Inc Publication, July 2024. | | 2. | Prompt Engineering for generative AI by Johnny M Hill |

| Designers | | |
|---|---|----------------------------|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 Dr. B. Nagarajan, SRMIST |

| | | | | | |
|------|---|--|--|-----------------------|--------------------------|
| SO-1 | Self-analysis through SWOT, The Johari Window | Personal, Professional and Social Etiquette | Resume Preparation and Activity | Synonyms and Antonyms | Statement and Assumption |
| SO-2 | Goal Setting Importance, Goal Setting based on the Principle of SMART | Professional Communication - Presentation Skills | E-mail Drafting and Practice | One Word Substitution | Paragraph Summary |
| SO-3 | Emotional Intelligence (Identifying, Managing and Understanding Emotions) | Presentation for Internal and External Communication - online & offline Meetings | Techniques to Follow in Group Discussion | Word Analogy | Idioms and Phrases |
| SO-4 | Process of Career Exploration | Time Management and Planning Tools | Mock Group Discussion | Verbal Classification | Cloze Test |
| SO-5 | STAR Technique (situation, task, approach and response) for Facing an Interview | Decision Making Skills | Interview Techniques | Spotting Errors | Theme Detection |
| SO-6 | Professional Attitude – Entrepreneurial, Rational, Optimistic Attitude | Teamwork in Workspace - Resilience and Stress Management | Mock Personal Interview | Sentence Correction | Reading Comprehension |

| Assessment | | | | | | | | | |
|-------------------|--|----------|---------|----------|---------|----------|---------|----------|--|
| Level of Thinking | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | | |
| | CLA – 1 | | CLA – 2 | | CLA – 3 | | CLA – 4 | | |
| | (20 %) | | (20 %) | | (30 %) | | (30%) | | |
| | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | |
| 1 Remember | | | | | | | | | |
| 2 Understand | 25% | - | 20% | - | 30% | - | 50% | - | |
| 3 Apply | | - | | - | | - | 25% | - | |
| 4 Analyze | 50% | | 50% | | 40% | | | | |
| 5 Evaluate | | - | | - | | - | 25% | - | |
| 6 Create | 25% | | 30% | | 30% | | | | |
| Total | 100 % | | 100 % | | 100 % | | 100 % | | |

| Strategies | | | |
|------------------------------|---|------------------------|-----------------------------|
| Technology | | Pedagogy / Andragogy | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ No Poverty |
| Emulations | ✓ | Group Discussion | ✓ Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ Good Health & Well Being |
| Hands-on Practice Tools | ✓ | Inquiry Learning | ✓ Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ Gender Equality |
| Field Visit | | Leading Question | ✓ Clean Water & Sanitation |
| | | Mind Map | ✓ Affordable & Clean Energy |
| | | Minute Paper | |
| | | Peer Review | ✓ |
| | | Problem Based Learning | ✓ |

| Resources | | | |
|-----------|--|---|---|
| 1 | "The Johari Window: A Model for Self-awareness and Personal Growth" by Joseph Luft & Harrington Ingham | 2 | Campus Recruitment complete Reference , Praxis Groups |
| 3 | "The 7 Habits of Highly Effective People" by Stephen R. Covey | 4 | A Modern Approach to Verbal and Non Verbal Reasoning – Dr A S Agarwal |
| 5 | "SMART Goals: How to Set and Achieve Your Personal and Professional Goals" by S.J. Scott | 6 | Verbal Ability & Reading Comprehension for CAT - Arun Sharma |

| Designers | | |
|---|--|---|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Mr. Varadha Rajan M (External Expert), Assistant Manager – Human Resources, Justdial Limited, Chennai – 600015 varadha1723@gmail.com | 1 Dr. Premavathy M, Associate Professor , Department of English Center for Distance and Online Education, Bharathidasan University, Tiruchirappalli – 620024 drmpremavathy@bdu.ac.in | 1 Dr. Deepalakshmi S, HoD, Department of Career Guidance Cell, FSH, SRMIST 2 Dr. Muthu Deepa M, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST 3 Dr. Sam Israel S, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST 4 Dr Elamathiyan E, Assistant Professor, Department of Career Guidance Cell, FSH, SRMIST |

SEMSTER III

| Code | PCA25C08J | Title | Data Communication Networks | Category | C | Professional Core Course | L | T | P | C |
|------|-----------|-------|------------------------------------|----------|----------|--------------------------|---|---|---|---|
| | | | | | | 3 | 0 | 2 | 4 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|----------------------------|------------------------|---------------|------------------------------|--------------------|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CR-1 | Understand the fundamental concepts and components of data communication systems, including network models, switching, and signal transmission. | | | | | | | | | | | | | | | | | | | |
| CR-2 | Analyze the functioning of data link layer protocols, media access control, and error handling mechanisms in both wired and wireless networks. | | | | | | | | | | | | | | | | | | | |
| CR-3 | Apply IP addressing schemes, routing algorithms, and transport protocols to configure and troubleshoot computer networks. | | | | | | | | | | | | | | | | | | | |
| CR-4 | Evaluate and demonstrate various application layer services and protocols, including DNS, FTP, HTTP, email, and multimedia communication. | | | | | | | | | | | | | | | | | | | |
| CR-5 | Explore modern trends in network security, automation, and software-defined networking (SDN), and implement scripts using open-source tools. | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| CO-1 | Describe data communication principles, network models, and switching mechanisms. | ✓ | | | | 2 | 85 | 75 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO-2 | Analyze media types, encoding schemes, and error control at the data link layer. | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO-3 | Configure IP addressing, routing protocols, and transport layer mechanisms. | | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 3 |
| CO-4 | Demonstrate application layer protocols and client-server interactions. | ✓ | ✓ | ✓ | ✓ | 5 | 85 | 75 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| CO-5 | Apply security concepts, SDN, and automation tools in modern networking environments. | ✓ | ✓ | ✓ | ✓ | 6 | 85 | 75 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |

| Title & Session Outcomes | Fundamentals of Data Communication | Data Link Layer and Network Technologies | Network and Transport Layer Protocols | Application Layer and Network Services | Network Security and Automation Tools |
|-------------------------------------|---|---|--|--|--|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Basics of Data Communication – Components, Direction, Delivery | Framing Techniques – Character and bit-oriented framing | Logical Addressing – IPv4, IPv6 structure and assignment | DNS and Domain Structure – Name resolution and hierarchy | Network Security Goals – Confidentiality, Integrity, Availability |
| SO-2 | Network Models – OSI and TCP/IP architectures w | Error Detection and Correction – Parity, CRC, Hamming Code | Subnetting and Supernetting – Practice and problem solving | HTTP Protocol – GET, POST methods and stateless nature | Cryptographic Concepts – Symmetric vs Asymmetric encryption |
| SO-3 | Transmission Modes – Simplex, Half Duplex, Full Duplex | Flow and Access Control – Stop-and-wait, Sliding Window | Routing Algorithms – Distance Vector and Link State | Email Protocols – SMTP, POP3, IMAP | Authentication Methods – Digital signatures, certificates |
| SO 4-5 | Practice: Tools: Packet Tracer, Python, command-line tools <ul style="list-style-type: none"> Simulate OSI and TCP/IP layered communication using Cisco Packet Tracer Design a basic LAN topology with routers and switches | Practice: Tools: Python, Packet Tracer, Wireshark <ul style="list-style-type: none"> Implement CRC and Parity checking using Python Demonstrate Hamming code for error correction | Practice: Tools: Packet Tracer, Wireshark, Python (socket module) <ul style="list-style-type: none"> Practice IPv4 and IPv6 addressing and subnetting Configure static and dynamic routing (RIP/OSPF) in Packet Tracer | Practice: Tools: Postman, Wireshark, FileZilla, PuTTY/SSH, Python, terminal <ul style="list-style-type: none"> Perform DNS queries using nslookup and dig Test HTTP/HTTPS requests using Postman and browser dev tools | Practice: Tools: Python, Wireshark, Nmap, Netmiko, Jenkins, VirtualBox (optional) <ul style="list-style-type: none"> Simulate symmetric/asymmetric encryption algorithms using Python Configure basic firewall rules using iptables or UFW |
| SO-6 | Analog and Digital Signals – Characteristics and conversions | HDLC and PPP Protocols – Features and formats | Types of Transmission – Unicast, Multicast, Broadcast | FTP and TFTP – File transfer mechanisms | Firewall Technologies – Packet filtering, stateful inspection |
| SO-7 | Bandwidth, Throughput, Latency – Definitions and calculations | MAC Protocols – CSMA/CD, CSMA/CA | Address Resolution Protocols – ARP, RARP, DHCP | Telnet and SSH – Remote terminal services | Intrusion Detection Systems – IDS/IPS and VPNs |
| SO-8 | Transmission Impairments – Attenuation, Noise, Distortion | Ethernet Standards – 802.3, Fast Ethernet, Gigabit Ethernet | ICMP and Ping Utilities – Diagnostic and reporting features | Client-Server Architecture – Concepts and practical examples | Wireless Network Security – WPA, WPA2, MAC filtering |
| SO 9-10 | Practice: <ul style="list-style-type: none"> Observe transmission modes (simplex, half, full-duplex) via simulation tools Analyze signal types and bit rate calculations using Python | Practice: <ul style="list-style-type: none"> Simulate Stop-and-Wait and Sliding Window protocols Frame creation using bit stuffing/character stuffing | Practice: <ul style="list-style-type: none"> Analyze ICMP and ARP packets using Wireshark Configure DHCP and NAT in Packet Tracer | Practice: <ul style="list-style-type: none"> Set up FTP and email (SMTP, POP3) servers using FileZilla and Thunderbird Demonstrate Telnet and SSH sessions to remote devices | Practice: <ul style="list-style-type: none"> Capture WPA2 authentication traffic using Wireshark Scan and analyze networks using Nmap and Zenmap |
| SO-11 | Data Encoding Techniques – NRZ, Manchester, Differential Manchester | Wireless LANs – IEEE 802.11, Wi-Fi architecture | TCP and UDP Protocols – Features, ports, reliability | Web Services and APIs – REST, SOAP basics | Software-Defined Networking (SDN) – Basics and architecture |
| SO-12 | Switching Techniques – Circuit, Packet, and Message Switching | VLANs and Switch Configuration – Concepts and benefits | Multiplexing and Port Addressing – Demultiplexing at receiver | Network Performance Tools – Ping, traceroute, netstat | Python for Network Scripting – Netmiko, Paramiko intro |
| SO-13 | Network Topologies and Protocols – Bus, Star, Ring, Hybrid | Token Ring and FDDI – Legacy protocols and architecture | Congestion Control and Flow Control – TCP mechanisms | Multimedia Networking – VoIP, Streaming, QoS basics | Monitoring and Automation Tools – Wireshark, Nmap, Jenkins overview |
| SO 14-15 | Practice: <ul style="list-style-type: none"> Measure and compare latency, bandwidth, throughput using ping/traceroute | Practice: <ul style="list-style-type: none"> Configure Ethernet LAN and VLANs in Packet Tracer Capture MAC layer packets using | Practice: <ul style="list-style-type: none"> Compare TCP and UDP connections using Wireshark Simulate port communication and | Practice: <ul style="list-style-type: none"> Create simple web service client using REST API (Python/Browser) | Practice: <ul style="list-style-type: none"> Automate router config using Netmiko (Python) Create Jenkins pipeline for automated |

| | | | | |
|--|-----------|---|--|---------------|
| Visualize network topologies (bus, star, ring, hybrid) and packet flow | Wireshark | congestion control using socket programming | Use ping, traceroute, netstat to analyze performance | network tests |
|--|-----------|---|--|---------------|

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | |
|------------------------------|------------------------|-------------------------|---------------------------|
| Technology | Pedagogy / Andragogy | Sustainable Development | |
| Simulations | Case Studies | ✓ | No Poverty |
| Emulations | ✓ Group Discussion | ✓ | Zero Hunger |
| Prototypes | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | ✓ Inquiry Learning | ✓ | Quality Education ✓ |
| Mathematical Computing Tools | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | Leading Question | | Clean Water & Sanitation |
| | Mind Map | | Affordable & Clean Energy |
| | Minute Paper | | |
| | Peer Review | | |
| | Problem Based Learning | ✓ | |

| Resources | | | |
|-----------|--|---|--|
| 1 | West, J., & White, C. M. (2024). <i>Data communications and computer networks</i> (9th ed.). Cengage Learning. | 2 | Kurose, J. F., & Ross, K. W. (2023). <i>Computer networking: A top-down approach</i> (8th ed.). Pearson. |
| 3 | Stallings, W. (2021). <i>Data and computer communications</i> (10th ed.). Pearson Education. | 4 | Lowe, S., Oswalt, M., & Edelman, J. (2025). <i>Network programmability and automation</i> (2nd ed.). O'Reilly Media. |
| 5 | Forouzan, B. A. (2017). <i>Data communications and networking</i> (5th ed.). McGraw-Hill Education. | 6 | Tanenbaum, A. S., Feamster, N., & Wetherall, D. J. (2021). <i>Computer networks</i> (6th ed.). Prentice Hall. |

Designers

| Professional Experts | | Higher Institution Experts | | Internal Experts | |
|----------------------|---|----------------------------|---|------------------|--------------------------------|
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr. R. Reena Rose, SRMIST, KTR |
| | | | | 2 | Dr. R. Kiruthiga, SRMIST, KTR |

| Code | PCA25C09T | Title | Cloud and Quantum Computing | | | Category | C | Professional Core Course | L | T | P | C |
|------|-----------|-------|-----------------------------|--|--|----------|---|--------------------------|---|---|---|---|
| | | | | | | | | | 4 | 0 | 0 | 4 |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|----------------|---|-------|---|---|---|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CR-1 | Understand the foundational principles, architecture, and service models of modern cloud computing, including virtualization and deployment strategies. | | | | | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning |
| CR-2 | Analyze the infrastructure, orchestration, and automation tools used in scalable cloud environments across various service providers. | | | | | 2 | 85 | 75 | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CR-3 | Explore practical applications and emerging trends in cloud computing, including DevOps, AI/ML integration, sustainability, and ethical practices. | | | | | 4 | 85 | 75 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 3 |
| CR-4 | Comprehend the theoretical foundations of quantum computing, including quantum states, gates, circuits, and quantum algorithms. | | | | | 3 | 85 | 75 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 3 |
| CR-5 | Investigate quantum algorithmic frameworks and platforms, and evaluate their integration with classical and cloud-based computing paradigms. | | | | | 5 | 85 | 75 | 3 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 3 |
| CO-1 | Explain the concepts of cloud computing architecture, virtualization, and service models. | ✓ | | | | 6 | 85 | 75 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 3 |
| CO-2 | Analyze cloud infrastructure, orchestration tools, and security frameworks used in enterprise cloud setups. | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | | |
| CO-3 | Apply knowledge of cloud platforms to develop use cases involving DevOps, AI/ML, and serverless models. | | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |
| CO-4 | Demonstrate understanding of core quantum principles including qubits, superposition, and quantum gates. | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |
| CO-5 | Evaluate quantum algorithms and platforms, and discuss their applications in cryptography and hybrid cloud systems. | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | |

| Title & Session | Cloud Computing Fundamentals and | Cloud Infrastructure and Services | Applied Cloud and Emerging Trends | Foundations of Quantum Computing | Quantum Algorithms and Cloud Integration |
|-----------------|----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|--|
|-----------------|----------------------------------|-----------------------------------|-----------------------------------|----------------------------------|--|

| Outcomes | Architecture | | | | |
|-----------------|--|--|---|---|---|
| Duration (hour) | 12 | 12 | 12 | 12 | 12 |
| SO-1 | Introduction to Cloud Computing <ul style="list-style-type: none"> Evolution of computing: Mainframe → Grid → Cloud Need for elasticity and scalability | Compute, Storage, and Network Architecture <ul style="list-style-type: none"> Server farms, virtual network functions, block/file/object storage | Hands-on with AWS Core Services <ul style="list-style-type: none"> Launch EC2, upload to S3, configure RDS basics | Classical vs Quantum Paradigm <ul style="list-style-type: none"> Bit vs qubit, classical logic vs quantum logic | Quantum Fourier Transform (QFT) <ul style="list-style-type: none"> Period finding, phase estimation |
| SO-2 | Characteristics and Benefits of Cloud <ul style="list-style-type: none"> On-demand, resource pooling, rapid elasticity, measured service Cost-efficiency, global access, resilience | Resource Provisioning and Auto-Scaling <ul style="list-style-type: none"> Elastic Load Balancing, Auto-Scaling Groups | Azure & GCP: Cross-Platform Feature Mapping <ul style="list-style-type: none"> Compute Engine vs EC2, Azure Functions vs Lambda | Qubits and Superposition <ul style="list-style-type: none"> Quantum state representation, basis states | Grover's Search Algorithm <ul style="list-style-type: none"> Oracle model, quadratic speedup |
| SO-3 | Cloud Service Models: IaaS, PaaS, SaaS <ul style="list-style-type: none"> Examples: EC2, Google App Engine, Salesforce Use cases and service management | Virtual Machine Provisioning <ul style="list-style-type: none"> Image templates, orchestration, lifecycle | CI/CD Pipelines in Cloud <ul style="list-style-type: none"> Jenkins setup, GitHub Actions, deployment workflow | Quantum Entanglement <ul style="list-style-type: none"> Bell states, EPR paradox | Shor's Algorithm <ul style="list-style-type: none"> Periodicity and RSA cracking |
| SO-4 | Cloud Deployment Models <ul style="list-style-type: none"> Public, Private, Hybrid, Community When to choose which model | Cloud Storage Systems <ul style="list-style-type: none"> Amazon S3, Azure Blob, Google Cloud Storage | Serverless Computing <ul style="list-style-type: none"> Lambda functions, Cloud Functions, event-driven models | Quantum Gates and Circuits <ul style="list-style-type: none"> X, Y, Z, H, CNOT, Toffoli gates | Quantum Key Distribution (QKD) <ul style="list-style-type: none"> BB84 protocol, security guarantees |
| SO-5 | Cloud Reference Architecture (NIST) <ul style="list-style-type: none"> Roles: Consumer, Provider, Auditor, Broker Architectural components | Cloud Networking Concepts <ul style="list-style-type: none"> VPC, routing, subnetting, internet gateway | Big Data Tools in Cloud <ul style="list-style-type: none"> EMR, Dataproc, HDInsight, integration with S3/GCS | Measurement in Quantum Systems <ul style="list-style-type: none"> Collapse, expectation values, probabilities | Quantum Teleportation <ul style="list-style-type: none"> Entangled pair usage, measurement-based transmission |
| SO-6 | Virtualization Technologies <ul style="list-style-type: none"> Hypervisors (Type I | Identity and Access Management (IAM) | Cloud-native App Deployment <ul style="list-style-type: none"> DevOps lifecycle, Helm, | Bloch Sphere Visualization <ul style="list-style-type: none"> Polar coordinates, pure and | Quantum Error Correction <ul style="list-style-type: none"> 3-qubit bit-flip, Shor code, |

| | | | | | |
|--------------|---|--|---|---|--|
| | <ul style="list-style-type: none"> & II), VM lifecycle Containers vs Virtual Machines | <ul style="list-style-type: none"> Roles, policies, permission boundaries | Docker Compose | mixed states | stabilizers |
| SO-7 | Overview of Cloud Providers <ul style="list-style-type: none"> AWS, Azure, Google Cloud core services Service coverage comparison | Cloud Monitoring and Logging Tools <ul style="list-style-type: none"> AWS CloudWatch, Azure Monitor, GCP Stackdriver | Cloud AI/ML Platforms <ul style="list-style-type: none"> AWS SageMaker, Google Vertex AI, Azure ML Studio | Quantum Interference and Parallelism <ul style="list-style-type: none"> Probabilistic output manipulation | Quantum Machine Learning <ul style="list-style-type: none"> Variational circuits, quantum kernel methods |
| SO-8 | Containerization and Docker Basics <ul style="list-style-type: none"> Images, containers, volumes, orchestration intro Docker CLI basics | Security Mechanisms and Best Practices <ul style="list-style-type: none"> Encryption, MFA, Shared Responsibility Model | Disaster Recovery and High Availability <ul style="list-style-type: none"> RTO, RPO, backup strategies, multi-zone architecture | Basic Quantum Algorithms <ul style="list-style-type: none"> Deutsch Algorithm, Bernstein-Vazirani | Quantum Supremacy Benchmarks <ul style="list-style-type: none"> Google Sycamore, IBM Eagle |
| SO-9 | Microservices vs Monolithic Architecture <ul style="list-style-type: none"> Advantages and limitations Case study examples | Kubernetes and Container Orchestration <ul style="list-style-type: none"> Pods, Services, Deployment, Scaling | Multi-cloud & Hybrid Strategies <ul style="list-style-type: none"> Federation, failover, data transfer challenges | Quantum Mechanics Postulates <ul style="list-style-type: none"> State space, evolution, measurement postulates | Cloud Quantum Platforms <ul style="list-style-type: none"> IBM Q, Amazon Braket, Azure Quantum features |
| SO-10 | Multi-tenancy and Interoperability <ul style="list-style-type: none"> Tenant isolation, APIs, vendor lock-in issues | Infrastructure as Code Tools <ul style="list-style-type: none"> Terraform: providers, resources, plans Ansible for configuration management | Green Computing Initiatives <ul style="list-style-type: none"> Data center energy efficiency, sustainability metrics | Reversible Computing & No-Cloning Theorem <ul style="list-style-type: none"> Unitary transformations, cloning limitations | Hybrid Quantum-Classical Systems <ul style="list-style-type: none"> QAOA, VQE, simulation frameworks |
| SO-11 | Legal and Regulatory Issues <ul style="list-style-type: none"> GDPR, HIPAA, data locality and compliance | Billing and Pricing Models <ul style="list-style-type: none"> Pay-as-you-go, reserved instances, spot pricing | Cloud Ethics and Privacy <ul style="list-style-type: none"> Ownership, transparency, consent, access control | Quantum Noise and Decoherence <ul style="list-style-type: none"> T1, T2 times, gate fidelity, quantum error causes | Security and Ethics in Quantum Tech <ul style="list-style-type: none"> Crypto threats, misuse risks, future-proofing |
| SO-12 | Case Study Discussion <ul style="list-style-type: none"> Enterprise cloud adoption roadmap Migration challenges and best practices | Edge and Fog Computing <ul style="list-style-type: none"> Concepts, differences, applications in IoT | Capstone: Cloud Adoption Case Study <ul style="list-style-type: none"> Solution design, architectural decision-making | Quantum Programming Frameworks <ul style="list-style-type: none"> Qiskit basics, Q# overview, IBM Q experience | Future of Quantum Computing <ul style="list-style-type: none"> Quantum internet, post-quantum cryptography |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------|----------|--------|----------|--------|----------|----------------------------|---|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | | | |
| | | (10 %) | | (10%) | | (20%) | | (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | | Case Studies | ✓ | No Poverty |
| Emulations | | Group Discussion | ✓ | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | ✓ | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | ✓ | |

| Resources | | | | |
|-----------|--|---|---|--|
| 1 | Buyya, Rajkumar, James Broberg, and Andrzej Goscinski. <i>Cloud Computing: Principles and Paradigms</i> . Wiley, 2011. | 2 | Erl, Thomas, Zaigham Mahmood, and Ricardo Puttini. <i>Cloud Computing: Concepts, Technology & Architecture</i> . Prentice Hall, 2013. | |
| 3 | Hwang, Kai, and Geoffrey C. Fox. <i>Distributed and Cloud Computing: From Parallel Processing to the Internet of Things</i> . Morgan Kaufmann, 2012. | 4 | Thomas, Gordon. <i>Hands-On Cloud Computing with AWS, Azure, and GCP</i> . Packt, 2022. | |
| 5 | Nielsen, Michael A., and Isaac L. Chuang. <i>Quantum Computation and Quantum Information</i> . Cambridge UP, 2010. | 6 | Yanofsky, Noson S., and Mirco A. Mannucci. <i>Quantum Computing for Computer Scientists</i> . Cambridge UP, 2008. | |
| 7 | Sutor, Robert. <i>Dancing with Qubits: How Quantum Computing Works and How It Can Change the World</i> . Packt, 2020. | 8 | Rieffel, Eleanor G., and Wolfgang H. Polak. <i>Quantum Computing: A Gentle Introduction</i> . MIT Press, 2011. | |

| Designers | | |
|---|---|----------------------------------|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 Dr. R. Kiruthiga, SRMIST, KT R |

| Code | PCA25C10L | Title | Capstone Project | Category | C | Professional Core Course | L 0 | T 0 | P 8 | C 4 |
|------|-----------|-------|------------------|----------|---|--------------------------|--------|--------|--------|--------|
|------|-----------|-------|------------------|----------|---|--------------------------|--------|--------|--------|--------|

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | | |
|----------------|---|-------|---|---|---|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|---|---|---|---|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | |
| CR-1 | Demonstrate skills learnt in the real time environment. | | | | | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | | | |
| CR-2 | Explore the different industries that are using IT | | | | | Conceive | Design | Implement | Operate | 5 | 85 | 75 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 | |
| CR-3 | Enhance the skills in the system aspects | | | | | 4 | 85 | 75 | 3 | - | - | 3 | 3 | - | - | - | - | 3 | 3 | - | - | 3 | - | 3 | |
| CR-4 | Understanding the professional connections with the knowledge learnt | | | | | 6 | 85 | 75 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | - | - | 3 | - | 3 | - | |
| CR-5 | Applying the skills in problem solving | | | | | 3 | 85 | 75 | 3 | - | 2 | 3 | 3 | - | - | - | 3 | 3 | - | - | 3 | - | 3 | 3 | |
| CO-1 | To get an inside view of an industry and organization/company | ✓ | | | | 2 | 85 | 75 | 3 | - | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 | 2 | 3 | 3 | |
| CO-2 | To gain valuable skills and knowledge | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | | |
| CO-3 | To make professional connections and enhance networking | | ✓ | | | | | | | | | | | | | | | | | | | | | | |
| CO-4 | To get experience in a field to allow the student to make a career transition | ✓ | ✓ | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | |
| CO-5 | To get an inside view of an industry and organization/company | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | | | |

Students can choose problems of their own interest to develop software package using the programming languages/tools available. There will be two reviews conducted during the project period for all the students. At the end of the project, every student shall submit a structured project report and will take a Viva Voce examination.

| Assessment | | | | |
|--------------|---|------------|----------------------------------|-----------|
| Project Work | Continuous Learning Assessment (CLA) (50 % weightage) | | Final Evaluation (50% weightage) | |
| | Review – 1 | Review – 2 | Project Report | Viva-Voce |
| | 20% | 30 % | 30 % | 20 % |

| Code | PGI25D07J | Title | Computer Vision in Smart Robotics | | | | Category | D | Discipline Elective Course | L | T | P | C |
|------|-----------|-------|-----------------------------------|--|--|--|----------|---|----------------------------|---|---|---|---|
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|
|---------------------|-----------------------|-----------------------|-----|----------------------|-----|---------------------|-----|-----------------------------|-----|

| Rationale (CR) | The purpose of learning this course is to: | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | |
|----------------|---|----------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| CR-1 | To understand the basic principles of computer vision and its applications in robotics. | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | |
| CR-2 | To learn about different techniques for image processing and feature extraction. | | | | | | | | | | | | | | | | | | | | |
| CR-3 | To study methods for object recognition and visual tracking in robotics. | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Explain the basic principles of computer vision and its role in robotics. | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Apply image processing techniques to enhance images for robotic perception. | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | At the end of this course, learners will be able to: | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Demonstrate an understanding of the principles of computer vision and its role in robotics. | ✓ | | | | 3 | 80 | 70 | 3 | 3 | 3 | 3 | 3 | 2 | - | 3 | 2 | 2 | - | 3 | |
| CO-2 | Apply image processing techniques such as filtering, segmentation, and feature extraction to process images for robotic perception. | ✓ | ✓ | ✓ | | 3 | 85 | 75 | 2 | 2 | 3 | 3 | 3 | - | - | 2 | 2 | 2 | - | 3 | |
| CO-3 | Implement machine learning algorithms for tasks such as object detection and recognition in robotics. | | ✓ | | | 3 | 75 | 70 | 2 | 2 | 3 | 3 | 3 | - | - | 2 | 2 | 1 | - | 3 | |
| CO-4 | Design and develop computer vision algorithms using libraries such as OpenCV for robotic applications. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 80 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 1 | 3 | 2 | 3 | |
| CO-5 | Integrate computer vision systems with robotic platforms and demonstrate their functionality in real-world scenarios. | ✓ | ✓ | | | 3 | 75 | 70 | 3 | 3 | 3 | 3 | 3 | 1 | - | 2 | 3 | 1 | 1 | 3 | |

| Title & Session Outcomes | Overview of Robotics and Computer Vision | Image Acquisition & Pre Processing Techniques | Advanced Computer Vision Techniques | Understanding and Tracking for Intelligent Robotic Systems | Vision-Based Robotics |
|-------------------------------------|---|--|--|--|---|
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |
| SO-1 | Overview of robotics and computer vision, Importance of Computer Vision in robotics systems | Introduction on Image Acquisition | Techniques for object detection in images and videos, | Introduction to Scene Understanding and Tracking in Robotics, Sensor Fusion for Scene Understanding and Tracking | Vision-based Human-Robot Interaction (HRI): Gesture recognition, Face detection and tracking, Emotion recognition from visual input, Gaze estimation and social cues analysis |
| SO-2 | Computer Vision Work flow steps | Image Acquisition Techniques in robotics | Object recognition and classification techniques | Object Tracking, Multi-Object Tracking, Visual SLAM | Visual Servoing: Using visual feedback to control the robot's motion or manipulation tasks. |
| SO-3 | Computer Vision Frame Work (OpenCV, TensorFlow, PyTorch) | Object Detection Methods | Data Augmentation Techniques for Object Detection | Deep Learning Approaches for Scene understanding 3D Scene, understanding for Robotics | Robust Vision Systems for Dynamic Environments: Visual feedback for robotic arm control Positioning and alignment using cameras, Image-based control systems for robot motion |
| SO 4-5 | Practice 1: Reading and Writing Images using OpenCV | Practice 4: Write a program to capture images from a camera and display them on a screen using OpenCV or a similar library. | Practice 7: Write a program, to implement data augmentation techniques to training images and labels to improve model generalization. | Practice 10: Implement 3D Scene Reconstruction | Practice 13: Detect and track a face in a live video stream |
| SO-6 | Image Processing Fundamentals: Image formation, filtering techniques | Image Preprocessing Techniques Noise types: Gaussian, salt-and-pepper | Deep Learning Models: Convolutional Neural Networks (CNNs) for Object Detection | Machine Learning for Adaptive scene understanding Probabilistic Models for scene understanding and tracking | Multi-Modal Sensor Fusion Techniques |
| SO-7 | Edge detection | Smoothing techniques: Gaussian blur, median filter | YOLOv5/v8: Real-time detection SSD (Single Shot Detector), Faster R-CNN | Contextual Understanding in Scene Analysis | Learning-based Visual Navigation Techniques |
| SO-8 | Color models and segmentation | Morphological operations: erosion, dilation, opening, closing | Instance Segmentation: Mask R-CNN, SegFormer, SAM (Segment Anything Model) | Cognitive Approaches to scene understanding in Robotics | Moving Object Detection and Tracking |
| SO | Practice 2: Given an image | Practice 5: Implement | Practice 8: Object | Practice 11: Build a classifier to | Practice 14: Develop a vision- |

| | | | | | |
|----------|--|--|--|---|---|
| 9-10 | with noise, apply a suitable filtering technique to reduce the noise. Compare the effects of these filters on the image quality | preprocessing IoT Devices with Computer Vision Technologies Techniques | Detection -Use a pre-trained object detection model (e.g., YOLO, SSD) to detect objects in a video stream and draw bounding boxes around them | classify the scenes into their respective categories. | based system to detect and track moving objects in a dynamic environment. |
| SO-11 | Integration of Computer Vision and Robotics: Applications of computer vision in robotic systems, such as navigation, manipulation, and perception. | Image filtering and enhancement techniques | Transformers in Vision: DETR (DEtection TRansformer) DINOv2, OWL-ViT for open-world object detection | Real-Time Scene Understanding, Adaptive Learning, Cognitive Approaches | Visual SLAM in Dynamic Environments: Handling moving objects and changing scenes in SLAM |
| SO-12 | Calibration of cameras and sensors for robotic applications | Feature extraction method | Transfer Learning for Object Detection in Robotics | Benchmark Datasets and Evaluation Metrics for Scene Understanding | Vision-based Localization in GPS-denied Environments: Localizing robots using vision when GPS is unavailable. |
| SO-13 | Calibration of cameras and sensors for robotic applications | Image Segmentation | Tracking Techniques - KLT tracker (Lucas-Kanade) , DeepSORT, ByteTrack, StrongSORT for multi-object tracking | Ethical Considerations in Scene Understanding and Tracking | Deep Reinforcement Learning for Vision-based Robotics: Using deep RL to train robots for various vision tasks. |
| SO 14-15 | Practice 3: Implement a Python function using OpenCV to calibrate a camera using multiple images of a checkerboard pattern | Practice 6:Write a program to implement image filtering and feature extraction techniques | Practice 9: Object Tracking-Implement a basic object tracking algorithm (e.g., KLT tracker) to track a moving object in a video stream | Practice 12: Implement a semantic segmentation algorithm to label each pixel in an image with the corresponding object class, providing a detailed understanding of the scene's content. | Practice 15: Develop a Visual SLAM system that can handle dynamic objects and changing scenes, making the SLAM algorithm robust to moving objects. |

| Assessment | | | | | | | | | | | |
|-------------------|------------|--|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|----------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|-----------|--|---|---|
| 1 | Robot Vision, Berthold Klaus Paul Horn. McGraw-Hill Higher Education | 2 | Simon J.D. Prince, Computer Vision: Models, Learning, and Inference, University College London,2012 |

| Designers | | |
|---|--|-----------------------------|
| Professional Experts | Higher Institution Experts | Internal Experts |
| 1 Dr. Gangadharan G.R,Professor,National Institute of Technology, Tiruchirappalli- 620015 | 1 Mr. Harishankher Selvaraj, Talent Lead and Head of Placements,GUVI Geek Networks Pvt Ltd | 1 <i>Dr.Pandian, SRMIST</i> |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|---|--|--|--|-----------------|---|-----------------------------------|---|---|---|---|
| Code | PGI25D08J | Title | Building Conversational AI for Human Resources | | | | Category | D | Discipline Elective Course | L | T | P | C |
| | | | | | | | | | 3 | 0 | 2 | 4 | |

| | | | | | | | | | |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|---|--------------|--------|-----------|---------|-------------------|--------------------------|-------------------------|------------------------------|-----------------|----------------------|----------------------------|-------------------|-------------------|------------------------------|---|------------------------|---------------|------------------------------|--------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | | | | | | | | | | |
| CR-1 | Discover Conversational Artificial Intelligence technologies. | | | | | | | | Disciplinary Knowledge | Problem Solving | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethical Practices & Social Responsibility | Individual & Team Work | Communication | Project Management & Finance | Life Long Learning | | | | | | | | | | | | | | |
| CR-2 | Study the basics of designing intelligent agents that can solve HR problems | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-3 | Discover appropriate HR dialogue system using natural language processing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-4 | Perform conversational design process with different use cases of HR context | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CR-5 | Formalize conversational AI linear and nonlinear dialogue | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | Conceive | Design | Implement | Operate | Level of Thinking | Expected Proficiency (%) | Expected Attainment (%) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CO-1 | Demonstrate fundamental understanding of the Conversational Artificial Intelligence and its foundations | ✓ | | | | 2 | 85 | 80 | 1 | - | - | 3 | - | 2 | - | 2 | 3 | 3 | 2 | 3 | | | | | | | | | | | | | | |
| CO-2 | Apply basic principles conversational artificial intelligence in HR domain knowledge | ✓ | ✓ | ✓ | | 3 | 85 | 80 | 3 | - | - | 3 | 3 | - | - | - | 3 | 3 | 2 | 3 | | | | | | | | | | | | | | |
| CO-3 | Develop conversational AI models with understanding of HR policies and procedures. | | ✓ | | | 3 | 85 | 80 | 3 | - | - | 3 | - | - | - | - | 3 | 3 | 2 | 3 | | | | | | | | | | | | | | |
| CO-4 | Ability to understand Natural Language Processing fundamentals | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 80 | 3 | 1 | 2 | 3 | 3 | - | - | - | 3 | 3 | 2 | 3 | | | | | | | | | | | | | | |
| CO-5 | Ability to learn conversational agents and develop dialogue systems. | ✓ | ✓ | | | 3 | 85 | 80 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 2 | 3 | | | | | | | | | | | | | | |

| | | | | | |
|-------------------------------------|---|----------------------------|--|---|---|
| Title & Session Outcomes | Introduction to Conversational AI for HR | HR Domain Knowledge | Building Conversational AI Models | Ethical and Legal Considerations | Project Development and Presentation |
| Duration (hour) | 15 | 15 | 15 | 15 | 15 |

| | | | | | |
|---------|---|---|--|--|---|
| SO-1 | Overview of Conversational AI technologies. | Understanding HR policies, procedures, and regulations. | Overview of machine learning models for NLP tasks. | Privacy concerns. | Provide students with an opportunity to work on a project integrating concepts learned throughout the course. |
| SO-2 | Applications and benefits of conversational AI in HR. Challenges and limitations of conversational AI in HR contexts | Employee lifecycle management - Recruitment, on-boarding, performance management, off-boarding. | Pre-trained language models for conversational AI - Fine-tuning models on HR-specific datasets. | Data protection regulations - Bias and fairness in conversational AI systems. | Project Proposal - Develop a project proposal outlining the problem statement. |
| SO-3 | Conversational Design Process - Use cases of HR context. | HR compliance and legal considerations - Employee benefits, compensation, and payroll administration. | Model evaluation - Performance metrics. | Transparency and accountability in AI decision-making - Ethical use of Conversational AI in HR interactions. | Objectives, methodology - Expected outcomes. |
| SO 4-5 | Practice 1: Implement a tokenization function to split input text into tokens. | Practice 4: Construct dialogue trees representing various conversation paths based on user inputs and system responses | Practice 7: Access HR-related data sources (e.g., employee database, leave management system) using APIs or database queries. | Practice 10: Implement strategies to mitigate biases and ensure fairness and inclusivity in conversational AI systems. | Practice 13: Project integrating concepts learned throughout the course. |
| SO-6 | Natural Language Processing (NLP) Fundamentals - Basics of text processing and tokenization. | User-centered design principles for conversational interfaces - Personal development and conversational tone. | Linear and Non-linear dialogue - Actions & Parameters. | Fulfilment using webhook - Basic setup of webhook code. | Project Implementation - Implement the proposed conversational AI system. |
| SO-7 | Part-of-speech tagging- Syntactic parsing. | Prompt design -Error handling. | Understanding slot filling context - Extended Lead Generation. | Extracting parameter values and structuring responses - Fulfillment using cloud function. | Incorporating NLP - Dialogue management. |
| SO-8 | Named entity recognition and entity linking -Sentiment analysis and emotion detection. | Multimodal interactions - Accessibility considerations. | Linear dialogue - Nonlinear Dialogue. | SAP Conversational AI Connect Chatbot to HR systems. | Integration with HR systems. Ethical considerations. |
| SO 9-10 | Practice 2: Use an NLP library to perform part-of-speech tagging on sample sentences. | Practice 5: Implement error handling strategies to handle user misunderstandings or unexpected inputs. | Practice 8: Preprocess retrieved data to extract relevant information and prepare it for use in conversational interactions. | Practice 11: Build a Web hook for a Chatbot and connect with HR Systems. | Practice 14: Demonstrating the functionality and effectiveness of the conversational AI system. |
| SO-11 | Introduction to dialogue systems architecture - Dialogue Systems and Conversational Agents. | Building blocks of Interaction models -Agents, types of Intents. | Accessing HR databases - APIs, and third-party services. | Assess the performance of conversational AI systems using appropriate metrics. - User Testing. | Deployment: Introduction to Heroku, Deploying to Heroku. |
| SO-12 | Intent recognition and dialogue state tracking - Dialogue management strategies (rule-based, statistical, reinforcement learning) | Creating Intents, training phrases - Entities, configuring rich responses. | Integrating conversational AI with HR management software - Applicant tracking systems. | Conduct user testing sessions with human participants - Evaluate the usability and effectiveness of the conversational AI system | Deploying on Alexa, Re-training, Validation& Testing. |

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|----------|---|--|---|---|---|
| SO-13 | Handling multi-turn conversations. Context preservation. | Small talk and salutations- Configuring and testing Intents on Google Assistant. | Data privacy - Security, and compliance considerations. | Analyze common errors and misunderstandings encountered during user interactions - Identify areas for improvement. | Building a AI application on Heruku Demonstrating with HR systems. |
| SO 14-15 | Practice 3: Designing Conversational Flows: Define common HR scenarios (e.g., employee onboarding, leave request) and outline the conversation flow for each scenario. | Practice 6: Design and train a simple intent recognition model using a rule-based or machine learning approach. | Practice 9: Test the integration between the conversational AI system and HR systems to ensure data accuracy and consistency | Practice 12: Conduct user testing sessions with human participants to evaluate the usability and effectiveness of the conversational AI system | Practice 15: Deploying a chatbot on Heruku. |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| | | | | | | | | | | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | | |
|------------------------------|---|------------------------|---|---------------------------|---|
| Technology | | Pedagogy / Andragogy | | Sustainable Development | |
| Simulations | ✓ | Case Studies | ✓ | No Poverty | ✓ |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger | ✓ |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being | ✓ |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education | |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality | |
| Field Visit | | Leading Question | | Clean Water & Sanitation | |
| | | Mind Map | | Affordable & Clean Energy | |
| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | | | |
|-----------|---|----|--|
| 1. | Wurafsky, Daniel; Martin, James H. , <i>Speech and Language Processing</i> , 3rd Edition (draft), Pearson, 2023. (Covers NLP fundamentals, tokenization, POS tagging, syntactic parsing, dialogue systems, sentiment analysis.) | 2. | Tegmark, Max , <i>Life 3.0: Being Human in the Age of Artificial Intelligence</i> , 1st Edition, Penguin Books, 2017. (Explores long-term impacts, bias, accountability, and ethical use of AI.) |
| 3. | Chowdhary, R.A. , <i>Natural Language Processing: Fundamentals for the Real World</i> , 1st Edition, BPB Publications, 2020. (Practical introduction to NLP techniques and applications relevant to HR chatbots.) | 4. | Weblink: https://www.oreilly.com/library/view/designing-bots/9781491974810/ Description: Focuses on conversational design principles, dialogue flows, and user-centric interaction strategies. |
| 5. | Rashid, Md. Rezaul Karim , <i>Building Chatbots with Python</i> , 2nd Edition, Apress, 2022. (Hands-on development of chatbot applications using NLP and Python libraries.) | 5. | Weblink: https://www2.deloitte.com/us/en/insights/focus/cognitive-technologies/ethical-use-of-ai-in-human-resources.html Description: Industry report focusing on ethical, fair, and compliant use of AI tools in HR functions. |
| 6. | Wooldridge, Michael , <i>Artificial Intelligence: A Guide for Thinking Humans</i> , 1st Edition, Penguin Books, 2021. (Introduces ethical, legal, and fairness aspects of AI systems in human contexts.) | 7. | Weblink: https://link.springer.com/book/10.1007/978-3-030-68252-3 Description: Covers advanced NLP and deep learning techniques applicable to building scalable, smart conversational AI systems. |

| Designers | | | | | |
|----------------------|---|----------------------------|---|------------------|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.S.Arunarani, SRMIST, arunaras@srmist.edu.in |

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|----------------|---|--|---|---|--|
| SO-2 | Physical design of IoT, Things in IoT, IoT protocols | Device to Cloud Model, Device to Gateway Model, M2M, Differences between IoT and M2M | Computer Vision defined from an academic perspective, Computer Vision defined from Industry perspective | Success Criteria Definition, Right Computer Vision Techniques | Image Processing Techniques, Image Restoration, Linear, Filtering, Independent Component Analysis, Pixelation |
| SO-3 | Logical Design of IoT, IoT Functional Blocks | Architecture of M2M, Software Defined Networking (SDN), SDN, Architecture of SDN | Signal Processing for Computer Vision, Pattern recognition of Computer Vision | Collect Training Data, Label Train and Test Datasets | Challenges and opportunities in integrating IoT with computer vision. Overview of edge computing and its role in IoT |
| SO 4-5 | Practice :1 Explain working of Raspberry Pi. | Practice 4: Describe gateway as a service deployment in Iot toolkit | Practice 7: Install OpenCV, Displaying images OpenCV | Practice 10: Text in Images | Practice 13: Image Edge Detection OpenCV |
| SO-6 | IoT Levels and Deployment Templates, Levels 0, Levels 1 | Network Function, Virtualization (NFV), Architecture of NFV, NFV for IOT, YANG - NETCONF | Challenges of Computer Vision, Computer Vision Data, Requirements | Train the computer vision model Evaluate the computer vision model | Median Filter, Feature detection and matching |
| SO-7 | Levels 2, Levels 3, Level 4, Level 5 | IoT System Management. Advantages and Disadvantages of IoT System management NETCONF, YANG and NETOPEER | How much data is needed, Is your data good enough? | Test the model, Deploy the model | Security challenges in IoT deployments, Secure communication protocols and encryption techniques |
| SO-8 | IoT Deployment Challenges Domain Specific IoT | IoT Systems and Devices Management with NETCONF-YANG, Purpose & Requirements, process model specification, domain model specification | Data Structure Data Format | Iterate the steps process Computer vision architecture | Problems that Computer Vision can Solve Text Classification |
| SO 9-10 | Practice 2: Controlling LED with Raspberry Pi | Practice 5: Weather Monitoring System | Practice 8: Reading & Writing images OpenCV | Practice 11: Color Space OpenCV Thresholding OpenCV | Practice 14: Image Scaling & Rotation using OpenCV |
| SO-11 | Home, Cities Environment, Energy systems | Information model specifications, service specifications, IoT level, Specifications, Functional view specifications, operational view specifications | Data Type, Training Data | Data Ingestion, Data Pre-processing | Privacy concerns in computer vision applications, Implementing secure communication for IoT devices |
| SO-12 | Industry Agriculture | Device & component Integration, Application development, IoT | Validation Data, Test Data | Multiprocessing, Transfer Learning/Model, Processing | Introduction to edge devices: Raspberry Pi, Arduino, NVIDIA Jetson Nano, Hands-on exercises: |

| | | | | | |
|-----------------|---|--|--|---|--|
| | | System for Agriculture | | | Implementing secure communication for IoT devices |
| SO-13 | Health and Lifestyle IoT components | Functional view specifications, operational view specifications IoT Security and Interoperability, Risks and Attacks, and Tools for Security | Image Processing Techniques Filtering Techniques in Image Processing Linear Filter, Non-Linear Filter | Data Transformation, Popular Computer Vision frameworks: OpenCV, TensorFlow, Matlab | Hands-on exercises: Setting up an edge device, installing OpenCV Hands-on exercises: Implementing object detection on IoT devices |
| SO 14-15 | Practice 3: Interfacing Light Sensor with Raspberry pi | Practice 6: IoT based Soil Moisture Monitoring Device | Practice 9: Draw a Rectangle, Draw a Circle | Practice 12: Finding Contours | Practice 15: Image Translation OpenCV, Image Filtering OpenCV |

| Assessment | | | | | | | | | | | |
|-------------------|------------|---|----------|--------------|----------|--------------|----------|--------------|----------|----------------------------|-----|
| Level of Thinking | | Continuous Learning Assessment (CLA) (50 % weightage) | | | | | | | | Final Exam (50% Weightage) | |
| | | CLA – 1 (10 %) | | CLA– 2 (10%) | | CLA– 3 (20%) | | CLA– 4 (10%) | | | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice | | |
| 1 | Remember | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 2 | Understand | | | | | | | | | | |
| 3 | Apply | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| 4 | Analyze | | | | | | | | | | |
| 5 | Evaluate | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% | 10% |
| 6 | Create | | | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | | 100 % | |

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| | | Minute Paper | | | |
| | | Peer Review | | | |
| | | Problem Based Learning | | | |

| Resources | |
|-----------|---|
| 1 | ArshdeepBahga and Vijay Madiseti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015. |
| 2 | Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014. |
| 3 | R. Jain, R. Kasturi, and B. G. Schunck, Machine Vision, McGraw-Hill, Inc. 1995. |
| 4 | Digital Image Processing and Analysis: Application with MATLAB and CVIPtools, 3rd Edition, SE Umbaugh, Taylor&Francis/CRC Press, 2018 |
| 5 | Computer Vision: Algorithms and Applications by Richard Szeliski. Available for free online. |
| 6 | Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce. Available for free online. |

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| | | | | | |
|------|---|--|---|---|---|
| SO-2 | Data types and sources: structured, semi-structured, unstructured | NoSQL databases: MongoDB, Cassandra, HBase | Building ETL/ELT pipelines using Apache NiFi, Airflow, or similar tools | Data exploration using Python/R (Pandas, NumPy, Matplotlib) | Stream processing using Apache Kafka, Apache Flink, Spark Streaming |
| SO-3 | Data ingestion techniques: batch vs. streaming | Data Lakes and Warehouses: Redshift, BigQuery, Snowflake, Delta Lake | Data ingestion from APIs, logs, and streaming platforms (Kafka, Flume) | Statistical methods for data analysis | Case Study 1: Building a real-time analytics dashboard |
| SO-4 | Data formats: CSV, JSON, Parquet, Avro | Distributed file systems: Hadoop HDFS | Handling schema evolution, late arriving data, and data quality | Introduction to machine learning for analytics (regression, classification) | Case Study 2: Implementing a scalable data pipeline |
| SO-5 | Data modeling basics: relational, dimensional, and NoSQL models | Apache Spark and MapReduce: architecture and use cases | Monitoring and logging in data pipelines | BI tools: Tableau, Power BI, Looker basics | Data governance, privacy, and security in analytics |
| SO-6 | Overview of ETL (Extract, Transform, Load) processes | Data partitioning and sharding concepts | Introduction to CI/CD in data pipelines | Dashboard creation and storytelling with data | Industry trends in Data Engineering and Analytics |

| Assessment | | | | | | | | | |
|-------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
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| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

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| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|------------------|--|----|--|
| 1. | Data Engineering with Python – Paul Crickard | 2. | Designing Data-Intensive Applications – Martin Kleppmann |
| 3 | Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley | 4 | Fundamentals of Data Engineering – Joe Reis and Matt Housley |
| 5 | Anil Maheshwari, “Data Analytics Made Accessible”, CreateSpace Independent Publishing. | | |

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| | | | | | |
|------|---|---|--|--|--|
| SO-3 | Distributed Database Architectures – Client-server, peer-to-peer, multi-tier models, Distributed data storage and management | Indexing in Distributed Databases – B-Trees, Hash-based indexing, LSM Trees | Query Optimization Techniques – Cost-based and rule-based optimization | Fault Tolerance Techniques – Replication, backups, data recovery | Distributed Databases in Cloud Computing – Concepts and architectures |
| SO-4 | Data Distribution and Fragmentation – Horizontal, vertical, and hybrid fragmentation | Sharding and Partitioning Strategies – Range-based, Hash-based, Consistent Hashing | Concurrency Control Mechanisms – Locking, Timestamp ordering, MVCC | Scalability in Distributed Databases – Vertical vs Horizontal scaling | Edge Computing and Federated Databases – Modern distributed data management |
| SO-5 | Replication and Consistency – Types of replication, eventual consistency | Replication Techniques – Synchronous vs Asynchronous replication | Deadlocks and Resolution Strategies – Detection and Prevention techniques | Blockchain Integration – Decentralization and consensus models | Future Trends in Distributed Databases – AI integration, |
| SO-6 | CAP Theorem – Trade-offs in distributed databases | Performance Considerations – Latency, throughput, load balancing | Transaction Management – ACID, isolation levels | Load Balancing – Techniques and strategies | Quantum databases |

| Assessment | | | | | | | | | |
|-------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
| 6 | Create | | | | | | | | |
| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

| Strategies | | | | |
|------------------------------|---|------------------------|---|---------------------------|
| Technology | | Pedagogy / Andragogy | | Sustainable Development |
| Simulations | ✓ | Case Studies | ✓ | No Poverty |
| Emulations | ✓ | Group Discussion | ✓ | Zero Hunger |
| Prototypes | | Hands-on Practice | ✓ | Good Health & Well Being |
| Hands-on Practice Tools | | Inquiry Learning | ✓ | Quality Education |
| Mathematical Computing Tools | | Interactive Lecture | ✓ | Gender Equality |
| Field Visit | | Leading Question | | Clean Water & Sanitation |
| | | Mind Map | | Affordable & Clean Energy |
| | | Minute Paper | | |
| | | Peer Review | | |
| | | Problem Based Learning | | |

| Resources | | | |
|------------------|--|---|--|
| 1 | M. Tamer Özsu, Patrick Valduriez, Principles of Distributed Database Systems 4th Edition Springer 2019 | 2 | Pramod J., NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition Addison-Wesley Professional 2012 |
| 3 | Abraham Silberschatz, Henry F. Korth, S. Sudarshan "Database System Concepts 7th Edition McGrawHill 2019 | 4 | Andrew S. Tanenbaum, Maarten Van Steen Distributed Systems: Principles and Paradigms 2nd edition Pearson 2006 |
| 5 | William Stallings Cryptography and Network Security" 8th Edition Pearson 2020 | | |

| Designers | | | | | |
|-----------------------------|---|-----------------------------------|---|-------------------------|--|
| Professional Experts | | Higher Institution Experts | | Internal Experts | |
| 1 | Dr. Gangadharan G.R, Professor, National Institute of Technology, Tiruchirappalli- 620015 | 1 | Mr. Harishankher Selvaraj, Talent Lead and Head of Placements, GUVI Geek Networks Pvt Ltd | 1 | Dr.Srividhya.B, SRMIST, srividhb@srmist.edu.in |
| 2 | | 2 | | 2 | Dr.S.Vanitha, SRMIST |

| | | | | | | | | | | | | | |
|-------------|------------------|--------------|---------------------------------|--|--|--|-----------------|----------|--------------------------------|----------|----------|----------|----------|
| Code | PGI25G06T | Title | Quantum Machine Learning | | | | Category | G | Generic Elective Course | L | T | P | C |
| | | | | | | | | | 2 | 0 | 0 | 2 | |

| | | | | | | | | | |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|
| Offering Department | Computer Applications | Pre-requisite Courses | Nil | Co-requisite Courses | Nil | Progressive Courses | Nil | Data Book / Codes/Standards | Nil |
|----------------------------|-----------------------|------------------------------|-----|-----------------------------|-----|----------------------------|-----|------------------------------------|-----|

| Rationale (CR) | <i>The purpose of learning this course is to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | | | | |
|-----------------------|---|--------------|--------|-----------|---------|--------------------------|---|---|---|---|---|---|---|---|---|---|---|----|----|----|--|--|--|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | |
| CR-1 | Learn the aspects related to Machine learning is a subset of artificial intelligence in the field of computer science | | | | | Level of Thinking | | | Disciplinary Knowledge | | | | | | | | | | | | | | |
| CR-2 | Familiarize statistical techniques to give computers the ability to "learn" with data, without being explicitly programmed | | | | | Expected Proficiency (%) | | | Problem Solving | | | | | | | | | | | | | | |
| CR-3 | Conceive the concept of model that assigns unseen inputs to one or more (multi-label classification) of these classes. | | | | | Expected Attainment (%) | | | Design & Development | | | | | | | | | | | | | | |
| CR-4 | Identify and acquire knowledge in various Supervised learning, Un Supervised learning, Instance based Learning algorithms | | | | | | | | Analysis, Design, Research | | | | | | | | | | | | | | |
| CR-5 | Ability to identify the machine learning methods which identifies learns, or evolves "rules" to store, manipulate or apply knowledge. | | | | | | | | Modern Tool Usage | | | | | | | | | | | | | | |
| | | Conceive | Design | Implement | Operate | | | | Society & Culture | | | | | | | | | | | | | | |
| | | | | | | | | | Environment & Sustainability | | | | | | | | | | | | | | |
| | | | | | | | | | Ethical Practices & Social Responsibility | | | | | | | | | | | | | | |
| | | | | | | | | | Individual & Team Work | | | | | | | | | | | | | | |
| | | | | | | | | | Communication | | | | | | | | | | | | | | |
| | | | | | | | | | Project Management & Finance | | | | | | | | | | | | | | |
| | | | | | | | | | Life Long Learning | | | | | | | | | | | | | | |

| Outcomes (CO) | <i>At the end of this course, learners will be able to:</i> | Depth | | | | Attainment | | | Program Outcomes (PO) | | | | | | | | | | | |
|----------------------|---|--------------|---|---|---|-------------------|----|----|------------------------------|---|---|---|---|---|---|---|---|----|----|----|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| CO-1 | Acquire the basics of procedures for the Machine Learning algorithms | ✓ | | | | 5 | 85 | 75 | 3 | 2 | 3 | 3 | - | 2 | - | 2 | 3 | 3 | - | 3 |
| CO-2 | Apply appropriate data sets to the Machine Learning algorithms | ✓ | ✓ | ✓ | | 4 | 85 | 75 | 3 | 3 | - | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-3 | Use Machine Learning algorithms to solve real-world problems. | | ✓ | | | 6 | 85 | 75 | 3 | 2 | 2 | 3 | - | - | - | - | 3 | 3 | - | 3 |
| CO-4 | To gain knowledge of Outline predictions using machine learning algorithms. | ✓ | ✓ | ✓ | ✓ | 3 | 85 | 75 | 3 | - | 2 | 3 | 3 | - | - | - | 3 | 3 | - | 3 |
| CO-5 | To gain knowledge quantum computing techniques. | ✓ | ✓ | | | 2 | 85 | 75 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | - | 3 |

| Title & Session Outcomes | Overview | Data Storage, NoSQL, and Indexing | Query Processing | Transactions | Security |
|-------------------------------------|--|--|--|---------------------------|--|
| Duration (hour) | 6 | 6 | 6 | 6 | 6 |
| SO-1 | Introduction to Quantum Computing, Quantum Uncertainty | Diagonal Representation of an Operator, Normal Operators | Grover's Algorithm, Quantum Fourier Transform and Related Algorithms | Quantum Linear Regression | Quantum Variational Optimization and Adiabatic Methods Variational Quantum Eigen solver |

| | | | | | |
|------|---|--|--|---|--|
| SO-2 | Superposition, Entanglement Quantum bits (Qubits), | Unitary Operators Commutator and Anti-commutator Operators | Fourier Series Fourier Transform | Swap Test Implementation Quantum Euclidean Distance Calculation | Expectation Computation Ising Model and Its Hamiltonian |
| SO-3 | Multiple Qubits Bell State | Postulates of Quantum Mechanics Hamiltonian Simulation and Trotterization | Kronecker Delta Function Quantum Fourier Transform | Quantum Euclidean Distance Quantum K-Means Clustering | VQE Algorithm Implementation of the VQE Algorithm |
| SO-4 | Dirac Notation Single-Qubit Gates, Multiple-Qubit Gates | Overview of Qiskit / Cirq / PennyLane | Hadamard Transform as a Fourier Transform Quantum Phase Estimation | Quantum Support Vector Machines | Quantum Max-Cut Graph Clustering Quantum Adiabatic Theorem |
| SO-5 | Bell States with Quantum Gates Quantum Teleportation | Simulation in Cirq with a Hadamard Gate Quantum Random Number Generator | Introduction to Quantum Machine Learning | Quantum Principal Component Analysis | Proof of the Adiabatic Theorem Quantum Approximate Optimization Algorithm |
| SO-6 | Quantum Interference Qubits states | Bell's Inequality Test Simons Algorithm | HHL Algorithm | Introduction to Quantum Deep Learning Hybrid Quantum-Classical Neural Networks | Implementation of QAOA Quantum Random Walk |

| Assessment | | | | | | | | | |
|----------------------|------------|--|----------|--------|----------|--------|----------|--------|----------|
| Level of Thinking | | Continuous Learning Assessment (CLA) (100 % weightage) | | | | | | | |
| | | CLA – 1 | | CLA– 2 | | CLA– 3 | | CLA– 4 | |
| | | (20 %) | | (20%) | | (40%) | | (20%) | |
| | | Theory | Practice | Theory | Practice | Theory | Practice | Theory | Practice |
| 1 | Remember | 40% | - | 40% | - | 40% | - | 40% | - |
| 2 | Understand | | | | | | | | |
| 3 | Apply | 40% | - | 40% | - | 40% | - | 40% | - |
| 4 | Analyze | | | | | | | | |
| 5 | Evaluate | 20% | - | 20% | - | 20% | - | 20% | - |
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| Total | | 100 % | | 100 % | | 100 % | | 100 % | |

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| Resources | | | |
|------------------|---|---|--|
| 1 | Quantum Machine Learning-Thinking and Exploration in Neural Network Models for Quantum Science and Quantum Computing, Claudio Conti, QST. | 2 | Machine Learning with Quantum Computers, Francesco Petruccione and Maria Schuld |
| 3 | An introduction to quantum machine learning, M. Schuld, I. Sinayskiy, F. Petruccione | 4 | Quantum Machine Learning with Python: Using Cirq from Google Research and IBM Qiskit, Santanu Pattanayak, 2021 |

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| | | | | 2 | Dr. R. Kiruthiga, SRMIST, KTR |
| | | | | 3 | Mrs. M. Divya, SRMIST, RMP |

