# B.E. COMPUTER SCIENCE AND ENGINEERING DEGREE PROGRAMME

**SCHEDULING OF COURSES**
**&**

**CURRICULUM AND DETAILED SYLLABI**

**FOR**

**FIRST SEMESTER TO EIGHTH SEMESTER**

**FOR THE STUDENTS ADMITTED IN THE**

**ACADEMIC YEAR 2023-24 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**
(A Government Aided Autonomous Institution affiliated to Anna University)
**MADURAI – 625 015, TAMILNADU**

Phone: 0452 – 2482240, 41
Fax: 0452 2483427
Web: www.tce.edu

# Department of Computer Science and Engineering

## Vision

Excellence in Computer Science and Engineering education and research.

## Mission

1. Strive for academic excellence in Computer Science and Engineering through a creative teaching learning process.

2. Transform students into technically competent, socially responsible and ethical Computer Science professionals.

3. Create Centres of Excellence in leading areas of Computer Science and Engineering.

4. Incubate, apply and spread innovative ideas by collaborating with relevant industries and R&D labs through focused research groups.

5. Attain these through continuous team work by a group of committed faculty, transforming the Computer Science and Engineering department as a leader in imparting Computer Science and Engineering education and research.

## Program Educational Objectives (PEOs) for B.E. (CSE) Programme

**PEO1:** Graduates will be able to perform in technical/managerial roles ranging from design, development, problem solving to production support in software industries and R&D sectors.

**PEO2:** Graduates will be able to successfully pursue higher education in reputed institutions.

**PEO3:** Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Computer Science and Engineering.

**PEO4:** Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.

# Program Outcomes (POs) for B.E. (CSE) Programme

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs) for B.E.(CSE) Programme

**PSO1: (Cognitive Outcome)**

Ability to solve complex Knowledge Engineering problems by building systems across domains including Systems Engineering, Software Development & Engineering, Networks & Security, Data Mining and Artificial Intelligence.

**PSO2: (Skill Outcome)**

Ability to apply technical and research based skills learnt through professional society events, certification programs, projects and lab exercises to provide sustainable solutions to Computer Science and Engineering problems related to the society and environment.

**PSO3: (Attitudinal and Behavioral Outcome)**

Ability to practice as an ethical Software Engineer and/or Researcher in the evolving disciplines of Computer Science and Engineering and its allied application domains by employing soft and project management skills learnt through internships, project work and/or collaborative projects with industry.

**<u>Thiagarajar College of Engineering, Madurai - 625015</u>**
**Credit Distribution for B.E (CSE) Programme – 2023 – 2024 Batch**

| S.No | Category of Courses | Credits |
|---|---|---|
| | | **Regular Admission** |
| **A** | **Foundation Courses(FC)** | **54 - 66** |
| | Humanities and Social Sciences including Management Courses (HSMC) | 09 - 12 |
| | Basic Science Courses (BSC) | 24 - 27 |
| | Engineering Science Courses (ESC) | 21 - 27 |
| **B** | **Professional Core Courses (PCC)** | **55** |
| **C** | **Professional Elective Courses (PEC)** | **24 - 39** |
| | Programme Specific Electives (PSE) | 15 – 24 |
| | Programme Electives for Expanded Scope (PEES) | 9 - 15 |
| **D** | **Open Elective Courses (OEC)** | **6 - 12** |
| | Interdisciplinary Elective (IE) | 3 - 6 |
| | Basic Science Elective (BSE) | 3 - 6 |
| **E** | **Project work** | **12** |
| **E** | Internship and Mandatory Audit as per the Regulatory Authorities | Non Credit ( Not included for CGPA) |
| | **Minimum credits to be earned for the award of the Degree** | **160 (from A to E) and the successful completion of Mandatory Courses** |

**Thiagarajar College of Engineering, Madurai-625015**
**Department of Computer science and Engineering**
**Scheduling of Courses – for those join in the year 2023 – 2024**

| Sem | Theory / Theory cum Practical / Practical | | | | | | | | | Audit Courses (Mandatory Non- credit} | Credit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| I | 22MA110 Calculus for Engineers (BS-4) | 23PH120 Physics (BS-3) | 22CH130 Chemistry (BS-3) | 22EG140 Technical English (HSS-2) | 22CS150 Engineering Exploration (ES-2) | 22CS161 Foundations of Computer Programming (PC -3) | 22EG170 English Laboratory (HSS-1) | 22PH180 Physics Laboratory (BS-1) | 22CH190 Chemistry Laboratory (BS-1) | | 20 |
| II | 22CS210 Matrices and Linear Algebra (BS-4) | 22CS220 Electronics and Digital Systems (PC -3) | 22CS230 Computer Organization and Architecture (PC-3) | 22CS240 Problem Solving and Programming (ES-3) | 22CS250 System Programming (ES- 2) | 22CS261 Engineering Graphics and Extended Reality (ES-3) | 22CS270 Computer Systems Lab (ES-1) | 22CS280 Programming Lab (PC-1) | | 22CHAA0 Environmental Science | 20 |
| III | 22CS310 Probability and Statistics (BS-4) | 22CS320 Theory and Design of Programming Languages (ES-3) | 22CS330 Object Oriented Programming (PC-3) | 22CS340 Data Structures and Algorithms (PC-3) | | 22CS360 Operating Systems (PC-4) | 22CS370 Data Structures Lab (PC-1) | 22CS380 Object Oriented Programming Lab (PC-1) | 22ES390 Design Thinking (ES-3) | | 22 |
| IV | 22CS410 Discrete Mathematics (BS-4) | 22CS420 Design and Analysis of Algorithms (PC-3) | 22CS430 Data Communication and Networks (PC-3) | 22CS440 Database Management Systems (PC-3) | 22CS450 Web Programming (PC-3) | 22EG660 Professional Communication (HSS-2) | 22CS470 Databases Lab (PC-1) | 22CS480 Algorithms Lab (PC-1) | 22CS490 Project Management (HSS-3) | 23CHAD0 Indian Constitution and Knowledge Systems | 23 |
| V | 22CS510 Modelling and Optimization (ES-3) | 22CS520 Theory of Computation (ES-3) | 22CS530 Artificial Intelligence (PC-3) | 22CSPX0 Programme Elective (PE - 3) | 22XXGX0 Interdisciplinary Elective (OE-3) | 22CS560 Software Engineering (PC-4) | 22CS570 Network Programming Lab (PC-1) | 22CS580 Artificial Intelligence Lab (PC-1) | 22CS590 Project – I (P-3) | 23CHAE0 Universal Human Values and Ethics | 24 |
| VI | 22CS610 Cryptography and Network Security (PC-3) | 22CS620 Distributed Computing (PC-3) | 22CS630 Compiler Design (PC-3) | 22CSPX0 Programme Elective (PE - 3) | 22XXFX0 Basic Science Elective (OE-3) | 22CSPX0 Programme Elective (PE - 3) | 22CS670 Distributed Computing Lab (PC-1) | | 22CS690 Project - II (P-3) | | 22 |
| VII | 22CS710 Engineering Economics (HSS-3 ) | 22CS720 Human Computer Interaction (ES-2) | 22CSPX0 Programme Elective (PE - 3) | 22CSPX0 Programme Elective (PE - 3) | 22CSPX0 Programme Elective (PE - 3) | 22CSPX0 Programme Elective (PE - 3) | | | 22CS790 Project - III (P-3) | | 20 |
| VIII | 22CSPX0 Programme Elective (PE - 3) | 22CSPX0 Programme Elective (PE - 3) | | | | | | | 22CS890 Project - IV (P-3) | | 9 |

**THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015**
(A Govt. Aided, Autonomous Institution affiliated to Anna University)
**Department of Computer Science and Engineering**
**Categorization of Courses**

## List of Humanities and Social Sciences including Management Courses (9-12)

- Technical English (2)
- English Laboratory (1)
- Professional Communication (2)
- Project Management (3)
- Engineering Economics (3)

## List of Basic Science Courses (24-27)

- Calculus for Engineers (4)
- Matrices and Linear Algebra (4)
- Probability and Statistics (4)
- Discrete Mathematics (4)
- Physics (3)
- Chemistry (3)
- Physics Laboratory (1)
- Chemistry Laboratory (1)

## List of Engineering Science Courses (21-27)

- Engineering Exploration (2)
- Problem Solving and Programming (3)
- System Programming (2)
- Engineering Graphics and Extended Reality (3)
- Computer Systems Lab (1)
- Theory and Design of Programming Languages (3)
- Design Thinking (3)
- Modelling and Optimization (3)
- Theory of Computation (3)
- Human Computer Interaction (2)

## List of Core Courses (55)

- Foundations of Computer Programming (3)
- Electronics and Digital Systems (3)
- Computer Organization and Architecture (3)
- Programming Lab (1)
- Object Oriented Programming (3)
- Object Oriented Programming Lab (1)
- Data Structures and Algorithms (3)
- Data Structures Lab (1)
- Operating Systems (4)
- Design and Analysis of Algorithms (3)
- Algorithms Lab (1)
- Database Management Systems (3)
- Databases Lab (1)
- Data Communication and Networks (3)

- Web Programming (3)
- Network Programming Lab (1)
- Artificial Intelligence (3)
- Artificial Intelligence Lab (1)
- Software Engineering (4)
- Cryptography and Network Security (3)
- Distributed Computing (3)
- Compiler Design (3)
- Distributed Computing Lab (1)

**Programme Elective Courses (24 – 39)**
- Programme Electives (27)

**Open Elective Courses (OEC): (6 – 12)**
- Interdisciplinary Elective (3)
- Basic Science Elective (3)

**Project (12)**
- Project – I (3)
- Project - II (3)
- Project – III (3)
- Project – IV (3)

# B.E. COMPUTER SCIENCE AND ENGINEERING DEGREE PROGRAMME

**CURRICULUM AND DETAILED SYLLABI**

**FOR**

**FIRST SEMESTER**

**FOR THE STUDENTS ADMITTED IN THE**

**ACADEMIC YEAR 2023-24 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**
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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

## COURSES OF STUDY

(For the candidates admitted from 2023-24 onwards)

**FIRST SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22MA110 | Calculus for Engineers | BSC | 3 | 1 | - | 4 |
| 23PH120 | Physics | BSC | 3 | - | - | 3 |
| 22CH130 | Chemistry | BSC | 3 | - | - | 3 |
| 22EG140 | Technical English | HSMC | 2 | - | - | 2 |
| 22CS150 | Engineering Exploration | ESC | 1 | 1 | - | 2 |
| **THEORY CUM PRACTICAL** | | | | | | |
| 22CS161 | Foundations of Computer Programming | PC | 2 | - | 2 | 3 |
| **PRACTICAL** | | | | | | |
| 22EG170 | English Laboratory | HSMC | - | - | 2 | 1 |
| 22PH180 | Physics Laboratory | BSC | - | - | 2 | 1 |
| 22CH190 | Chemistry Laboratory | BSC | - | - | 2 | 1 |
| | | | | | | |
| **Total** | | | **14** | **2** | **8** | **20** |

BSC : Basic Science Courses
HSMC : Humanities and Social Sciences including Management Courses
ESC : Engineering Science Courses

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**

**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**FIRST SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22MA110 | Calculus for Engineers | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 23PH120 | Physics | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CH130 | Chemistry | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22EG140 | Technical English | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22CS150 | Engineering Exploration | 3 | 40 | 60 | 100 | 27 | 50 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6 | 22CS161 | Foundations of Computer Programming | 3 (Terminal Exam Type : Theory) | 50 | 50 | 100 | 25 | 50 |
| **PRACTICAL** | | | | | | | | |
| 7 | 22EG170 | English Laboratory | 3 | 60 | 40 | 100 | 18 | 50 |
| 8 | 22PH180 | Physics Laboratory | 3 | 60 | 40 | 100 | 18 | 50 |
| 9 | 22CH190 | Chemistry Laboratory | 3 | 60 | 40 | 100 | 18 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

| 22MA110 | CALCULUS FOR ENGINEERS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BSC | 3 | 1 | 0 | 4 |

## Preamble

This course aims to provide technical competence of modeling engineering problems using calculus. This course is implements the calculus concepts geometrically, numerically, algebraically and verbally. Students will apply the main tools for analyzing and describing the behavior of functions of single and multi-variables: limits, derivatives, integrals of single and multi-variables to model and solve complex engineering problems using analytical methods and MATLAB.

## Prerequisite

NIL

## Course Outcomes

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

| CO's | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Cognize the concept of functions, limits and continuity | TPS2 | 75 | 70 |
| CO2 | Compute derivatives and apply them in solving engineering problems | TPS3 | 70 | 65 |
| CO3 | Employ partial derivatives to find maxima minima of functions of multi variables | TPS3 | 70 | 65 |
| CO4 | Demonstrate the techniques of integration to find the surface area of revolution of a curve. | TPS3 | 70 | 65 |
| CO5 | Utilize double integrals to evaluate area enclosed between two curves. | TPS3 | 70 | 65 |
| CO6 | Apply triple integrals to find volume enclosed between surfaces | TPS3 | 70 | 65 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | S | M | M | | | | | L | | L | |
| CO2. | S | S | M | M | | | | | L | | L | |
| CO3. | S | S | M | M | | | | | L | | L | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4. | S | S | M | M | | | | | L | | L | |
| CO5. | S | S | M | M | | | | | L | | L | |
| CO6. | S | S | M | M | | | | | L | | L | |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Written Test 1 (%) | | | Assignment 1 (%) | | | Written Test 2 (%) | | | Assignment 2 (%) | | | | | | |
| **TPS** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **TOTAL (%)** |
| **CO1** | 20% | | | 50% | | | - | | | - | | | - | 10% | - | 10% |
| **CO2** | 32% | | | | | | - | | | - | | | - | - | 16% | 16% |
| **CO3** | 36% | | | | | | - | | | - | | | - | - | 18% | 18% |
| **CO4** | 12% | | | - | | | 39% | | | 50% | | | - | - | 25% | 25% |
| **CO5** | - | | | - | | | 35% | | | | | | - | - | 17% | 17% |
| **CO6** | - | | | - | | | 26% | | | | | | - | - | 14% | 14% |
| **MATLAB** | - | | | 50% | | | - | | | 50% | | | | | | |
| **TOTAL** | **100%** | | | **100%** | | | **100%** | | | **100%** | | | **-** | **10%** | **90%** | **100 %** |

* Assignment 1: (i)Application Problems in CO1, CO2 and CO3 (50%).
(ii) MATLAB Onramp & Introduction to symbolic Math with MATLAB (50%).

**Assignment 2: (i) Application Problems in CO4, CO5 and CO6 (50%).
(ii) Application problems using MATLAB. (50%).

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

### DIFFERENTIAL CALCULUS

Functions - New functions from old functions - Limit of a function - Continuity - Limits at infinity - Derivative as a function - Maxima and Minima of functions of one variable – Mean value theorem - Effect of derivatives on the shape of a graph- Application problems in engineering using MATLAB.

### FUNCTIONS OF SEVERAL VARIABLES

Function of several variables- Level curves and level surfaces - Partial derivatives – Chain rule - Maxima and minima of functions of two variables –Method of Lagrange's Multipliers - Application problems in engineering using MATLAB.[9 hours]

**INTEGRAL CALCULUS:**
The definite integral – Fundamental theorem of Calculus – Indefinite integrals and the Net Change Theorem – Improper integrals – Area of surface of revolution - Volume of solid of revolution -Application problems in engineering using MATLAB.

**MULTIPLE INTEGRALS:**
Iterated integrals-Double integrals over general regions-Double integrals in polar coordinates-Applications of double integrals (density, mass, moments & moments of inertia problems only)-triple integrals- triple integrals in cylindrical coordinates- triple integrals in spherical coordinates-change of variables in multiple integrals - Application problems in engineering using MATLAB.

**Text Books**

1) James Stewart, "Calculus Early Transcendentals", 9e, Cengage Learning, New Delhi, 2019.

**DIFFERENTIAL CALCULUS:** [Sections: 1.3, 2.2, 2.5, 2,6,2.8, 4.1, 4.2 and 4.3.]
**FUNCTIONS OF SEVERAL VARIABLES:** [Sections: 14.1,14.3,14.5,14.7 and 14.8.]
**INTEGRAL CALCULUS:** [Sections: 5.2, 5.3, 5.4, 7.8, 8.2 and 6.2.]
**MULTIPLE INTEGRAL:** [Sections: 15.1-15.4, 15.6-15.9]

2) Lecture Notes on Calculus Through Engineering Application Problems and Solutions, Department of Mathematics, Thiagarajar College of Engineering, Madurai.

**Reference Books and web resources**

1. George B. Thomas, "Thomas Calculus: early Transcendentals", $14^{th}$e ,Pearson, New Delhi, 2018.
2. Howard Anton, Irl Bivens and Stephen Davis, "Calculus: Early Transcendentals", $12^{th}$e, John Wiley & Sons, 2021.
3. Kuldeep Singh, "Engineering Mathematics Through Appplications",$2^{nd}$e, Blooms berry publishing, 2019,
4. Kuldip S. Rattan, Nathan W. Klingbeil, Introductory Mathematics for Engineering Applications, $2^{nd}$ e John Wiley&Sons , 2021.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **DIFFERENTIAL CALCULUS** | |
| 1.1 | Functions and New functions from old functions | 2 |
| 1.2 | Limit of a function &Continuity of a function | 1 |
| | Tutorial | 1 |
| 1.3 | Limits at infinity | 1 |
| 1.4 | Derivative as a function | 2 |
| | Tutorial | 1 |
| 1.5 | Maxima and Minima of functions of single variable | 2 |
| 1.6 | The Mean value theorem and effect of derivatives on the shape of a graph of a function | 1 |
| | Tutorial | 1 |
| 1.7 | Application problems in engineering using MATLAB | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **2** | **FUNCTIONS OF SEVERAL VARIABLES** | |
| 2.1 | Level curves and level surfaces | 2 |
| 2.2 | Partial derivatives – Chain rule | 1 |
| | Tutorial | 1 |
| 2.3 | Maxima and minima of functions of two variables | 2 |
| 2.4 | Method of Lagrange’s Multipliers | 1 |
| | Tutorial | 1 |
| 2.5 | Application problems in engineering using MATLAB | 1 |
| **3** | **INTEGRAL CALCULUS** | |
| 3.1 | The definite integral | 1 |
| 3.2 | Fundamental theorem of Calculus | 2 |
| | Tutorial | 1 |
| 3.3 | Indefinite integrals and the Net Change Theorem | 1 |
| 3.4 | Improper integrals | 2 |
| | Tutorial | 1 |
| 3.5 | Area of surface of revolution | 1 |
| 3.6 | Volume of solid of revolution. | 2 |
| 3.7 | Application problems in engineering using MATLAB | 1 |
| **4** | **MULTIPLE INTEGRALS** | |
| 4.1 | Iterated integrals | 1 |
| 4.2 | Double integrals over general regions | 2 |
| | Tutorial | 1 |
| 4.3 | Double integrals in polar coordinates | 1 |
| 4.4 | Applications of double integrals (density, mass, moments & moments of inertia problems only) | 2 |
| | Tutorial | 1 |
| 4.5 | Triple integrals | 1 |
| 4.6 | Triple integrals in cylindrical coordinates | 1 |
| 4.7 | Triple integrals in spherical coordinates | 1 |
| | Tutorial | 1 |
| 4.8 | Change of variables in multiple integrals | 1 |
| 4.9 | Application problems in engineering using MATLAB | 1 |
| | **Total** | **48** |

**Course Designer(s):**


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5. Dr.M.Sundar msrmat@tce.edu

| 22CH130 | CHEMISTRY |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BSC | 3 | 0 | 0 | 3 |

## Preamble

The objective of this course is to bestow basic concepts of chemistry and its applications in engineering domain. It imparts knowledge on properties and treatment methods of water, spectroscopic techniques and their applications. This course provides exposure on electrochemical techniques for corrosion control, surface coatings and energy storage devices and also emphasis the properties and applications of engineering materials.

## Prerequisite

Nil

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the essential water quality parameters of water | TPS2 | 70 | 70 |
| CO2 | Determine hardness of water and identify suitable water treatment method | TPS3 | 70 | 70 |
| CO3 | Explain the electrochemical process involved in energy storage devices and corrosion of metals | TPS2 | 70 | 70 |
| CO4 | Interpret the electrochemical principles in modern energy storage devices and corrosion control methods | TPS3 | 70 | 70 |
| CO5 | Identify the appropriate spectroscopic technique for various applications | TPS3 | 70 | 70 |
| CO6 | Select the materials based on the properties for Engineering applications | TPS3 | 70 | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1.** | M | L | - | - | - | - | - | - | - | - | - | - |
| **CO2.** | S | M | L | - | - | - | L | - | - | - | - | - |
| **CO3.** | M | L | - | - | - | - | - | - | - | - | - | - |
| **CO4.** | S | M | L | - | - | - | - | - | L | - | - | - |
| **CO5.** | S | M | L | - | - | - | L | - | L | - | - | - |
| **CO6.** | S | M | L | - | - | - | - | - | - | - | - | - |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | 4 | 20 | 0 | | | | | | | | | | 2 | 8 | | | | |
| **CO2** | 4 | 0 | 20 | | | | | | | | | | 2 | 4 | 10 | | | |
| **CO3** | 4 | 20 | 0 | | | | | | | | | | 2 | 8 | | | | |
| **CO4** | 8 | 0 | 20 | | | | | | | | | | 2 | 4 | 10 | | | |
| **CO5** | | | | | | | 12 | 20 | 20 | | | | 6 | 8 | 10 | | | |
| **CO6** | | | | | | | 8 | 20 | 20 | | | | 6 | 8 | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

| CO | Assignment 1* | | | | | | Assignment 2* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | | | | | | | | | | | | |
| **CO2** | | | 20 | | | | | | | | | |
| **CO3** | | | | | | | | | | | | |
| **CO4** | | | 20 | | | | | | | | | |
| **CO5** | | | | | | | | | 20 | | | |
| **CO6** | | | | | | | | | 20 | | | |

*Assessment type: Quiz / Test /Presentation

## Syllabus

**Water:** Water-sources- physical - characteristics - alkalinity - hardness of water – types - determination of hardness by EDTA method. Boiler trouble-Softening of water: Internal and External treatment methods. Waste water treatment process. **Electrochemical technologies for energy storage and surface engineering:** Electrochemistry and Energy storage: Basics of electrochemistry. Batteries **-** Primary and Secondary batteries. Fuel cells.Hydrogen generation and storage. Corrosion and Surface Engineering–Basics –Corrosion - causes- factors- types - corrosion of metal and computer components- Corrosion control. Electroplating - Electroless process. **Spectroscopic technique and applications:** Principle, instrumentation, and applications: X-ray-diffraction - UV–Visible spectroscopy- Atomic Absorption Spectroscopy - Fluorescence spectroscopy - Inductively Coupled Plasma - Optical Emission Spectroscopy- Infra-red spectroscopy - Nuclear magnetic resonance spectroscopy**. Engineering materials:** Bonding and their influences on the property of materials - melting point - brittleness, ductility – thermal, electrical, and ionic conductivity - optical – magnetic properties, hydrophobic, hydrophilic. **Polymer composites** - structure and properties-applications.**Ceramics and advanced ceramics** - types-properties-applications-**Nano-materials** – Synthesis, structure, and properties –applications.

## Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16th edition, 2015.

## Reference Books & web resources


1. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", S.Chand& Company, 12thEdition, Reprint, 2013.
2. ShashiChawla, " A text book of Engineering Chemistry", DhanpatRai& Co.(pvt) ltd, 3rd edition, reprint 2011.
3. C. N. Banwell and E.M. McCash, "Fundamentals of Molecular Spectroscopy", Tata McGraw-Hill (India), 5thEdition, 2013.
4. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
5. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.
6. M. Akay, 2015, An introduction to polymer matrix composites," from: https://www.academia.edu/37778336/An_introduction_to_polymer_matrix_composites


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Water** | |
| 1.1 | Importance of water, sources, standards for drinking water, (WHO, BIS & ICMR standards) physical, chemical & biological characteristics, Alkalinity (principle only) | 1 |
| 1.2 | Hardness of water - types, units. Determination of hardness by EDTA method and numerical problems | 2 |
| 1.3 | **boiler trouble:** Scale and sludge formation, boiler corrosion, priming and foaming, caustic embrittlement | 1 |
| 1.4 | **Internal treatment methods:** Carbonate, Phosphate, Colloidal, Calgon conditioning | 1 |
| 1.5 | **softening of water:** External treatment methods:Lime-soda process (concept only), zeolite process,ion exchange process | 2 |
| 1.6 | Desalination- reverse osmosis, electro dialysis, solar and multistage flash distillation, nano-filtration | 1 |
| 1.7 | Waste water treatment – primary, secondary, and tertiary treatment | 1 |
| **2** | **Electrochemical technologies for energy storage and surface engineering** | |
| 2.1 | **Electrochemistry and Energy storage**: Introduction**–** Basics of electrochemistry – Redox process, EMF | 1 |
| 2.2 | **Energy storage** – Batteries, Battery quality parameters | 1 |
| 2.3 | Primary battery – Dry cell and Alkaline cell | 1 |
| 2.4 | Secondary battery – Lead-acid battery, Lithium-ion battery | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.5 | Fuel cells – Fundamentals, types and applications. Hydrogen generation and storage | 1 |
| 2.6 | **Corrosion and Surface Engineering**- Basics – Corrosion - causes- factors- types | 1 |
| 2.7 | chemical, electrochemical corrosion (galvanic, differential aeration), corrosion of metal and computer components- | 1 |
| 2.8 | Corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method | 1 |
| 2.9 | Electroplating –Introduction, Process, Applications (Gold and nickel plating). Electroless plating – Principle, process, Applications (PCB manufacturing) | 1 |
| **3** | **Spectroscopic technique and applications** | |
| 3.1 | Introduction to Electromagnetic Radiation, Types of atomic and molecular spectra | 1 |
| 3.2 | ***Principle, Instrumentation and Applications:***<br><br>X-ray-diffraction | 1 |
| 3.3 | UV–Visible spectroscopy,Atomic Absorption Spectroscopy | 2 |
| 3.4 | Fluorescence spectroscopy, Inductively Coupled Plasma - Optical Emission Spectroscopy | 2 |
| 3.5 | Infra-red spectroscopy | 2 |
| 3.6 | Nuclear magnetic resonance spectroscopy – Magnetic resonance imaging | 1 |
| **4** | **Engineering materials** | |
| 4.1 | Bonding and its influence on the property of materials | 1 |
| 4.2 | Properties of materials- melting point - brittleness, ductility - thermal, electrical and ionicconductivity | 1 |
| 4.3 | optical – magnetic properties, hydrophobic, hydrophilic | 1 |
| 4.4 | **Polymer composites** - structure and properties | 1 |
| 4.5 | applications -automotive, aerospace, marine, biomedical, and defense | 1 |
| 4.6 | **Ceramics and advanced ceramics** - types- properties | 1 |
| 4.7 | applications- medicine, electrical, electronics, space | 1 |
| 4.8 | **Nano-materials** – Synthesis, structure and properties | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.9 | applications - sensors, drug delivery, photo and electro-catalysis, and pollution control | 1 |
| | Total | 36 |

**Course Designer(s):**



| | |
|---|---|
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| 22EG140 | TECHNICAL ENGLISH |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| HSMC | 2 | 0 | 0 | 2 |

## Preamble

The course aims at fostering the students' ability to communicate effectively in various academic, professional, and social settings through oral and written forms. Besides imparting the basic skills such as Listening, Speaking, Reading and Writing (LSRW), significant emphasis is placed on enriching their analytical, descriptive, and creative skills, enabling them to develop and demonstrate a holistic English language proficiency.

## Prerequisite

- NIL

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Relate the fundamentals of language in terms of vocabulary, grammar and pronunciation in technical communication. | Understand | 60% | 70% |
| CO2 | Infer ideas from technical and general contexts by identifying main ideas, specific details, predicting and note-making. | Understand | 60% | 70% |
| CO3 | Make use of language in professional and social contexts with clarity and conciseness. | Apply | 60% | 70% |
| CO4 | Identify specific contexts in technical writing, where appropriate lexical and grammatical functions are applied | Apply | 60% | 70% |
| CO5 | Develop the skills such as understanding, evaluating, analysing and summarising the text and graphical representations. | Apply | 60% | 70% |
| CO6 | Organise ideas with coherence, cohesion and precision in formal written communication | Apply | 70% | 80% |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | M | S | | S |
| CO2 | | | | | | | | | M | S | | S |
| CO3 | | | | | | | | L | M | S | | S |
| CO4 | | | | | | | | | M | S | | S |
| CO5 | | | | | | | | | M | S | | S |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | | | | | | | | L | M | S | | S |
| S- Strong; M-Medium; L-Low | | | | | | | | | | | | |

## Assessment Pattern

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Written Test 1 (%) | | | Assignment 1 (%) | | | Written Test 2 (%) | | | Assignment 2 (%) | | | | | |
| **TPS** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| **CO1** | | 24 | | | | | | | | | - | | - | 10 | - |
| **CO2** | | 34 | | | 100 | | | | | | - | | - | 20 | |
| **CO3** | | | 14 | | | | | | 24 | | - | | - | - | 20 |
| **CO4** | | | 14 | | - | | | | 34 | | | | - | - | 10 |
| **CO5** | | | 14 | | - | | | | | | 100 | | - | - | 20 |
| **CO6** | | | | | - | | | | 42 | | | | - | - | 20 |
| **TOTAL** | **100** | | | **100** | | | **100** | | | **100** | | | **100** | | |

* Assignment 1:Speaking activities in CO1, CO2, and CO3 (100).
**Assignment 2: Writing activities in CO4, CO5, and CO6 (100).
*******Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus:

**MODULE- I - Basics of Language (CO1)**

Vocabulary - Word Building, Prefix, Suffix and Root Words, Basics of Grammar – Parts of Speech, Tenses, Phonetics - Phonemes, Syllables and Stress.

**MODULE- II – Reading (CO2)**

Reading - Skimming and Scanning of Short Comprehension Passages and Answering Questions or Cloze exercises based on the text prescribed for extensive reading, Note-Making.

**MODULE- III – Functional English (CO3)**

Framing Questions (WH and Yes/No), Modals, Manual Writing, Recommendations Writing, Agenda and Minutes of Meeting.

**MODULE-IV – Technical Notions (CO4)**

Technical Notions - Subject-Verb Agreement, Relative Clause, Phrasal Verbs, Impersonal Passive Voice, Noun Compounds, Classifications and Definitions, Cause and Effect, Purpose and Function, Numerical Adjectives.

**MODULE-V – Analytical Writing and Business Correspondence (CO5 & CO6)**

Summary Writing, Interpretation of Graphics, Jumbled Sentences, Paragraph Writing, Formal Letters (Seeking Permission for Industrial Visit/internship/Bonafide), E-mail Writing (BEC Vantage Writing Task I)

**Suggested Reading:**

Books:


1. Murphy, Raymond, English Grammar in Use with Answers; Reference and Practice for Intermediate Students, Cambridge: CUP, 2004
2. Jones, Daniel. An English Pronouncing Dictionary, Cambridge: CUP, 2006
3. Brook-Hart,Guy. Cambridge English- Business Benchmark-Upper Intermediate, CUP,2013.
4. Dhanavel, S.P. English and Communication Skills for Students of Science & Engineering, Orient BlackSwan, Chennai: 2016.
5. Swan, Michael.Practical English Usage.4$^{th}$Edn. OUP. 2017.
6. Elbow, Peter. Writing with Power: Techniques for Mastering the Writing Process. New York, Oxford University Press, 1998.


**Extensive Reading:**

1. Anthology of Select Five Short Stories
2. Tagore, Rabindranath. *Chitra, a Play in One Act.* London, Macmillan and Co., 1914

Websites:

1. www.englishclub.com
2. owl.english.purdue.edu
3. www.oxfordonlineenglish.com
4. www.bbclearningenglish.com
5. tcesrenglish.blogspot.com

**Course Contents and Lecture Schedule**

| S.No | Topic | No. of Hours |
|---|---|---|
| 1. | Word Building, Prefix, Suffix and Root Words | 1 |
| 2. | Parts of Speech | 1 |
| 3. | Tenses | 1 |
| 4. | Skimming and Scanning of Short Comprehension Passages | 1 |
| 5. | Manual Writing | 1 |
| 6. | Recommendations | 1 |
| 7. | Note-Making | 1 |
| 8. | Subject-Verb Agreement | 1 |
| 9. | Phonemes | 1 |
| 10. | Syllables and Stress | 1 |
| 11. | Answering Questions or Cloze exercises based on the text prescribed for extensive reading | 1 |
| 12. | Noun Compounds, Classifications and Definitions | 1 |

| | | |
|---|---|---|
| 13. | Summary Writing | 1 |
| 14. | Interpretation of Graphics | 1 |
| 15. | Cause and Effect, Purpose and Function | 1 |
| 16. | Jumbled Sentences | 1 |
| 17. | Formal Letters (Seeking Permission for Industrial Visit/internship/ Bonafide) | 1 |
| 18. | Phrasal Verbs and Impersonal Passive Voice | 1 |
| 19. | Numerical Adjectives | 1 |
| 20. | Framing Questions (WH and Yes/No) and Modals | 1 |
| 21. | Agenda and Minutes of Meeting | 1 |
| 22. | Relative Clause | 1 |
| 23. | E-mail Writing (BEC Vantage Writing Task I) | 1 |
| 24. | Paragraph Writing | 1 |
| | **Total** | **24** |

**Course Designers:**


1. Dr.A.Tamilselvi tamilselvi@tce.edu
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| 22CS150 | ENGINEERING EXPLORATION | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ESC | 1 | 1 | - | 2 |

## Preamble

The course Engineering Exploration provides an introduction to the engineering field. It is designed to help the student to learn about engineering and how it affects our everyday lives. On the successful completion of the course, students will be to explain how engineering is different from science and technology and how science, mathematics and technology are an integral part of engineering design.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency | Expected Attainment |
|---|---|---|---|---|
| CO1 | Explain technological & engineering development, change and impacts of engineering | TPS2 | 70 | 70 |
| CO2 | Draw a product in enough detail that others can accurately build it and write specification sheet for a given product | TPS3 | 70 | 70 |
| CO3 | Complete initial steps (Define a problem, list criteria and constraints, brainstorm potential solutions and document the ideas) in engineering design process | TPS3 | 70 | 70 |
| CO4 | Draw sketches to a design problem and provide a trade-off matrix | TPS3 | 70 | 70 |
| CO5 | Communicate possible solutions through drawings, modelling and Testing Final output | TPS3 | 70 | 70 |
| CO6 | Apply the concept of engineering fundamentals in Electrical and Computer Engineering | TPS3 | 70 | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | M | L | - | - | - | - | - | - | - | - | - | - | L | - | - |
| C02 | S | M | L | - | - | - | - | - | - | - | - | - | M | - | - |
| C03 | S | M | L | - | - | - | - | - | - | - | - | - | M | - | - |
| C04 | S | M | L | - | - | - | - | - | - | - | - | - | M | - | - |
| C05 | S | M | L | - | - | - | - | - | - | - | - | - | M | - | - |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C0 6 | S | M | L | - | - | - | - | - | - | - | - | - | M | - | - |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| CO | Worksheet-1 | | | Worksheet-2 | | | CAT | | | Terminal (Theory) |
|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | |
| CO1 | 5 | 20 | | | | | | | 5 | 10 |
| CO2 | | 5 | 20 | | | | | | 5 | 10 |
| CO3 | | | | 5 | 20 | | | | 10 | 20 |
| CO4 | | | | | 5 | 20 | | | 10 | 20 |
| CO5 | | | | | | | | | 10 | 20 |
| CO6 | | | | | | | | | 10 | 20 |

**Syllabus**

**What is Engineering:** Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements **Engineering Design:** Problem definition, idea generation through brainstorming and researching, solution creation through evaluating and communicating, text/analysis, final solution and design improvement. **Defining problems and Brainstorming:** Researching design, sketching problem solving **Communicating solution**: Dimensioning orthographic drawing, perspective drawing **Modeling and Testing final output:** Product evaluation, reverse engineering, final project report. **Electrical Engineering:** Reading analog multimeter, measuring current, voltage and resistance, electricity from chemicals, solar cells, magnets, Ohms law and watts law, circuit identification and circuit calculation, resistor color code, continuity **Computer Engineering:** Logic gates, algorithms, computer architecture, binary code

**Reference Books**

1. Ryan A.Brown, Joshua W.Brown and Michael Berkihiser: “Engineering Fundamentals: Design, Principles, and Careers”, Goodheart-Willcox Publisher, Second Edition, 2014.
2. Saeed Moaveni ,“Engineering Fundamentals: An Introduction to Engineering”, Cengage learning, Fourth Edition, 2011.

**Course Contents and Lecture Schedule**

| No. | Topic | No. of Lectures |
|---|---|---|
| 1. | **What is Engineering** | |
| 1.1 | Engineering Requirement | 1 |
| 1.2 | Knowledge within Engineering disciplines, | 1 |
| 1.3 | Engineering advancements | 1 |
| 2 | **Engineering Design** | |
| 2.1 | Problem definition, | 1 |
| 2.2 | idea generation through brainstorming and researching | 1 |
| 2.3 | solution creation through evaluating and communicating, | 1 |
| 2.4 | text/analysis | 1 |
| 2.5 | final solution and design improvement | 1 |
| 3 | **Defining problems and Brainstorming:** | |
| 3.1 | Researching design | 1 |
| 3.2 | sketching problem solving | 2 |

| No. | Topic | No. of Lectures |
|---|---|---|
| 4 | **Communicating solution** | |
| 4.1 | Dimensioning orthographic drawing | 1 |
| 4.2 | perspective drawing | 1 |
| 5 | **Modeling and Testing final output** | |
| 5.1 | Product evaluation | 1 |
| 5.2 | reverse engineering | 1 |
| 5.3 | final project report | 1 |
| 6. | **Electrical Engineering:** | |
| 6.1 | Reading analog multimeter, measuring current, voltage and resistance | 1 |
| 6.2 | electricity from chemicals, solar cells, magnets | 1 |
| 6.3 | Ohms law and watts law, circuit identification and circuit calculation | 2 |
| 6.4 | resistor color code, continuity | 1 |
| **7** | **Computer Engineering** | |
| 7.1 | Logic gates, algorithms, | 1 |
| 7.2 | computer architecture, | 1 |
| 7.3 | binary code | 1 |
| | Total | 24 |

**Course Designers:**

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| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS161** | **FOUNDATIONS OF COMPUTER PROGRAMMING** | PC | 2 | - | 2 | 3 |

**Terminal Exam: Theory**

## Preamble

The course on computer programming is intended to introduce the students to computational thinking, Python programming and constructs of programming. The course aims to provide exposure to solve the problems through Python programming. It aims to train the student to the fundamental concepts of the Python programming language. This course has a lab component which is designed to give the student hands-on experience with the concepts.

## Prerequisite

NIL

## Course Outcomes

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

| CO. No | Course Outcomes (COs) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Practice the basics of Procedural programming using Python | TPS3 | B | 85 |
| CO2 | Solve the problems using basic data types, operators and expressions. | TPS3 | B | 85 |
| CO3 | Appreciate the usage of collections, Array techniques in Python to solve problems. | TPS3 | B | 85 |
| CO4 | Make use of appropriate control structure to solve engineering problems. | TPS3 | B | 85 |
| CO5 | Demonstrate the Python functions, scoping, recursion and functions as modules to develop simple applications | TPS3 | B | 85 |
| CO6 | Take part in real world problem solving using Python programming. | TPS4 | B | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO2. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO3 | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO4 | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO5. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO6 | S | S | M | L | L | L | L | M | M | M | L | L | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | | | | CAT 2 | | | | | | OCR | | | | | | Model Examination | | | | | | Terminal (Theory Component) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | | | | | | 100 | | | | | | 100 | | | | | | 100 | | | | | | 100 | | | | | |
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 10 | 15 | | | | | | | | | | | | 15 | | | | | 5 | 10 | | | | 3 | 5 | 7 | | | |
| CO2 | 5 | 10 | 20 | | | | | | | | | | | | 15 | | | | | 5 | 10 | | | | 2 | 5 | 8 | | | |
| CO3 | 5 | 10 | 20 | | | | | | | | | | | | 15 | | | | | 10 | 10 | | | | 5 | 5 | 10 | | | |
| CO4 | | | | | | | 5 | 10 | 15 | | | | | | 20 | | | | | 5 | 10 | | | | 3 | 5 | 7 | | | |
| CO5 | | | | | | | 5 | 10 | 20 | | | | | | 20 | | | | | 5 | 10 | | | | 5 | 5 | 10 | | | |
| CO6 | | | | | | | 5 | 10 | 20 | | | | | | 15 | | | | | | 10 | 10 | | | 2 | 5 | 8 | | | |

## Syllabus

**Procedural Programming and Python Programming** - Fundamentals of Computing- Problems-Pseudo-code and flowcharts- Memory and Programs-Python Programming Language –Alternate Implementations-Highlights- Setting Up Python Programming Environment- Python on Different Operating Systems -Creating and Running Python Program

**Variables and simple Data Types**- Identifiers and Keywords – Strings- Numbers-Comments- User Input-Operators and expressions- operator precedence – Boolean expression – expression evaluation

**Collection Data Types and Array Techniques** – Lists- Numerical List-Tuples - Sets and Frozen Sets -Mapping Types - Dictionaries - Changing, Adding, Removing, Slicing Elements- Avoiding Errors in collections- **Array Techniques -**Counting, reversal, partitioning and removal of duplicates in an array

**Control Structures** - Conditional Tests- if Statements Looping- for and while -Nesting-Control Statements – break, continue and pass- Iterating and Copying Collections

**Functions and Modules** -Defining a Function- Function Arguments-Return Values- Passing an Arbitrary Number of Arguments- scoping – specifications – recursion – Fibonacci numbers – palindromes – global Variables- Modules and Packages- Overview of Python’s Standard Library

**File Handling -Classes and objects -Projects** - Writing and Reading Binary Data - Writing and Parsing Text Files- Writing and Parsing XML Files- Random Access Binary Files-**Classes and objects -Projects**

## Text Books

1. Eric Matthes , “Python Crash Course A Hands-On , Project - Based Introduction to Programming”, No Starch Press, Inc. 2nd Edition,2019
2. Mark Summerfield, “Programming in Python 3: A Complete Introduction to the Python Language”, Pearson Education, 2nd Edition, 2018

## Reference Books& web resources

1. Mark Lutz, “Python Pocket Reference”, O Reilly, Fifth Edition, 2014
2. Zed Shaw, “Learn Python the Hard Way” Addison-Wesley, 2013.
3. Martin C. Brown, “Python: The Complete Reference “,McGraw Hill,2018.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| **1** | **Procedural Programming and Python Programming** | | |
| 1.1 | Fundamentals of Computing- Problems-Pseudo-code and flowcharts- Memory and Programs- | 1 | CO1 |
| 1.2 | Python Programming Language –Alternate Implementations-Highlights | 1 | CO1 |
| 1.3 | Setting Up Python Programming Environment-Python on Different Operating Systems -Creating and Running Python Program | 1 | CO1 |
| **2** | **Variables and simple Data Types** | | |
| 2.1 | Identifiers and Keywords – Strings- Numbers-Comments | 1 | CO2 |
| 2.2 | User Input-Operators and expressions- operator precedence | 1 | CO2 |
| 2.3 | Boolean expression – expression evaluation | 1 | CO2 |
| **3** | **Collection Data Types and Array Techniques** | | |
| 3.1 | Lists- Numerical List-Tuples - Sets and Frozen Sets | 2 | CO3 |
| 3.2 | Mapping Types - Dictionaries - Changing, Adding, Removing, Slicing Elements-Avoiding Errors in collections | 1 | CO3 |
| 3.3 | **Array Techniques -**Counting, reversal, partitioning and removal of duplicates in an array | 1 | CO3 |
| **4** | **Control Structures** | | |
| 4.1 | Conditional Tests- if Statements Looping- for and while -Nesting- | 1 | CO4 |
| 4.2 | Control Statements – break, continue and pass- | 1 | CO4 |
| 4.3 | Iterating and Copying Collections | | |
| 5 | **Functions and Modules** | | |
| 5.1 | Defining a Function- Function Arguments-Return Values- Passing an Arbitrary Number of Arguments | 1 | CO5 |
| 5.2 | Scoping – abstractions – Recursion – Fibonacci numbers – palindromes | 1 | CO5 |

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| 5.3 | Modules and Packages- Overview of Python's Standard Library- global Variables | 1 | CO5 |
| 6 | **File Handling -Classes and objects -Projects** | | |
| 6.1 | Writing and Reading Binary Data - Writing and Parsing Text Files- Writing and Parsing XML Files- Random Access Binary Files- | 2 | CO6 |
| 6.2 | **Classes and objects -Projects** | 1 | CO6 |
| | **Total Hours** | **24** | |

**Course Contents and Lecture Schedule for Laboratory**

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| 1. | Write a Python program using basic datatypes | 2 | CO1 |
| 2. | Write a Python program to display multiple variables using operators and expressions | 2 | CO1 |
| 3. | Develop a Python Program for number conversions | 2 | CO2 |
| 4. | Demonstrate a Python Program for String manipulations | 2 | CO2 |
| 5. | Implement all the collections in Python | 2 | CO3 |
| 6. | Write a Python program to perform Array Techniques | 2 | CO3 |
| 7. | Write a Python Program using different types of function call to find Prime number, generate Fibonacci series, sorting and searching etc. | 2 | CO4 |
| 8. | Create a Python module for recursive functions. | 2 | CO4 |
| 9. | Write a program in Python for various file handling | 2 | CO5 |
| 10. | Write a Python Program for implementing classes and objects | 2 | CO5 |
| 11. | Mini project | 4 | CO1, CO2, CO3, CO4, CO5, CO6 |
| | **Total Hours** | **24** | |

**Course Designers:**

1. Dr.M.P.Ramkumar ramkumar@tce.edu
2. Dr.M.Nirmala Devi mnit@tce.edu
3. Dr.S.Prasanna sprcse@tce.edu

| 22EG170 | ENGLISH LABORATORY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | HSMC | 0 | 0 | 2 | 1 |

**Preamble**

This practical course enables the students to develop and evaluate their basic English language skills through individualized learning process at the Language Lab, using English Software and online resources. In addition, it facilitates students with the need-based student-centric presentation sessions in a multi-media driven classroom environment.

**Prerequisite**

NIL

**Course Outcomes**

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

| COs | Course Outcomes | TCE Proficiency Scale |
|---|---|---|
| CO1 | Interpret words correctly through listening and watching general and technical online contents | Understand |
| CO2 | Develop appropriate pronunciation skills through listening and speaking practices | Apply |
| CO3 | Build and apply a wide range of lexicons in general and technical presentations | Apply |
| CO4 | Identify and apply the key ideas and spoken English features learnt through auditory and visual listening tools | Apply |
| CO5 | Experiment with inventiveness by creating a blog, vlog, or YouTube channel. | Apply |
| CO6 | Prepare and deliver oral and written presentations using digital tools. | Apply |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | M | S | | S |
| CO2 | | | | | | | | | M | S | | M |
| CO3 | | | | | | | | L | M | S | | S |
| CO4 | | | | | | | | L | M | S | | M |
| CO5 | | | | | | | | L | M | S | | S |
| CO6 | | | | | | | | L | S | S | | S |

**Assessment Pattern**

Students' performance will be assessed in the language lab/ classroom as given below:

- Spoken Task - General / Technical Presentation / Picture Description: 20 Marks
- Listening Task –(MCQs, Gap Filling Exercises) : 10 Marks
- Written Test - Phonetics, Grammar, Vocabulary, Reading : 20 Marks

**External:** Online Exam- Phonetics, Grammar, Vocabulary, Reading (45 Minutes): 50 Marks

Listening Test : 20 Marks

Submission of Students' Record on Practical Tasks in the Class and Lab :10 Marks

BEC Vantage Speaking Tasks I and II : 20 Marks

**List of Experiments**

| S.No | Topic | Hours |
|---|---|---|
| | **LAB ACTIVITIES (12 Hours)** | |
| 1 | Listening to TED Talks/ Podcasts/ Product Advertisements/ NewsBulletins. | 2 |
| 2 | Phonetics – Tutorials through Online Repositories, English Movie Clips and Software in the Lab(S-net) | 2 |
| 3 | Vocabulary Development through Movies / Short Films/ Documentaries | 2 |
| 4 | Language Development through English softwareS-net and Online Content (Te Voices, SV Agreement, Prepositions, Coherence Markers, Relative Clauses, M Punctuation) | 2 |
| 5 | Reading Comprehension – I (General / Technical, BEC Vantage Reading Task | 2 |
| 6 | Creating a Blog/Vlog/YouTube Channel –Uploading MP3/MP4 – Practice (Movie/Book/ Gadget Review, General/Tech Talks, Interview with Celebrities) | 1 |
| 7 | Revision – Model Online Aptitude Test | 1 |
| | **CLASSROOM ACTIVITIES (12 Hours)** | |
| 8 | Introduction of Spoken English Features | 1 |
| 9 | Self-introduction and Introducing others | 1 |
| 10 | Video Comprehension – Brainstorming and Note-Taking | 2 |
| 11 | Role-Play, Picture/Movie Description | 1 |
| 12 | Reporting the events from Media / Newspapers – Discussion | 1 |
| 13 | Interactive Games for Language Development | 1 |
| 14 | Reading / Note Making (Extensive Reading – News Paper Reports) | 1 |
| 15 | Presentation – I (Book /Movie Review, Story Telling, General Presentations) | 2 |
| 16 | Presentation – II (Technical Presentations) | 2 |
| | Total | 24 |

**Software Used:**

1. English Software S Net
2. Business English Certificate-Vantage- Practice Software

**Teaching Resources and Websites:**

1. Open Online Repositories from Oxford / Cambridge / British Council/ Voice of America
2. Free Video Downloads from YouTube
3. www.ted.com
4. tcesrenglish.blogspot.com

**Course Designers:**

| | | |
|---|---|---|
| 1 | Dr.A.Tamilselvi | tamilselvi@tce.edu |
| 2 | Dr. S. Rajaram | sreng@tce.edu |
| 3 | Dr.RS. Swarnalakshmi | rssleng@tce.edu |
| 4 | Mrs. M. Sarpparaje | mseeng@tce.edu |

| 22PH180 | PHYSICS LABORATORY |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BSC | 0 | 0 | 2 | 1 |

## Preamble

This course ensures that students are able to apply the basic physics concepts and carry out the experiments to determine the various physical parameters related to the material

• Learn the necessary theory to understand the concept involved in the experiment.

• Acquire the skills to carry out the experiment.

• Tabulate the observed data and use the formula to evaluate the required quantities.

• Plot the data in a graph and use it for calculation.

## Prerequisite

- None

## Course Outcomes

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

| | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Analyze the mechanical & electrical oscillations and determine their resonance frequency | TPS3 | 85 | 90 |
| CO2 | Analyse the interference and diffraction patterns for micron sized objects | TPS3 | 85 | 90 |
| CO3 | Investigate the V-I characteristics of photodiode, phototransistor under dark and bright illumination conditions | TPS3 | 85 | 90 |
| CO4 | Determine the Planck's constant using LEDs | TPS3 | 85 | 90 |
| CO5 | Plot the VI characteristics of solar cell and find the fill factor | TPS3 | 85 | 90 |
| CO6 | Determine the reversibility of classical and quantum logic gates | TPS3 | 85 | 90 |
| CO7 | Identify the variation of magnetic field with distance for circular coils | TPS3 | 85 | 90 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | - | M | - | - | - | S | - | - | L |
| CO2. | S | M | L | - | M | - | - | - | S | - | - | L |
| CO3 | S | M | L | - | M | - | - | - | S | - | - | L |
| CO4 | S | M | L | - | M | - | - | - | S | - | - | L |
| CO5 | S | M | L | - | M | - | - | - | S | - | - | L |
| CO6 | S | M | L | - | M | - | - | - | S | - | - | L |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO7 | S | M | L | - | M | - | - | - | S | - | - | L |

S- Strong; M-Medium; L-Low

**LIST OF EXPERIMENTS**

1. Quantum Logic Gate-Toffoli gate
2. Study of Optoelectronic Devices- Photodiode, Phototransistor.
3. Solar cell VI characteristics,fill factor & Optical fibre-Determination of numerical aperture.
4. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of regular objects.
5. Laser Diffraction - Determination of wave length of the laser using grating and determination of micro particle size.(Observing diffraction pattern due to single and double slit)
6. Air wedge – Determination of thickness of a thin sheet/wire.
7. Determination of Planck's constant through V-I characteristics of LED.
8. Determination of magnetic field-Stewart and Gees.
9. LCR Circuit – Determination of resonant frequency

**Course Designer(s):**


1. Dr. N. Sankarasubramanian nssphy@tce.edu
2. Dr. A.L .Subramaniyanalsphy@tce.edu
3. Dr.P.K.Kannan akphy@ce.edu

| 22CH190 | CHEMISTRY LABORATORY (Common to all branches) |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BSC | 0 | 0 | 2 | 1 |

## Preamble

This course aims to provide the students, a basic practical knowledge in chemistry. The objective of this course is to develop intellectual and psychomotor skills of the students by providing hands on experience in quantitative, electrochemical and photo-chemical analysis.

## Prerequisite

Nil

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale |
|---|---|---|
| CO1 | Estimate the chemical water quality parameters of sample water / effluent | Apply |
| CO2 | Demonstrate presence of calcium ions in milk sample | Apply |
| CO3 | Determine the surface tension of solvent mixtures | Apply |
| CO4 | Estimate pH and acid content of samples using pH metric and conduct metric titrations | Apply |
| CO5 | Illustrate the strength of oxidisable materials present in given sample by potentiometric method | Apply |
| CO6 | Determine $Fe^{2+}$ ion in effluent using colorimetric method | Apply |
| CO7 | Calculate the efficiency of electroplating | Apply |
| CO8 | Determine the rate of corrosion of metal & alloy using potentio-dynamic polarisation method | Apply |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO2. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO3. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO4. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO5. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO6. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO7. | S | M | L | - | M | - | - | - | L | - | - | - |
| CO8. | S | M | L | - | M | - | - | - | L | - | - | - |

S- Strong; M-Medium; L-Low

## List of Experiments/Activities with CO Mapping

| Experimental List | CO |
|---|---|
| **Quantitative Analysis** | |
| Estimation of total hardness of water sample | CO1 |
| Estimation of COD of industrial effluent | CO1 |
| Determination of calciumion inmilk sample | CO2 |
| Determination of surface tension of solvent mixture | CO3 |
| **Electrochemical and Photochemical Analysis** | |
| Determination of the Phosphoric acid content in soft drinks using conductometric titration | CO4 |
| Determination of pH of soil by pH metric titration | CO4 |
| Potentiometric redox titration ($K_2Cr_2O_7$vs FAS, $KMnO_4$vs FAS) | CO5 |
| Estimation of iron content in water sample using colorimeter | CO6 |
| Estimation of current density of electroplating process using Hull cell | CO7 |
| Determination of rate of corrosion of metal and alloy using potentiodynamic polarisation technique (TAFEL) | CO8 |

## Learning Resources

1. Vogel's Textbook of Quantitative Chemical Analysis ($8^{TH}$edition, 2014)
2. LaboratoryManual – Department of Chemistry, Thiagarajar College of Engineering (2022)

## Course Designers:


1. Dr.M.Kottaisamy hodchem@tce.edu
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5. Dr.M.Velayudham mvchem@tce.edu
6. Dr.R.Kodi Pandyan rkp@tce.edu
7. Dr.A.Ramalinga chandrasekar arcchem@tce.edu
8. Dr. B. Shankar bsrchem@tce.edu

| 23PH120 | PHYSICS (Common to all branches) |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BS | 3 | 0 | 0 | 3 |
| Terminal Exam Type | | | Theory | |

## Preamble

**The course work aims in imparting fundamental knowledge of classical and quantum mechanics, thermodynamics, electromagnetic waves, lasers and optical fibers, which are essential in understanding and explaining engineering devices.**

## Prerequisite

None

## Course Outcomes

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

| | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Calculate the position, velocity and acceleration of an object using Cartesian, polar and cylindrical coordinates | TPS3 | 85 | 80 |
| CO2 | Apply Schrodinger wave equation to arrive at the energy values and wave function for a particle in a box | TPS3 | 85 | 80 |
| CO3 | Compute the theoretical efficiency of heat engines and change in entropy in a thermal cycle | TPS3 | 85 | 80 |
| CO4 | Demonstrate electromagnetic wave propagation using the Maxwell's equations | TPS3 | 85 | 80 |
| CO5 | Describe the physical principles, working and applications of Quantum Cascade laser and Nd:YAG laser | TPS2 | 85 | 80 |
| CO6 | Demonstrate the wave propagation in an optical fiber and its applications | TPS3 | 85 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | - | - | - | - | - | L | L | - | - |
| CO2. | S | M | L | - | - | - | - | - | L | L | - | - |
| CO3 | S | M | L | - | - | - | - | - | L | L | - | - |
| CO4 | S | M | L | - | - | - | - | - | L | L | - | - |
| CO5 | M | L | - | - | - | - | - | - | L | L | - | - |
| CO6 | S | M | L | - | - | - | - | - | L | L | - | - |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO \ TPS Scale | Assessment - I CAT – I (%) | | | Assg. I * (%) | | | Assessment - II CAT – II (%) | | | Assg. II * (%) | | | Terminal Exam (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| **CO1** | 4 | 10 | 20 | | 100 | | | | | | | | 4 | - | 10 |
| **CO2** | 8 | 10 | 15 | | | | | | | | | | 4 | - | 10 |
| **CO3** | 8 | 10 | 15 | | | | | | | | | | 2 | 10 | 10 |
| **CO4** | | | | | | | 4 | 10 | 25 | | 50 | | 4 | - | 10 |
| **CO5** | | | | | | | 12 | 10 | - | | - | | 4 | 10 | - |
| **CO6** | | | | | | | 4 | 10 | 25 | | 50 | | 2 | 10 | 10 |
| **Total** | **20** | **30** | **50** | | **100** | | **20** | **30** | **50** | | **100** | | **20** | **30** | **50** |

*Assignment I, II – Quiz/ Puzzle/ Case analysis/ Problem-solving/ Presentation/ Writing tasks

## Syllabus

**Classical Mechanics**: (6 Hours)

Scalars and vectors under rotation transformation – Cartesian coordinate system – Degrees of freedom – Constraints - Position, velocity, acceleration and force vector for Polar, Cylindrical coordinate system – Satellite manoeuvre - Problems

**Quantum Mechanics:** (6 Hours)

Failures of Classical Mechanics - Wave nature of particles - Uncertainty principle - wave function and its properties - expectation values – Classical wave equation (qualitative) - Schrodinger wave equation - Particle in a box – Quantum computation - Problems

**Thermodynamics:** (6 Hours)

Laws of thermodynamics – Thermodynamic Processes - Concept of entropy - Change in entropy in reversible and irreversible process - Entropy of a perfect gas - Temperature-Entropy diagram – Efficiency of Petrol engine – CNG engine - Problems

**Electromagnetic waves:** (7 Hours)

Electromagnetic waves – Maxwell's equation in Differential and Integral form – Propagation of EM Waves in free space - Energy of EM waves - Poynting Vector - Equation of continuity – Smart Phone – Problems

**Lasers:** (5 Hours)

Spontaneous and stimulated emission - Population inversion - Einstein's coefficients – Lasing action - Quantum Cascade laser - Nd: YAG Laser – Light Detection and Ranging, Bridge deflection and Laser Cutting

**Fiber Optics:** (6 Hours)

Principle and classification of optical fibers - Propagation of light in optical fibers - Numerical aperture and Acceptance angle – Losses in Optical Fibers - Attenuation and Dispersion (Qualitative) - Fiber Optical Communication system – Temperature Sensor – Endoscopy - Problems

## Text Books


1. M.N. Avadhanulu, P.G. Kshirsagar and TVS Arun Murthy, A Text book of Engineering Physics, 11th Edition, S. Chand, 2018.


## Reference Books


1. Manoj K. Harbola, Engineering Mechanics, 2nd Edition, Cengage, 2018.
2. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers with Modern Physics, 10th Edition, Brooks and Cole, 2018.
3. Paul A. Tipler and G. Mosca, Physics for Scientists and Engineers, 6th Edition, Freeman, 2008.
4. David J. Griffiths, Darrell F. Schroeter, Introduction to quantum mechanics, 3rd Edition, Cambridge University Press, 2018.
5. Satya Prakash, Quantum Mechanics, Pragati Prakashan, 9th Edition, 2018.
6. Yunus Cengel & Boles, Thermodynamics – An Engineering Approach, 9th Edition, McGraw-Hill Education, 2019.
7. Heat Thermodynamics and Statistical Physics, Brij Lal, N Subrahmanyam, PS Hemne, 2nd Edition, S.Chand, 2018.
8. Halliday, Resnick and Jearl Walker, Principles of Physics, 11th Edition, Wiley, 2020 (Chapters - 23, 24, 32 & 33).
9. Raymond A. Serway, John W. Jewett, Physics for Scientists and Engineers with Modern Physics, 10th Edition, Brooks and Cole, 2018.
10. R. K. Gaur, S. L. Gupta, “Engineering Physics”, Dhanpat Rai Publications, 2017.
11. Ajoy Ghatak, Optics, 7th Edition, Tata McGraw Hill, 2020.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Classical Mechanics** | **(6 Hours)** |
| 1.1 | Scalars and vectors under rotation transformation - Cartesian Coordinate system – Degrees of freedom – Constraints | 2 |
| 1.2 | Position, velocity, acceleration and force vector for Polar, Cylindrical coordinate system | 2 |
| 1.3 | Satellite Manoeuvres | 1 |
| 1.4 | Problems | 1 |
| **2** | **Quantum Mechanics** | **(6 Hours)** |
| 2.1 | Failures of classical mechanics - Wave nature of particles – Uncertainty Principle - wave function and its properties - expectation values | 2 |
| 2.2 | Classical wave equation (qualitative) - Schrodinger wave equation | 1 |
| 2.3 | Particle in a box | 1 |
| 2.4 | Quantum computation | 1 |
| 2.5 | Problems | 1 |
| **3** | **Thermodynamics** | **(6 Hours)** |

| | | |
|---|---|---|
| 3.1 | Laws of thermodynamics – Thermodynamic Processes | 1 |
| 3.2 | Concept of entropy - change in entropy in reversible and irreversible process | 1 |
| 3.3 | Entropy of a perfect gas - Temperature–Entropy diagram | 1 |
| 3.4 | Efficiency of Petrol engine – CNG engine | 2 |
| 3.5 | Problems | 1 |
| | *CAT-I after 18 contact hours* | |
| **4** | **Electromagnetic waves** | **(7 Hours)** |
| 4.1 | Electromagnetic waves | 1 |
| 4.2 | Maxwell's equation in Differential and Integral form | 2 |
| 4.3 | Propagation of EM Waves in free space | 1 |
| 4.4 | Energy of EM waves - Poynting Vector | 1 |
| 4.5 | Equation of continuity – Smart Phone | 1 |
| 4.6 | Problems | 1 |
| **5** | **Lasers** | **(5 Hours)** |
| 5.1 | Spontaneous and stimulated emission - Population inversion - Einstein's coefficients - Lasing action | 2 |
| 5.2 | Quantum Cascade laser - Nd: YAG Laser | 2 |
| 5.3 | Light Detection and Ranging, Bridge deflection and Laser Cutting | 1 |
| **6** | **Fiber Optics** | **(6 Hours)** |
| 6.1 | Principle and classification of optical fibers - Propagation of light in optical fibers – Numerical aperture and Acceptance angle | 2 |
| 6.2 | Losses in Optical Fibers – Attenuation and Dispersion (Qualitative) | 1 |
| 6.3 | Fiber Optical Communication system – Temperature Sensor – Endoscopy | 2 |
| 6.4 | Problems | 1 |
| | *CAT-II after 18 contact hours* | |
| | *Total* | **36** |

**Course Designers:**


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**CURRICULUM AND DETAILED SYLLABI**

**FOR**

**B.E DEGREE (Computer Science and Engineering) PROGRAMME**

**SECOND SEMESTER**

**FOR THE STUDENTS ADMITTED FROM THE**

**ACADEMIC YEAR 2023 - 2024 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

**SECOND SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS210 | Matrices and Linear Algebra | BSC | 3 | 1 | - | 4 |
| 22CS220 | Electronics and Digital Systems | PC | 2 | 1 | - | 3 |
| 22CS230 | Computer Organization and Architecture | PC | 3 | - | - | 3 |
| 22CS240 | Problem Solving and Programming | ESC | 3 | - | - | 3 |
| 22CS250 | System Programming | ESC | 2 | - | - | 2 |
| **THEORY CUM PRACTICAL** | | | | | | |
| 22CS261 | Engineering Graphics and Extended Reality | ESC | 2 | - | 2 | 3 |
| **PRACTICAL** | | | | | | |
| 22CS270 | Computer Systems Lab | ESC | - | - | 2 | 1 |
| 22CS280 | Programming Lab | PC | - | - | 2 | 1 |
| **AUDIT COURSE** | | | | | | |
| 22CHAA0 | Environmental Science | AC | | | | - |
| | **Total** | | **14** | **2** | **8** | **20** |

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
AC : Audit Course

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**

**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**SECOND SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS210 | Matrices and Linear Algebra | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS220 | Electronics and Digital Systems | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CS230 | Computer Organization and Architecture | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CS240 | Problem Solving and Programming | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22CS250 | System Programming | 3 | 40 | 60 | 100 | 27 | 50 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6 | 22CS261 | Engineering Graphics and Extended Reality (Terminal Exam: Theory) | 3 | 50 | 50 | 100 | 22.5 | 50 |
| **PRACTICAL** | | | | | | | | |
| 7 | 22CS270 | Computer Systems Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| 8 | 22CS280 | Programming Lab | 3 | 60 | 40 | 100 | 18 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS210** | **MATRICES AND LINEAR ALGEBRA** | BSC | 3 | 1 | 0 | 4 |

## Preamble

This course introduces the concept of vector space, which is a unifying abstract framework for studying linear operations involving a diverse set of mathematical objects such as vector space, matrices, and functions. Students learn to use the concepts of basis and linear transformations to operate within and between vector spaces. They can perform approximations and orthogonal projections and construct an orthonormal basis for vector spaces. Moreover, this course demonstrates procedure to solve linear and non-linear system of equations.

## Prerequisite

- Nil

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Evaluate basis and dimension of a vector space | TPS3 | B | 60 |
| CO2 | Compute the orthonormal basis of an inner product space given a basis | TPS3 | B | 60 |
| CO3 | Represent linear transformations by a matrix and hence verify their similarity | TPS3 | B | 60 |
| CO4 | Compute the Eigen value of a matrix and hence its singular value decomposition and generalised inverse | TPS3 | B | 60 |
| CO5 | Solve linear system of equations using matrices. | TPS3 | B | 60 |
| CO6 | Compute the solution of non-linear systems. | TPS3 | B | 60 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO2. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO3. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO4 | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO5 | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO6 | S | M | L | | M | | | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CAT 1 (%) | | | Assignment 1 (%) | | | CAT 2 (%) | | | Assignment 2 (%) | | | | | |
| TPS | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |
| CO1 | 5 | 15 | 30 | - | - | 50 | - | - | - | - | - | - | | 12 | 14 |
| CO2 | 5 | 15 | 30 | - | - | 50 | - | - | - | - | - | - | | 9 | 14 |
| CO3 | - | - | - | - | - | - | 3 | 10 | 14 | - | - | 26 | | - | 14 |
| CO4 | - | - | - | - | - | - | 7 | 10 | 22 | - | - | 42 | | 9 | 14 |
| CO5 | - | - | - | - | - | - | | 5 | 12 | - | - | 16 | | - | 7 |
| CO6 | - | - | - | - | - | - | | 5 | 12 | - | - | 16 | | - | 7 |
| TOTAL | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.**

## Syllabus

**Vector Spaces:** Vector space - Definition and Examples, Subspaces, Linearly Independence, Basis and Dimension, Row space and Column spaces.

**Orthogonality:** The scalar Product in $\mathbf{R}^n$ **-** Orthogonal Subspaces- Inner Product spaces, Orthonormal sets - Gram-Schmidt process.

**Linear Transformations**: Linear Transformations-Definitions and Examples - Matrix Representations of Linear Transformations -Similarity.

**Eigen systems:** Eigen values of Matrices and Eigen vectors of Matrices–Diagonalization of Matrices – The Singular Value Decomposition (SVD) of Matrices –The eigen value problem of Matrices – Generalized inverse of Matrices.

**Linear Systems:** System of linear Equations-Row Echelon forms - Gauss Elimination. **Nonlinear systems:** System of Non-Linear Equations - Fixed point iteration- Newton Raphson Method - Nonlinear system of Equations-Gauss Jordan method.

## Text Books

1. Steven J. Leon., “Linear Algebra with Application” Ninth Edition, Pearson, 2015.

2. Steven C. Chapra& Raymond P. Canale., Numerical Methods for Engineers. 7th Edition, McGraw Hill Publications. 2015.

**Reference Books& web resources**

1. David C.Lay., “Linear Algebra And Its Applications” 5th Edition, 2015.
2. Gilbert Strang., “Introduction to Linear Algebra” 5th Edition, 2016.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of. Lectures |
|---|---|---|
| **1** | **VECTOR SPACES** | |
| 1.1 | Vector space-Definition and Examples | 1 |
| 1.2 | Subspaces | 2 |
| | Tutorial | 1 |
| 1.3 | Linearly Independence | 2 |
| 1.4 | Basis and Dimension | 2 |
| | Tutorial | 1 |
| 1.5 | Row space and Column space | 2 |
| | Tutorial | 1 |
| | Program Using Python / MATLAB | |
| **2** | **ORTHOGONALITY** | |
| 2.1 | The scalar Product in $\mathbf{R}^n$ | 1 |
| 2.2 | Orthogonal Subspaces | 2 |
| | Tutorial | 1 |
| 2.3 | Inner Product spaces | 2 |
| 2.4 | Orthonormal sets | 2 |
| | Tutorial | 1 |
| 2.5 | Gram-Schmidt process | 2 |
| | Tutorial | 1 |
| | Program Using Python / MATLAB | |
| 3 | **LINEAR TRANSFORMATION** | |
| 3.1 | Linear Transformation- Definition and Examples | 1 |
| 3.2 | Matrix Representations of Linear Transformations | 2 |
| | Tutorial | 1 |
| 3.3 | Similarity | 1 |
| | Tutorial | 1 |
| | Program Using Python / MATLAB | |
| **4** | **EIGEN SYSTEMS** | |
| 4.1 | Eigenvalues of Matrices and Eigen vectors of Matrices | 1 |
| 4.2 | Diagonalization of Matrices | 2 |
| | Tutorial | 1 |
| 4.3 | The Single Value Decomposition (SVD) of Matrices | 2 |
| 4.4 | The eigen value problem of Matrices | 2 |
| 4.5 | Generalized Inverse of Matrices | 1 |
| | Tutorial | 1 |
| | Program Using Python / Matlab | |

| | | |
|---|---|---|
| **5** | **LINEAR SYSTEMS** | |
| | | |
| 5.1 | System of linear equations | 1 |
| 5.2 | Row Echelon forms | 1 |
| 5.3 | Gauss Elimination | 1 |
| | Tutorial | 1 |
| | **NONLINEAR SYSTEMS** | |
| 5.4 | System of Non-Linear Equations, Fixed point iteration, Newton Raphson Method | 1 |
| 5.5 | Nonlinear system of Equations | 1 |
| 5.6 | Gauss Jordan Method | 1 |
| | Tutorial | 1 |
| | Program Using Python / Matlab | |
| | **Total** | **48** |

## Course Designer(s):


1. Dr.C.S.Senthilkumar kumarstays@tce.edu
2. Dr. P. Krishnapriya pkamat@tce.edu
3. Dr. P. Victor pvmat@tce.edu

| 22CS220 | ELECTRONICS AND DIGITAL SYSTEMS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 2 | 1 | 0 | 3 |

**Preamble**

This course is designed to enable the students to understand and apply the basic principles of analog operational amplifiers and digital circuits and systems. Operational amplifier principles and characteristics, their different configurations and applications are illustrated. Then introduction to number systems, binary arithmetic, Boolean algebra, digital logic gates, design and implementation of combinational logic circuits are discussed. HDL simulation of combinational logic is briefly introduced. The fundamental concepts of flip flops and their application in implementing sequential logic circuits are also illustrated. Principles of Mealy and Moore type of circuits and their design are briefly discussed.

**Prerequisite**

- 22CS150 - Engineering Exploration

**Course Outcomes**

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

| CO | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the operation and characteristics of an operational amplifier (Understand) | TPS2 | B | 75 |
| CO2 | Design and implement linear and nonlinear circuits using operational amplifiers. (Apply) | TPS 3 | B | 70 |
| CO3 | Perform simplification of boolean logic functions by applying the theorems and postulates of Boolean algebra and Karnaugh map. (Apply) | TPS 3 | B | 70 |
| CO4 | Design combinational logic circuits for given specifications and implement them using logic gates, multiplexers and programmable logic devices. (Apply) | TPS 3 | B | 70 |
| CO5 | Explain the HDL simulation of combinational logic circuits. (Understand) | TPS 2 | B | 75 |
| CO6 | Design sequential logic circuits like counters and sequence detectors and implement them using given flip flops. (Apply | TPS 3 | B | 70 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | | | | | | | | L | | |
| CO2. | S | M | L | | | | | L | M | M | | L | M | | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | S | M | L | | | | | L | M | M | | L | M | | L |
| CO4 | S | M | L | | | | | L | M | M | | L | M | | L |
| CO5 | M | L | | | L | | | | L | L | | L | L | | L |
| CO6 | S | M | L | | | | | L | M | M | | L | M | | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1/2 | | | | | | Terminal | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** |
| CO1 | 6 | 10 | | | | | | | | | | | | | | | | | 3 | 5 | |
| CO2 | | 6 | 24 | | | | | | | | | | | | 34 | | | | | 3 | 12 |
| CO3 | 4 | 4 | 46 | | | | | | | | | | | | 66 | | | | 2 | 2 | 22 |
| CO4 | | | | | | | 2 | 4 | 28 | | | | | | 40 | | | | 1 | 2 | 14 |
| CO5 | | | | | | | 6 | 10 | | | | | | | | | | | 3 | 5 | |
| CO6 | | | | | | | 2 | 6 | 42 | | | | | | 60 | | | | 1 | 3 | 22 |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.
Assignment 1 covers CO2 and CO3 only.
Assignment 2 covers CO4 and CO6 only.

## Syllabus

**Operational Amplifier (Op-Amp) Principles:** Internal structure of an op-amp- Ideal op-amp characteristics and non-idealities in a practical op-amp- Idealized analysis of op-amp circuits.

**Applications of Op-Amp:** Inverting, non-inverting and differential amplifiers -Integrator, differentiator and comparator - Waveform generator -Zero crossing detector, peak detector and precision rectifier

**Binary Number System and Boolean Algebra:** Binary Number system and its conversion to hexadecimal number System-Complements, Signed Binary Numbers and Arithmetic-Binary Coded Decimal (BCD) and decimal Addition using BCD-Theorems and Properties of Boolean Algebra-Digital Logic Gates and Logic Operations-Simplification of logic functions using Karnaugh Map Method.

**Combinational Logic Circuits: Design and Implementation**

Binary Adder, Subtractor and Multiplier - Magnitude comparator, decoder and encoder-Multiplexers and their applications in implementing combinational logic functions -Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits.

**Simulation of Combinational Logic Circuits using HDL:** Introduction to Hardware Description Language - Verilog model of simple combinational Circuits-Test benches, Boolean expressions and user defined primitives.

**Sequential Logic Circuits:** Introduction- Types of flip flops, their truth diagrams and conversions between them-Operation of shift Registers-Design of synchronous and ripple counters-. Principles and operation of Mealy and Moore type Circuits-Design of Mealy and Moore type simple sequence detectors.

**Text Books**

1. Ramakant A. Gayakwad,Op-Amps and Linear Integrated Circuits, Pearson Education; Fourth Edition, 2015.
2. M. Morris Mano, Micheal D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, Pearson Education; Sixth edition,2018.

**Reference Books & web resources**

1. R. P. Jain, Kishor Sarawadekar, Modern Digital Electronics, McGraw Hill; Standard Edition,2022.
2. Leach, Malvino, Saha, Digital Principles and Applications, McGraw Hill Education; Eighth edition, 2014.
3. Jacob Millman,Christos Halkias, Chetan D. Parikh, Millman's Integrated Electronics- Analog and Digital Circuit and Systems, McGraw Hill Education, 2nd edition, 2017.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Operational Amplifier (Op-Amp) Principles:** | |
| 1.1 | Internal structure of an op-amp. | 1 |
| 1.2 | Ideal op-amp characteristics and non-idealities in a practical op-amp. | 1 |
| 1.3 | Idealized analysis of op-amp circuits | 1 |
| 2 | **Applications of Op-Amp** | |
| 2.1 | Inverting, non-inverting and differential amplifier | 1 |
| 2.2 | Integrator, differentiator and comparator | 1 |
| 2.3 | Waveform generator | 2 |
| 2.4 | Zero crossing detector, peak detector and precision rectifier | 1 |
| **3** | **Binary Number System and Boolean Algebra** | |
| 3.1 | Binary Number system and its conversion to hexadecimal number system. | 1 |
| 3.2 | Complements, Signed Binary Numbers and arithmetic | 2 |
| 3.3 | Binary Coded Decimal (BCD) and decimal addition using BCD. | 1 |
| 3.4 | Theorems and Properties of Boolean Algebra | 1 |
| 3.5 | Digital Logic Gates and Logic Operations | 1 |
| 3.6 | Simplification of logic functions using Karnaugh Map Method | 3 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4 | **Combinational Logic Circuits: Design and Implementation** | |
| 4.1 | Binary Adder, Subtractor and multiplier | 1 |
| 4.2 | Magnitude comparator, decoder and encoder | 1 |
| 4.3 | Multiplexers and their applications in implementing logic functions. | 2 |
| 4.4 | Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits. | 2 |
| 5 | **Simulation of Combinational Logic Circuits using HDL** | |
| 5.1 | Introduction to Hardware Description Language | 1 |
| 5.2 | Verilog model of a simple combinational circuits | 2 |
| 5.3 | Test benches, Boolean expressions and user defined primitives | 1 |
| **6** | **Sequential Logic Circuits** | |
| 6.1 | Introduction- Types of flip flops, their truth diagrams and conversions between them. | 2 |
| 6.2 | Operation of shift registers | 1 |
| 6.3 | Design of synchronous and ripple counters | 2 |
| 6.4 | .Principles and operation of Mealy and Moore type circuits | 1 |
| 6.5 | Design of Mealy and Moore type simple sequence detectors | 3 |
| | **Total** | **36** |

**Course Designer(s):**

1. C.Sridharan, Associate Professor of Computer Science and Engineering, cscse@tce.edu
2. Dr.C.Senthil Kumar, Associate Professor of Computer Science and Engineering, **cskcse@tce.edu**

| 22CS230 | COMPUTER ORGANIZATION AND ARCHITECTURE |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 3 | 0 | 0 | 3 |

## Preamble

The purpose of the course is to introduce principles of computer organization and the basic architectural concepts. It gives a brief overview of the memory format and instruction execution. It explains the function of each element of memory hierarchy and different ways of communication with I/O devices. It helps to estimate the performance and trade-offs involved in designing.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Estimate the data transfer rate and length of the instruction cycle with bus interconnection and timing diagrams. | TPS3 | 70 | 70 |
| CO2 | Identify the impacts on cost/performance by making use of memory hierarchy | TPS3 | 70 | 70 |
| CO3 | Design the cache memory organization and replacement algorithms and evaluate the design trade-offs | TPS3 | 70 | 70 |
| CO4 | Explain the features of I/O and DMA transfer | TPS2 | 70 | 75 |
| CO5 | Perform ALU operations on binary numbers | TPS3 | 70 | 70 |
| CO6 | Identify the methods to deal with hazards in pipelining | TPS3 | 70 | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | S | M | L | | | | | L | L | L | | L | M | | L |
| CO2 | S | M | L | | | | | L | L | L | | L | M | | L |
| CO3 | S | M | L | | | | | L | L | L | | L | M | | L |
| CO4 | M | L | | | | | | | | | | | L | | |
| CO5 | S | M | L | | | | | | L | M | | L | M | | L |
| CO6 | S | M | L | | | | | | L | M | | L | M | | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 1 | 2 | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | | | | | | | | | | | 20 | | 10 | | | | | |
| CO2 | 10 | 10 | 20 | | | | | | | | | | 40 | | | 10 | | | | |
| CO3 | 10 | | 30 | | | | | | | | | | 40 | | | 10 | 20 | | | |
| CO4 | | | | | | | 20 | 10 | | | | | | 30 | 10 | 10 | | | | |
| CO5 | | | | | | | 10 | 10 | 15 | | | | | 30 | | | 20 | | | |
| CO6 | | | | | | | 10 | 10 | 15 | | | | | 40 | | | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Introduction to IAS Computer Structure and Operation.

**Computer Function and Interconnection:** Top level view of components and functions, Instruction cycle and program execution, Interrupts and instruction cycles, Multiple interrupts, Interconnection structures, Bus interconnection, Multiple buses, Synchronous and asynchronous bus timings, GPU Architecture - Overview.

**Memory and I/O:** Characteristics and hierarchy of memory, Cache memory principles and operation, Cache design and mapping functions, replacement algorithms, main memory, DRAM and SRAM, Types of ROMs, Module organization, Introduction to magnetic disks, I/O transfer and disk performance, Interrupt driven and DMA transfers, Performance estimation and trade-offs in design.

**Computer Arithmetic:** Arithmetic and Logic Unit, Integer multiplication of unsigned and signed numbers, Booth's algorithm, Division of unsigned binary, Floating point arithmetic. **Pipelining**: Basic Concepts, Data Hazards, Instruction hazards, Influence on Instruction Sets, Data path and Control Considerations, Superscalar Operation, Performance Considerations.

## Learning Resources

1. William Stallings, Computer Organization and Architecture Designing for Performance, Eleventh edition, Prentice Hall, 2013.
2. Andrew S Tanenbaum and Todd Austin, Structured Computer Organization, Sixth edition, Pearson, 2013.
3. Carl Hamacher, Computer Organization and Embedded Systems, Sixth edition, McGrawHill, 2012.
4. DodiyaTripti, Computer Organisation and Advanced Microprocessors, First edition, Cengage Learning India,2012.
5. Barry B.Brey, The Intel Microprocessors Architecture Programming and Interfacing, Eighth edition, Pearson Prentice Hall, 2009.
6. N.Senthil Kumar, M.Saravanan and S. Jeevananthan, Microprocessors and Microcontrollers, First edition, Oxford University Press, 2010.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| **1** | **Introduction (2)** | | |
| 1.1 | Introduction to IAS Computer Structure and Operation | 2 | CO1 |

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| **2** | **Computer Function and Interconnection (9)** | | |
| 2.1 | Top level view of components and functions | 1 | CO1 |
| 2.2 | Instruction cycle and program execution | 1 | |
| 2.3 | Interrupts and instruction cycles | 1 | |
| 2.4 | Multiple interrupts | 1 | |
| 2.5 | Interconnection structures | 1 | |
| 2.6 | Bus interconnection | 1 | |
| 2.7 | Multiple buses | 1 | |
| 2.8 | Synchronous and asynchronous bus timings | 1 | |
| 2.9 | GPU Architecture - Overview | 1 | |
| **3** | **Memory and I/O (11)** | | |
| 3.1 | Characteristics and hierarchy of memory | 2 | CO2 |
| 3.2 | Cache memory principles and operation | | |
| 3.3 | Cache design and mapping functions | | |
| 3.4 | Replacement algorithms | 1 | CO3 |
| 3.5 | Main memory | 1 | |
| 3.6 | DRAM and SRAM | 1 | |
| 3.7 | Types of ROMs, | 1 | |
| 3.8 | Module organization | 1 | CO4 |
| 3.9 | Introduction to magnetic disks | 1 | |
| 3.10 | I/O transfer and disk performance | 1 | |
| 3.11 | Interrupt driven and DMA transfers | 1 | CO4 |
| 3.12 | Performance estimation and trade-offs in design | 1 | |
| **4** | **Computer Arithmetic (7)** | | |
| 4.1 | Arithmetic and Logic Unit | 1 | CO5 |
| 4.2 | Integer multiplication of unsigned and signed numbers | 1 | |
| 4.3 | Booth's algorithm | 2 | |
| 4.4 | Division of unsigned binary | 2 | |
| 4.5 | Floating point arithmetic | 1 | |
| **5** | **Pipelining (7)** | | |
| 5.1 | Basic Concepts | 1 | CO6 |
| 5.2 | Data Hazards | 1 | |
| 5.3 | Instruction hazards | 1 | |
| 5.4 | Influence on Instruction Sets | 1 | |
| 5.5 | Data path and Control Considerations | 1 | |
| 5.6 | Superscalar Operation | 1 | |
| 5.7 | Performance Considerations | 1 | |
| | **Total Hours** | **36** | |

**Course Designer(s):**

1. Dr. K. NarasimhaMallikarjunan, Associate Professor, CSE — arjunkambaraj@tce.edu
2. Ms. C.Santhiya ,Assistant Professor, CSE — csit@tce.edu

| 22CS240 | PROBLEM SOLVING AND PROGRAMMING | Category | L | T | P | Credits |
|---|---|---|---|---|---|---|
| | | ESC | 3 | 0 | 0 | 3 |

**Preamble**

The main objective of this course is to learn problem solving methodologies and aspects of C programming. Programming is a fundamental task in finding solutions to real life problems. Aim of this course is to train the students to solve problems using the fundamentals of C programming.

**Prerequisite**

- NIL

**Course Outcomes**

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

| COs | Course Outcome 1 (CO1) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Interpret Mathematical problems using algorithms, flowchart and pseudocode. | TPS 2 | B | 85 |
| CO2 | Develop algorithms for solving engineering problems using appropriate conditional and control structure | TPS 3 | B | 80 |
| CO3 | Decompose a problem into functions for recursive solutions | TPS 3 | B | 80 |
| CO4 | Use arrays, pointers and structures to formulate algorithms and programs | TPS 3 | B | 80 |
| CO5 | Solve matrix addition, matrix multiplication, searching and sorting problems using C Programming | TPS 3 | B | 80 |
| CO6 | Implement file operations and pre-processor directives for a given application | TPS 3 | B | 80 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | - | - | L | - | - | L | L | L | L | L | L | - | L |
| CO2. | S | M | L | - | L | - | - | L | L | L | L | L | M | - | L |
| CO3 | S | M | L | - | L | - | - | L | L | L | L | L | M | - | L |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | S | M | L | - | L | - | - | L | L | L | L | L | M | - | L |
| CO5 | S | M | L | - | L | - | - | L | L | L | L | L | M | - | L |
| CO6 | S | M | L | - | L | L | L | L | L | M | L | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | | | | CAT 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | 5 | 5 | 10 | - | - | - |
| CO2 | - | 10 | 20 | - | - | - | - | - | - | - | - | - | - | 5 | 10 | - | - | - |
| CO3 | - | 10 | 20 | - | - | - | - | - | - | - | - | - | - | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 20 | - | - | - | 5 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | | 10 | 20 | - | - | - | - | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | | 10 | 20 | - | - | - | - | 5 | 10 | - | - | - |

| CO | Assignment 1 | | | | | | Assignment 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | - | - | 30 | - | - | - | - | - | - | - | - | - |
| CO2 | - | - | 30 | - | - | - | - | - | - | - | - | - |
| CO3 | - | - | 40 | - | - | - | - | - | - | - | - | - |
| CO4 | – | - | - | - | - | - | - | - | 30 | - | – | - |
| CO5 | - | - | - | - | - | - | - | - | 30 | - | - | - |
| CO6 | - | - | - | - | - | - | - | - | 40 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Problem Solving through programs**, Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops, compilation process, Syntax and Semantic Errors-Character set – Constants – Keywords – Primitive data types – Declaration, Type Conversion

**Conditional Branching and Iterative Loops**-Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, selective - If-Else-If, Switch- repetitive structures-for, while, do while, Nested loops, go to, break, continue –Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation.
**Arrays** – Declaration, initialization and accessing array elements - 2-D arrays, Character Arrays and String operations -Matrix Operations-Searching- Linear search, Binary Search and Sorting-Bubble sort and Selection Sort - Minimum, Maximum and average of n numbers

**Functions**: Definition – call – prototypes - block structure -Storage Classes- call by Value-Variable Length Arguments-Call by Reference-Passing Arrays to Functions –recursion-iteration vs recursion- types of recursion- Simple recursive and non-recursive programs, Factorial and Fibonacci Generation-Towers of Hanoi problem

**Pointers** – Address and indirection operators, Pointer type declaration – Pointer arithmetic-Functions and pointers – Arrays and pointers -Strings and Pointers – Pointer to Pointers-Dynamic memory management

**Structures** – Variables, Accessing members, Assignment and nesting – Pointers to Structures -Structures and functions – Array of Structures – Unions- Pre-processor Directives-Command line arguments

**Files:** -Input and Output: Standard I/O, Formatted Output – printf, Formatted Input – scanf- file access including FILE structure, fopen, stdin, stdout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

## Text Books

1. R.G.Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Publisher, 2015.
3. J.R.Hanly and E.B. Koffmann, "Problem Solving and Program design in C", Fifth Edition, Pearson Publisher, 2012

## Reference Books & web resources

1. YashwantKanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
2. ReemaThareja, “Programming in C”, Second Edition,Oxford University Press,2016.
3. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018
4. Paul Deital and Harvey Deital, "C How to Program", Seventh Edition, Prentice Hall, 2012.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Problem Solving through programs** | |
| 1.1 | Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops | 1 |
| 1.2 | compilation process, Syntax and Semantic Errors-Character set – Constants – Keywords | 1 |
| 1.3 | Primitive data types – Declaration, Type Conversion | 1 |
| **2** | **Conditional Branching and Iterative Loops** | |
| 2.1 | Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation | 2 |
| 2.2 | Selective - If-Else-If, Switch | 1 |
| 2.3 | Repetitive structures-for, while, do while, Nested loops, go to, break, continue | 1 |
| 2.4 | Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation. | 1 |
| **3** | **Arrays** | |
| 3.1 | Declaration, initialization and accessing array elements - 2-D arrays | 1 |
| 3.2 | Character Arrays and String operations | 1 |
| 3.3 | Matrix operations | 1 |
| 3.4 | Searching- Linear search, Binary Search | 1 |
| 3.5 | Sorting-Bubble sort and Selection Sort | 1 |
| 3.6 | Minimum, Maximum and average of n numbers | 1 |
| **4** | **Functions** | |
| 4.1 | Definition – call – prototypes - block structure -Storage Classes | 1 |
| 4.2 | call by Value- Variable Length Arguments-Call by Reference | 1 |
| 4.3 | Passing Arrays to Functions | 1 |
| 4.4 | Recursion-iteration vs recursion- types of recursion | 1 |
| 4.5 | Simple recursive and non-recursive programs, Factorial and Fibonacci Generation | 1 |
| 4.6 | Towers of Hanoi problem | 1 |

| | | |
|---|---|---|
| **5** | **Pointers** | |
| 5.1 | Address and indirection operators, Pointer type declaration – Pointer arithmetic | 1 |
| 5.2 | Functions and pointers | 1 |
| 5.3 | Arrays and pointers | 1 |
| 5.4 | Strings and pointers | 1 |
| 5.5 | Pointer to pointers | 1 |
| 5.6 | Dynamic memory management | 1 |
| **6** | **Structures** | |
| 6.1 | Variables, Accessing members, Assignment and nesting | 1 |
| 6.2 | Pointers to Structures | 1 |
| 6.3 | Structures and functions | 1 |
| 6.4 | Array of Structures,Unions | 1 |
| 6.5 | Pre-Processor Directives-Command line arguments | 1 |
| 7 | **Files** | |
| 7.1 | Input and Output: Standard I/O, Formatted Output – printf, Formatted Input – scanf | 2 |
| 7.2 | Variable length argument list | 1 |
| 7.3 | File access including FILE structure, fopen, stdin, stdout and stderr | 1 |
| 7.4 | Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr.M.Nirmala Devi, AP,CSE,TCE mnit@tce.edu
2. Ms.G.Bhavani, AP,CSE,TCE gbicse@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS250** | **SYSTEM PROGRAMMING** | ESC | 2 | 0 | 0 | 2 |

## Preamble

This course teaches students how to think about, build, debug, and test computer programs. The course also emphasizes the understanding of how programs execute on today's computers and their interaction with hardware and software. The practical programming is in C on Unix/Linux systems to introduce students to the mapping of high-level language constructs to the system software components and the underlying machine.

## Prerequisite

Nil

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Illustrate the role and types of components significant in computing systems. (CO1) | TPS2 | B | 85 |
| CO2 | Identify and utilize the proper system software component for computer program execution.(CO2) | TPS3 | B | 80 |
| CO3 | Perform Unix/Linux basic commands to facilitate user interaction with the Operating System.(CO3) | TPS3 | B | 80 |
| CO4 | Illustrate the system programming tools and resources that assists in program development.(CO4) | TPS2 | B | 85 |
| CO5 | Develop C programs using Process Management and File Management System calls.(CO5) | TPS3 | B | 80 |
| CO6 | Construct bash scripts to solve problems using control statements and functions.(CO6) | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | | | | | | | | L | | |
| CO2. | M | L | | | L | | | | | | | L | L | | |
| CO3 | M | L | | | M | | | | | L | | L | L | L | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | M | L | | | | | | | | | | | L | | |
| CO5 | M | L | | | L | | | | | L | | L | L | | |
| CO6 | S | M | L | | M | | | | | M | | L | M | L | |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Assignment 1 | CAT2 | | | | | | Assignment2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | - | - | - | - | 20 | - | - | - | - | - | - | - | 3 | 10 | - | - | - | - |
| CO2 | 10 | 10 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | 3 | 5 | 6 | - | - | - |
| CO3 | 10 | 10 | 20 | - | - | - | 50 | - | - | - | - | - | - | - | 3 | 5 | 12 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 15 | - | - | - | - | 20 | 3 | 10 | - | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 10 | 25 | - | - | - | 40 | 3 | 5 | 12 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 10 | 25 | - | - | - | 40 | 3 | 5 | 12 | - | - | - |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.**

## Syllabus

**Fundamentals of Computer System:** Functional components of a programming system: Machine Structure, Hardware and Software, Software: Application Software and System Software.

**System Software:** Operating System, Text Editor, Debugger, Language Translator, Linker and Loader, Programming Languages: Machine Language, Assembly Language and High level language, Programming language processing activities.

**System Programming:** Basics of Systems Programming, Tools of system programming: Shell, Editor, Debugger, IDE, Program Development and Management: Case Study "C" programming, Basics of C programming and C program execution model.

**System Programming on UNIX/Linux Systems:** Unix/Linux Operating System structure, Basic Unix/Linux commands, Input / Output – Streams, Buffers, Pipes, Files and Devices, Processes, Privileged instructions and Non-privileged instructions, Environments, Shells, Kernel System Resources, System Calls and System Libraries.

**System Calls & Libraries:** Basics of System Call and Operation of system calls, Process management system calls - fork(), exec(), wait() & exit(), File management system calls - fopen(), fclose(), fread(), fwrite() and fseek(), Libraries: purpose of libraries and example of C standard libraries.

**Scripting Language:** Basics of scripting languages, Shell scripting: Basic Shell commands, Variables, Conditionals, Loops and Functions.

## Text Books

1. System programming with C and Unix, Adam Hoover, Addison-Wesley, 2010 Pearson Education.
2. Practical System Programming with C: Pragmatic Example Applications in Linux and Unix-Based Operating Systems, Sri Manikanta Palakollu, Apress Media.
3. Systems Programming, John. J.Donovan, Tata McGraw Hill Edition.

4. System Software – An Introduction to Systems Programming, Leland L. Beck, Third Edition, Addison-Wesley.
5. Systems Programming, DM Dhamdhere, McGraw-Hill Education (India) Pvt Limited, 2011.

## Reference Books & web resources

1. System Software, Santanu Chattopadhyay, 2007, PHI Learning.
2. The Linux Programming Interface - A Linux and UNIX System Programming Handbook, Michael Kerrisk, 2010, No Starch Press.
3. https://script.spoken-tutorial.org/index.php/BASH/C2/Introduction-to-BASH-Shell-Scripting/English-timed
4. https://onlinecourses.swayam2.ac.in/aic20_sp05/preview

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Fundamentals of Computer System** | |
| 1.1 | Functional components of a programming system: Machine Structure, Hardware and Software. | 1 |
| 1.2 | Software: Application Software and System Software. | 1 |
| **2** | **System Software** | |
| 2.1 | Operating System and Text Editor | 1 |
| 2.2 | Programming Languages: Machine Language, Assembly Language and High level language. | 1 |
| 2.3 | Debugger, Language Translator, Linker and Loader. | 2 |
| 2.4 | Programming language processing activities. | 1 |
| **3** | **System Programming** | |
| 3.1 | Basics of Systems Programming and Tools of system programming: Shell, Editor, Debugger, IDE. | 1 |
| 3.2 | Program Development and Management: Case Study "C" programming and Basics of C programming, C program execution model | 2 |
| **4** | **System Programming on UNIX/Linux Systems** | |
| 4.1 | Unix/Linux Operating System structure and Basic Unix/Linux commands. | 1 |
| 4.2 | Input / Output – Streams, Buffers, Pipes, Files and Devices. | 1 |
| 4.3 | Processes, Privileged instructions and Non-privileged instructions, Environments and Shells. | 1 |
| 4.4 | Kernel System Resources, System Calls and System Libraries. | 1 |
| **5** | **System Calls & Libraries** | |

| | | |
|---|---|---|
| 5.1 | Basics of System Call and Operation of system calls. | 1 |
| 5.2 | Process management system calls - fork(), exec(), wait() and exit(). | 2 |
| 5.3 | File management system calls - fopen(), fclose(), fread(), fwrite() and fseek(). | 2 |
| 5.4 | Libraries: purpose of libraries and example of C standard libraries. | 1 |
| **6** | **Scripting Language** | |
| 6.1 | Basics of scripting languages and types of shells | 2 |
| 6.2 | Shell scripting: Basic Shell commands, Variables and Conditional control statements. | |
| 6.3 | Shell scripting using Loops and Functions. | 2 |
| | Total | 24 |

**Course Designer(s):**

1. Dr.S.MercyShalinie, Professor,CSE shalinie@tce.edu
2. Dr.G.Madhupriya, Associate Professor,CSE gmadhupriya@tce.edu

| 22CS270 | COMPUTER SYSTEMS LAB |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| ESC | 0 | 0 | 2 | 1 |

## Preamble

The laboratory course is designed to enable the students to design and construct practically the combinational and sequential logic circuits for different applications. The list of experiments starts with the verification of Boolean theorems and truth table of gates. Then the design and construction of a variety of circuits using gates, flip flops and other devices are performed. The simulation of simple circuits using Hardware Description Language is also performed and students will get a chance to reinforce concepts in the working of a “real” operating system like Operating system installation procedure, shell Commands, file system management and process management techniques

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Design half adder, full adder and Verify the truth tables of Boolean logic gates and theorems of Boolean algebra (Apply) | TPS3 | 70 | 80 |
| CO2 | Design combinational logic circuits for given specifications and implement them using HDL, multiplexers and programmable logic devices. (Apply) | TPS3 | 70 | 80 |
| CO3 | Design sequential logic circuits like counters, Registers, flip-flops and sequence detectors using Logic gates. (Apply) | TPS3 | 70 | 80 |
| CO4 | Identify and utilize the proper system software component, for programming Systems. (Apply) | TPS3 | 70 | 80 |
| CO5 | Implement Process Management and File Management system calls in C program. (Apply) | TPS3 | 70 | 80 |
| CO6 | Create shell scripts to automate and capture common repetitive tasks using bash scripting. (Apply) | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO2 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO3 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO5 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO6 | S | M | L | | L | - | - | M | M | M | | M | M | L | M |

S- Strong; M-Medium; L-Low

**Assessment Pattern: Cognitive Domain**

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyze | | |
| Evaluate | | |
| Create | | |

**List of Experiments/Activities with CO Mapping**

1. Verification and interpretation of truth table for AND, OR, NOT,NAND, NOR, Ex-OR, Ex-NOR gates
2. Construction of half / full adder using XOR and NAND gates andverification of its operation
3. Implementation of 4x1 multiplexer and 1x4 de-multiplexer using logic gates
4. Verification of Binary to Gray and Gray to Binary conversion usingNAND gates only
5. Verification of the truth table of RS, JK, T and D flip-flopsusing NAND & NOR gates
6. Design and Verification of the 4-Bit Serial In - Parallel OutShift Registers
7. Installation of Windows and Linux operating systems.
8. Perform operations using the text editors, Compilers and IDE in Windows and Linux OS.
9. Perform C programs using process management system calls.
10. Perform C programs using File system management system calls.
11. Perform shell scripts with the basic shell commands.
12. Perform shell scripts using conditional and looping constructs.

**Learning Resources**

1. Ramakant A. Gayakwad,Op-Amps and Linear Integrated Circuits, Pearson Education; Fourth Edition, 2015.
2. M. Morris Mano, Micheal D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, Pearson Education; Sixth edition,2018.
3. System programming with C and Unix, Adam Hoover, Addison-Wesley, 2010 Pearson Education.

**Course Designers:**

1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

| 22CS280 | PROGRAMMING LAB | Category | L | T | P | Credits |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Preamble

This course objective is to provide practical experience on fundamentals of C programming as well as the design of simplified computer solutions to real-world problems. Programming concepts, data types, conditional and control structures, functions, arrays, recursion, file handling, and preprocessor directives are all projected in solving the engineering and real life problems.

## Prerequisite

- NIL

## Course Outcomes

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

| COs | Course Outcome 1 (CO1) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Develop Programs using various Data types and operators | TPS 3 | B | 80 |
| CO2 | Use appropriate conditional and control structure to solve Engineering problems | TPS 3 | B | 80 |
| CO3 | Implement modular programming using user defined and recursive functions | TPS 3 | B | 80 |
| CO4 | Perform sorting , searching and matrix operations using C Programming | TPS 3 | B | 80 |
| CO5 | Make use of pointers, structure and union to solve problems | TPS 3 | B | 80 |
| CO6 | Solve real life problems by file handling functions and preprocessor directives | TPS 3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |
| CO2. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |
| CO3. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |
| CO4. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |
| CO5. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |
| CO6. | S | M | L | L | L | L | L | M | M | M | M | M | M | L | M |

**Assessment Pattern: Cognitive Domain**

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | - | - |
| Understand | - | - |
| Apply | 100 | 100 |
| Analyse | - | - |
| Evaluate | - | - |
| Create | - | - |

**List of Experiments/Activities with CO Mapping**

| Ex.NO | Experiment | CO |
|---|---|---|
| 1 | Develop C Programs with various data types | CO1 |
| 2 | Develop C Programs to illustrate operators and sequence control structure | CO1 |
| 3 | Write a C Program for decision making problems | CO2 |
| 4 | Implement C program to solve iterative problems using loops | CO2 |
| 5 | Implement bubble and selection sorting using modular programming | CO3 |
| 6 | Write C Programs for linear and binary searching techniques. | CO3,CO4 |
| 7 | Implement matrix operations and recursive fuctions using C programs | CO3,CO4 |
| 8 | Implement pointers to array and function | CO5 |
| 9 | Develop a C Program for user defined Data Types: Structure and Union | CO5 |
| 10 | Demonstrate file Handling operations using C program | CO6 |
| 11 | Illustrate C preprocessor directives through programming | CO6 |
| 12 | Simple Application Development | CO1,CO2,CO3,CO4,CO5,CO6 |

**Learning Resources**

1.R.G.Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.

2. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Publisher, 2015.
3. J.R.Hanly and E.B. Koffmann, "Problem Solving and Program design in C", Fifth Edition, Pearson Publisher, 2012
4. YashwantKanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
5. ReemaThareja, “Programming in C”, Second Edition,Oxford University Press,2016.
6. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018
7. Paul Deital and Harvey Deital, "C How to Program", Seventh Edition, Prentice Hall, 2012

**Course Designer(s):**

1. Dr.M.Nirmala Devi, AP,CSE,TCE mnit@tce.edu
2. Ms.G.Bhavani, AP,CSE,TCE gbicse@tce.edu

| 22CS261 | ENGINEERING GRAPHICS AND EXTENDED REALITY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ES | 2 | 0 | 2 | 3 |

Terminal Exam: Theory

## Preamble

Engineering Graphics and Extended Reality (XR) encapsulates various immersive technologies that can merge the physical and virtual worlds, including virtual reality (VR), and augmented reality (AR). This course is an introduction to engineering graphics, objects design and interactions to the virtual worlds with practical applications of Extended Reality concepts in human perception, immersion and presence, virtual world modelling and 3D user interaction.

## Prerequisite

Nill

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Define and explain the fundamental concepts in 2D 3D graphics, transformations and views. | TPS2 | B | 90 |
| CO2 | Understand the fundamental hardware and software for VR experiences | TPS2 | B | 85 |
| CO3 | Apply VR experience design for user interaction and interface design. | TPS3 | B | 85 |
| CO4 | Model and create a scene for interaction, navigation in Virtual Reality | TPS3 | B | 85 |
| CO5 | Design models in AR for using AR camara | TPS3 | B | 85 |
| CO6 | Develop and build an AR model to run on android/ iphone based mobile devices. | TPS4 | B | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | S | S | S | S | S | M | M | S |
| CO2 | M | L | | | S | | | S | S | S | S | S | M | M | S |
| CO3 | S | M | L | | S | | | S | S | S | S | S | M | M | S |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 4** | S | M | L | | S | | | S | S | S | S | S | M | M | S |
| **CO 5** | S | M | L | | | | | S | S | S | S | S | M | M | S |
| **CO 6** | S | S | M | L | S | | | S | S | S | S | S | S | M | S |

## Assessment Pattern

| **CO** | **CAT 1** | | | | | | **CAT 2** | | | | | | **Terminal** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **100** | | | | | | **100** | | | | | | **100** | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 7 | 20 | | | | | | | | | | | 4 | 10 | | | | |
| CO2 | 7 | 20 | | | | | | | | | | | 4 | 10 | | | | |
| CO3 | 6 | 10 | 30 | | | | | 10 | 20 | | | | 4 | 10 | 10 | | | |
| CO4 | | | | | | | | 10 | 20 | | | | 4 | 10 | 10 | | | |
| CO5 | | | | | | | | 10 | 20 | 10 | | | 4 | 10 | 10 | | | |
| CO6 | | | | | | | | | | | | | | | | | | |

| **CO** | **LAB** | | | | | | **OCR** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | | | | | | | | | | | |
| CO2 | | | 10 | | | | | | 10 | | | |
| CO3 | | | 20 | | | | | | 20 | | | |
| CO4 | | | 25 | | | | | | 25 | | | |
| CO5 | | | 25 | | | | | | 25 | | | |
| CO6 | | | | 20 | | | | | | 20 | | |

## Syllabus

**Engineering Graphics** Graphics Pipeline, 2D Linear Transformations, 3D Linear Transformations, Viewing and Projective Transformations, Perspective Projection and Perspective Transform.

**Defining Virtual Reality** Four Key Elements of Virtual Reality Experience, Interface to the Virtual World Input and Output, Position and Orientation tracking, Head-Mounted Displays, Augmenting Displays, Binocular Augmenting Displays, Fully Immersive Displays, Smartphone Based

Displays, 2D Versus 3D Interaction and Navigation, Hand and Gesture Tracking, Whole Body Tracking, Gaming and Entertainment.

**Development tools-** Interacting with the Virtual World, Interactions: Manipulation, Navigation, and Communication, Scene Graphs, Creating Basic Shapes, Navigation in 3D environment, Grouping and Components, Development of 3d objects using SketchUp.

**Building a sample scene in VR**, Interaction and Virtual Walkthrough using Jump and walk

**Defining Augmented Reality**, Getting started with Unity, Installing Unity Hub and a Unity Editor, Introducing the Unity Editor interface, preparing a project for AR development, Installing XR plugins for AR devices, Installing the AR Foundation package, Choosing an input handler Setting up for mobile development, Setting up for Android/ARCore development

**A sample scene in AR** Building and running the Samples project using Unity - AR Session, AR Session Origin, and AR Camera, Tracking Images using mobile devices

## Text Book


1. Steve Marschner Peter Shirley, "Funtamentals of Computer graphics", Taylor & Francis, fourth edition, 2016
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design", The Morgan Kaufmann Series, second edition, 2018.
3. Jonathan Linowes, "Augmented Reality with Unity AR Foundation", Packt Publishing, 2021


## Reference Books & web resources


1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, "Developing Virtual Reality Applications", 2017.
2. Matjaz Mihelj, Domen Novak, Samo Begus, "Virtual Reality Technology and Applications", 1st Edition, Springer Netherlands, 2014.
3. Grigore C. Burdea, Philip Coiffet, "Virtual Reality Technology", 2nd Edition, Wiley India, 2006
4. John Vince, "Introduction in Virtual Reality", Springer, 2004.
5. Steve Aukstakalnis, "Practical Augmented Reality", Addision Wesley 2017.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods | CO |
|---|---|---|---|
| **1** | **Engineering Graphics** | | |
| **1.1** | Graphics Pipeline, 2D Linear Transformations, 3D Linear Transformations, | 1 | CO1 |
| **1.2** | Viewing and Projective Transformations | 1 | CO1 |
| **1.3** | Perspective Projection and Perspective Transform. | 1 | CO1 |
| **2** | **Defining Virtual Reality** | | |

| Module No. | Topic | No. of Periods | CO |
|---|---|---|---|
| **2.1** | Four Key Elements of Virtual Reality Experience, Interface to the Virtual World Input and Output, Position and Orientation tracking, | 1 | CO2 |
| **2.2** | Head-Mounted Displays, Augmenting Displays, Binocular Augmenting Displays, Fully Immersive Displays, Smartphone Based Displays, | **1** | CO2, |
| **2.3** | 2D Versus 3D Interaction and Navigation, Hand and Gesture Tracking, | 1 | CO2, |
| **2.4** | Whole Body Tracking, Gaming and Entertainment. | 1 | CO2, |
| **3** | **Development tools-** | | |
| **3.1** | Interacting with the Virtual World, Interactions: Manipulation, Navigation, and Communication, | 2 | CO3 |
| **3.2** | Scene Graphs, Creating Basic Shapes, Navigation in 3D environment, . | 1 | CO3, CO6 |
| **3.3** | Grouping and Components, Development of 3d objects using SketchUp | 1 | CO3, C06 |
| **Continuous Assessment Test – I** | | | |
| **4** | **Building a sample scene in VR**, | | |
| **4.1** | Interaction to virtual scene using VR devices | 2 | CO4 |
| **4.2** | Virtual Walkthrough using Jump and walk using VR devices | **1** | CO4, CO6 |
| **4.3** | Creating a Walkthrough in a model on mobile devices | 1 | CO4, CO6 |
| | **Assignment 1** | | CO6 |
| **5** | **Defining Augmented Reality**, | | |
| **5.1** | Getting started with Unity, Installing Unity Hub and a Unity Editor, | 2 | CO5 |
| **5.2** | Introducing the Unity Editor interface, preparing a project for AR development | 1 | CO5 |
| **5.3** | Installing XR plugins for AR devices, Installing the AR Foundation package, | 1 | CO5, CO6 |
| **5.4** | Choosing an input handler Setting up for mobile development, Setting up for Android/ARCore development | 1 | CO5, CO6 |
| **6** | **A sample scene in AR** | | CO5 |
| **6.1** | Building and running the Samples project using Unity - AR Session, AR Session Origin, and AR Camera, | 1 | CO5, CO6 |
| **6.2** | Tracking Images using mobile devices | 1 | |
| | Build the scene in to application to run on android / ios based mobile devices | 2 | CO5, CO6 |

| Module No. | Topic | No. of Periods | CO |
|---|---|---|---|
| | **Total Hours** | **24** | |

**Course Contents and Lecture Schedule for Laboratory**

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| 1. | Create a sample scene with 3d objects in SketchUp | 2 | CO3 |
| 2. | Integrating the model with VR devices | 2 | CO3 |
| 3. | Virtual Walkthrough using Jump and walk using fully immersive kits | 2 | CO3 |
| 4. | Creating a walkthrough on mobile devices for a model | 2 | CO4 |
| 5. | Unity installation and configuration | 2 | CO4 |
| 6. | Unity Interface design | 2 | CO4 |
| 7. | Creating an APK file to run on mobile devices | 2 | CO6 |
| 8. | Placing a 3d object on a plane on mobile AR using Unity | 4 | CO5 |
| 9. | Tracking of images using mobile camara in AR using Unity | 4 | CO5, CO6 |
| 10. | Scripts, rigibody, physics material | 2 | CO3, CO4, CO5, CO6 |
| | **Total Hours** | **24** | |

**Course Designer(s):**

1. Dr. N. Shivakumar APCSE shiva@tce.edu

# CURRICULUM AND DETAILED SYLLABI

**FOR**

## B.E DEGREE (Computer Science and Engineering) PROGRAMME

## THIRD SEMESTER

**FOR THE STUDENTS ADMITTED FROM THE**

**ACADEMIC YEAR 2023 - 2024 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

**THIRD SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS310 | Probability and Statistics | BSC | 3 | 1 | - | 4 |
| 22CS320 | Theory and Design of Programming Languages | ESC | 3 | - | - | 3 |
| 22CS330 | Object Oriented Programming | PC | 3 | - | - | 3 |
| 22CS340 | Data Structures and Algorithms | PC | 3 | - | - | 3 |
| **THEORY CUM PRACTICAL** | | | | | | |
| 22CS360 | Operating Systems | PC | 3 | - | 2 | 4 |
| **PRACTICAL** | | | | | | |
| 22CS370 | Data Structures Lab | PC | - | - | 2 | 1 |
| 22CS380 | Object Oriented Programming Lab | PC | - | - | 2 | 1 |
| 22ES390 | Design Thinking | ESC | | | | 3 |
| | | **Total** | **15** | **1** | **6** | **22** |

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**

**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**THIRD SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS310 | Probability and Statistics | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS320 | Theory and Design of Programming Languages | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CS330 | Object Oriented Programming | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CS340 | Data Structures and Algorithms | 3 | 40 | 60 | 100 | 27 | 50 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 5 | 22CS360 | Operating Systems | 3 | 50 | 50 | 100 | 22.5 | 50 |
| **PRACTICAL** | | | | | | | | |
| 6 | 22CS370 | Data Structures Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| 7 | 22CS380 | Object Oriented Programming Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| 8 | 22ES390 | Design Thinking | | | | | | |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

| 22CS310 | PROBABILITY AND STATISTICS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BS | 3 | 1 | 0 | 4 |

## Preamble

A mathematical model of some phenomena is frequently impossible to construct due to inherent uncertainties. Many real-world problems, in fact, involve multiple variables (some of which may be unknown), making it difficult to define the problem and perform a precise mathematical analysis. Statistical inference can help in this situation by identifying and limiting the variability involved, as well as projecting outcomes with high probability. After constructing a probabilistic model, we can use correlation and regression to study the relationship between variables and solve the prediction problem. Furthermore, the significance of decisions based on experimental and observed data is validated using hypothesis testing. Discerete-transform concepts can also be used to solve difference equations, which can then be used to model discrete time systems.

## Prerequisite

Nil

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the concept of probability, conditional probability to solve problems in the field of science and technology. | TPS3 | B | 85 |
| CO2 | Computing expectation, variance, moments and moment generating functions of random variables. | TPS3 | B | 85 |
| CO3 | Modelling and solving science and engineering problems using discrete probability distributions. | TPS3 | B | 85 |
| CO4 | Modelling and solving science and engineering problems using continuous probability distributions. | TPS3 | B | 85 |
| CO5 | Apply the test of hypothesis and ANOVA for small and large samples to make decisions based on observed and experimental data. | TPS3 | B | 85 |
| CO6 | Model discrete time system using difference equation and solve it by applying Discrete transform techniques. | TPS3 | B | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO2. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO3. | S | M | L | | M | L | | L | M | L | | M | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | S | M | L | | M | L | | L | M | L | | M | M | L | L |
| CO5 | S | M | L | | M | L | | L | M | L | | M | M | L | L |
| CO6 | S | M | L | | M | | | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CAT 1 (%) | | | Assignment 1 (%) | | | CAT 2 (%) | | | Assignment 2 (%) | | | | | |
| TPS | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |
| **CO1** | - | 5 | 20 | - | - | 28 | - | - | - | - | - | - | | 6 | 10 |
| **CO2** | 7 | 10 | 20 | - | - | 44 | - | - | - | - | - | - | | 6 | 12 |
| **CO3** | 3 | 5 | 20 | - | - | 28 | - | - | - | - | - | - | | 3 | 10 |
| **CO4** | - | 10 | - | - | - | - | - | 10 | | | | 20 | | 3 | 10 |
| **CO5** | - | - | - | - | - | - | 7 | 10 | 30 | | | 40 | | 6 | 14 |
| **CO6** | - | - | - | - | - | - | 3 | 10 | 30 | | | 40 | | 6 | 14 |
| **TOTAL** | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Probability:** Sample space - Events and their Probabilities-Rules of Probability-Combinatorics-Conditional probability and independence – Baye’s theorem.

**Random Variables and Their Distributions:** Distribution of a random variable- Expectation- Expectation of a function-Variance and standard deviation – Probability density function- Expectation and variance-Moments-Moments generating functions.

**Discrete Random Variables and Their Distributions:** Bernoulli distribution -Binomial distribution -Negative Binomial distribution -Poisson distribution.

**Continuous Random Variables and Their Distributions:** Uniform distribution- Exponential distribution – Gamma distribution - Normal distribution.

**Testing of Hypotheses:** Hypotheses and test procedures – Z tests for Hypotheses about a population mean – The one sample t Test– Z tests for a difference between two population means – The twosample t Test – Analysis of paired data – inferences concerning two population variances- Single Factor ANOVA.

**Discrete Transforms:** The Z-transform – Properties of the Z-transform -The Inverse Z transform – Discrete Fourier transform - Discrete time systems and difference equations.

**Text Book**

1. Michael Baron., "Probability and Statistics for Computer Scientists" Second Edition, CRC Press, 2014.
2. Jay. L. Devore., "Probability and Statistics for Engineering and the Sciences", Ninth Edition, Cengage Learning, 2014.
3. Glyn James and Phil Dyke., "Advanced Modern Engineering Mathematics", Fifth Edition, Pearson Education Limited, 2018.

**Reference Books**

1. Douglas C. Montgomery., George C. Runger., "Applied Statistics and Probability for Engineers" Seventh Edition, 2018.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers., "Probability & Statistics for Engineers & Scientists", Ninth Edition, 2012.
3. Mendenhall, William, Robert J. Beaver, Barbara M. Beaver., "Introduction to probability and Statistics" Fifteenth Edition, 2019.
4. Introduction to Probability and Statistics for Engineers and Scientists, Sheldon M. Ross., USA,Elsevier, Fifthedition,2014.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of. Lectures |
|---|---|---|
| **1** | **Introduction to Probability** | |
| 1.1 | Sample space, Events and their Probabilities | 1 |
| 1.2 | Rules of Probability | 1 |
| 1.3 | Combinatorics | 1 |
| | Tutorial | 1 |
| 1.4 | Conditional probability and independence | 1 |
| 1.5 | Baye's theorem | 1 |
| | Program Using Python / Matlab | |
| | | |
| **2** | **Random Variables and Their Distributions** | |
| 2.1 | Distribution of a random variable | 1 |
| | Tutorial | 1 |
| 2.2 | Expectation, Expectation of a function | 1 |
| 2.3 | Variance and standard deviation | 1 |
| 2.4 | Probability density function, Expectation and variance | 1 |
| | Tutorial | 1 |

| | | |
|---|---|---|
| 2.5 | Moments | 1 |
| 2.6 | Moments generating functions | 2 |
| | Program Using Python / Matlab | |
| | | |
| **3** | **Discrete Random Variables and Their Distributions** | |
| 3.1 | Bernoulli Distribution | 1 |
| | Tutorial | 1 |
| 3.2 | Binomial distribution | 1 |
| 3.3 | Negative Binomial distribution | 1 |
| 3.4 | Poisson distribution | 1 |
| | Tutorial | 1 |
| | Program Using Python / Matlab | |
| | | |
| **4** | **Continuous Random Variables and Their Distributions** | |
| 4.1 | Uniform distribution | 1 |
| 4.2 | Exponential distribution | 1 |
| 4.3 | Gamma distribution | 1 |
| | Tutorial | 1 |
| 4.4 | Normal distribution | 2 |
| | Program Using Python / Matlab | |
| | | |
| **5** | **Testing of Hypotheses** | |
| 5.1 | Hypotheses and test procedures | 1 |
| | Tutorial | 1 |
| 5.2 | Z tests for Hypotheses about a population mean | 1 |
| 5.3 | The one sample t test | 1 |
| 5.4 | Z tests for a differencebetween two population means | 1 |
| | Tutorial | 1 |
| 5.5 | The two-Sample t Test | 1 |
| 5.6 | Analysis of paired data | 1 |
| 5.7 | Inferences concerning two population Variances | 1 |
| 5.8 | Single factor ANOVA | 1 |
| | Tutorial | 1 |
| | Program Using Python / Matlab | |
| | | |
| **6.** | **Discrete Transforms** | |
| 6.1 | The Z-transform | 1 |
| 6.2 | Properties of Z-transform | 2 |
| | Tutorial | 1 |
| 6.3 | The Inverse Z-transform | 2 |
| 6.4 | Discrete Fourier transform | 1 |
| | Tutorial | 1 |
| 6.5 | Discrete time systems and difference equations | 2 |
| 6.6 | Tutorial | 1 |
| | Program Using Python / Matlab | |

| | | |
|---|---|---|
| | Total | 48 |

**Course Designer(s):**

1. Dr.C.S.Senthilkumar kumarstays@tce.edu
2. Dr.P.Krishnapriya pkamat@tce.edu
3. Dr.P.Victor pvmat@tce.edu

| 22CS320 | THEORY AND DESIGN OF PROGRAMMING LANGUAGES | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | ESC | 3 | 0 | 0 | 3 |

## Preamble

This course is a fundamental course on programming principles. It gives an overview of different programming paradigms. It deals with the concepts common in various imperative programming languages and declarative programming languages. The course also covers the use of parallelism in programming. The principles of programming are dealt with the case study of programming languages C, Java, Ada, Haskell, Prolog and JavaScript.

## Prerequisite

22CS240 – Problem Solving and Programming

22CS250 – System Programming

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Solve engineering problems using Sequential Procedural Programming Paradigm (CO1) | TPS3 | B | 80 |
| CO2 | Solve engineering problems using Sequential Object Programming Paradigm (CO2) | TPS3 | B | 80 |
| CO3 | Solve engineering problems using Concurrent Programming Paradigm (CO3) | TPS3 | B | 80 |
| CO4 | Solve engineering problems using Functional Programming Paradigm (CO4) | TPS3 | B | 80 |
| CO5 | Solve engineering problems using Logic Programming Paradigm (CO5) | TPS3 | B | 80 |
| CO6 | Develop scripts for given specification using web scripting paradigm (CO6) | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | | | L | L | L | | L | M | | |
| CO2. | S | M | L | | M | | | L | L | L | | L | M | | |
| CO3. | S | M | L | | M | | | L | L | M | | L | M | | L |
| CO4. | S | M | L | | M | | | L | L | L | | L | M | | |
| CO5. | S | M | L | | M | | | L | L | M | | L | M | | L |
| CO6. | S | M | L | | M | | | L | L | M | | L | M | | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Assignment 1 | CAT2 | | | | | | Assignment 2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | - | 15 | - | - | - |
| CO2 | 10 | 10 | 15 | - | - | - | 40 | - | - | - | - | - | - | - | - | 5 | 15 | - | - | - |
| CO3 | 10 | 10 | 10 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | - | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | 30 | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | 50 | 2 | - | 15 | - | - | - |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**The Imperative Programming Paradigm:** Basics of Programming Paradigms, Expression Semantics, Data Semantics, Imperative Design principles – Structured, Turing Complete, Modularity, Procedural abstraction, Structured Theorem - Sequencing, Selection, Iteration and Recursion.

**Sequential Programming - Procedural Programming Paradigm**: Procedures, Parameter passing, Procedural abstraction, Case Study - C Programming.

**Sequential Programming - Object Oriented Programming Paradigm**: OOP design principles - Groupings of Data and Operations, Encapsulation, Data Abstraction, Inheritance and Polymorphism, Exceptions, Case Study - Java Programming.

**Concurrent Programming Paradigm:** Concurrency design with interleaving of process, Safe Access to Shared Data – Semaphore, Liveness property of concurrent programs - Case Study - Concurrency in ADA.

**Functional Programming Paradigm:** Declarative programming design – Functional and logic paradigm, Basics of Functional programming paradigm, Expressions – Syntax, Parsing, Types and Values, Assigning names to expressions, Lambda Calculus fundamentals, Function Abstraction and Recursive Functions - Case Study Haskell.

**The Logic Programming Paradigm:** Clauses and Predicates, Operations and Arithmetic, List and Operations, Unification and Backtracking, Case Study – Prolog.

**Scripting Paradigm:** – Basics of Web design language and Scripting Language, Case Study: JavaScript – Syntax of writing JavaScript, Variables and Functions.

## Text Book


1. Michael L. Scott, "Programming Language Pragmatics", Fourth Edition, Morgan Kaufmann, 2016.
2. Seyed Mohamed Buhari, "Principles of Programming Languages A Paradigm approach", Tata McGraw-Hill, 2011.
3. Ravi Sethi, "Programming Languages: Concepts and Constructs", AT&T Bell Laboratories, 2nd edition, Addison Wesley, 2007.
4. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000.
5. David A.Watt, "Programming Language Concepts and Paradigms", Prentice Hall, 1990.

6. Bruce J. Maclennan, “Principles of Programming Languages: Design, Evaluation and Implementation”, Second Edition.

## Reference Books & web resources

1. Minh Quang Tran, “The Art of Functional Programming Paradigm”, 2022.
2. Alejandro Serrano Mena, “Practical Haskell: A Real-World Guide to Functional Programming”, Apress Media, 2019.
3. Axel Rauschmayer, “Speaking JavaScript”, O’Reilly Media, 2015.
4. Max Bramer, "Logic Programming with Prolog", Springer 2005.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **The Imperative Programming Paradigm** | |
| 1.1 | Basics of Programming Paradigms, Expression Semantics, Data Semantics, Imperative Design principles – Structured, Turing Complete, Modularity, Procedural abstraction | 2 |
| 1.2 | Structured Theorem - Sequencing, Selection, Iteration and Recursion. | 1 |
| **2** | **Sequential Programming - Procedural Programming Paradigm** | |
| 2.1 | Procedures, Parameter passing, Procedural abstraction | 1 |
| 2.2 | Case Study - C Programming. | 2 |
| **3** | **Sequential Programming - Object Oriented Programming Paradigm** | |
| 3.1 | OOP design principles - Groupings of Data and Operations, Encapsulation, Data Abstraction | 1 |
| 3.2 | OOP design principles - Inheritance and Polymorphism, Exceptions | 2 |
| 3.3 | Case Study - Java Programming | 2 |
| **4** | **Concurrent Programming Paradigm** | |
| 4.1 | Concurrency design with interleaving of process | 1 |
| 4.2 | Safe Access to Shared Data – Semaphore | 2 |
| 4.3 | Liveness property of concurrent programs | 2 |
| 4.4 | Case Study - Concurrency in ADA. | 2 |
| **5** | **Functional Programming Paradigm** | |
| 5.1 | Declarative programming design – Functional and logic paradigm, Basics of Functional programming paradigm, Expressions – Syntax, Parsing, Types and Values, Assigning names to expressions | 2 |
| 5.2 | Lambda Calculus fundamentals | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 5.3 | Function Abstraction and Recursive Functions | 1 |
| 5.4 | Case Study Haskell. | 2 |
| **6** | **The Logic Programming Paradigm** | |
| 6.1 | Clauses and Predicates & Operations and Arithmetic | 1 |
| 6.2 | List and Operations, Unification and Backtracking, | 2 |
| 6.3 | Case Study – Prolog | 2 |
| **7** | **Scripting Paradigm** | |
| 7.1 | Basics of Web design language and Scripting Language | 2 |
| 7.2 | Case Study: JavaScript – Syntax of writing Java Script | 2 |
| 7.3 | Variables and Functions in JavaScript | 2 |
| | Total | 36 |

**Course Designer(s):**

1. G.Madhupriya, Associate Professor,CSE gmadhupriya@tce.edu
2. M.Suguna, Assistant Professor, CSE mscse@tce.edu

| **22CS330** | **OBJECT ORIENTED PROGRAMMING** |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 3 | 0 | 0 | 3 |

## Preamble

This syllabus is intended for Computer Science Engineering students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The syllabus emphasizes OOP concepts, Functions, Polymorphism, Inheritance and I/O. The intention is to provide sufficient depth in these topics to enable students to apply Object Oriented approach to programming. The modules in the syllabus reflect solving general problems via programming solutions. Thus, modules collectively focus on programming concepts, strategies and techniques; and the application of these toward the development of programming solutions.

## Prerequisite

Programming fundamentals

## Course Outcomes

Upon the successful completion of the course, students will be able to

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them. | TPS3 | B | 80 |
| CO2 | Demonstrate Compile-time and Run-time polymorphism using object oriented programs | TPS3 | B | 80 |
| CO3 | Illustrate the relationships between objects using inheritance hierarchies and aggregation | TPS3 | B | 80 |
| CO4 | Develop Object Oriented programs to handle data using Java collections, Files and Object Serialization | TPS3 | B | 80 |
| CO5 | Develop Object Oriented programs to handle exceptions | TPS3 | B | 80 |
| CO6 | Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming. | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | M | | L | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO4 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO5 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO6 | S | M | L | | L | L | | L | M | M | | L | M | L | L |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| **CO** | **CAT1** | | | | | | **CAT2** | | | | | | **Assignment** | | **Terminal** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | **1** | **2** | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | | 10 | | | | | | | | | | 20 | | 2 | 4 | 10 | | | |
| CO2 | 10 | 10 | 10 | | | | | | | | | | 40 | | 2 | 4 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | 40 | | 4 | 4 | 10 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | 30 | 4 | 4 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 10 | | | | | 30 | 4 | 4 | 10 | | | |
| CO6 | | | | | | | 10 | 20 | 20 | | | | | 40 | 4 | | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

**Syllabus**

**Basics of Object oriented Programming** Object oriented programming and its benefits - Object oriented programming concepts: Encapsulation, Information hiding and Abstraction – Generalization/Specialization and Polymorphism - Object oriented design: finding the Classes and their Responsibilities – Object oriented programming language: Java-

**Classes and Objects** Instance fields and Methods-Constructors–Passing Arguments to a Method – Returning Value from a Method – Method overloading –Constructor overloading-Passing Arrays as Arguments to Methods – Passing Objects to Methods- Returning Objects from Methods

**Class collaborations and Polymorphism** Object oriented Design: Class Collaborations – Aggregation –Composition –Chains of Inheritance – Overriding Super class methods – Abstract Classes and Abstract Methods – Interfaces

**I/O Handling and Exception Handling –** Binary files – Random-Access files- Object serialization – Exception handling

**Collection Framework** in Java – Introduction to java collections, Overview of java collection framework, commonly used collection classes- Array List, Vector, Hash table, Stack

**Event-Driven Programming Concurrent Programming Network programming –** Text-related GUI components – other GUI components – Handling mouse events and button events – Thread life cycle and methods – Runnable interface – Thread Synchronization – Basics of network programming

## Text Book

1. Herbert Schildt: "Java: The Complete Reference", Twelfth Edition, McGraw-Hill, 2021.
2. Tony Gaddis, "Starting Out with Java: From Control Structures through Objects", Sixth edition, Pearson Education Limited, 2016.
3. Bart Baesens, Aimee Backiel, SeppevandenBroucke, "Beginning Java Programming:The Object-Oriented Approach", John Wiley & Sons, 2015.
4. Kenneth L. Calvert and Michael J. Donahoo, "TCP/IP Sockets in Java: Practical Guide for Programmers", 2nd Edition. Elsevier, 2011.
5. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, Kelli Houston" Object Oriented Analysis and Design with Applications", Third Edition, 2012.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Hours |
|---|---|---|
| 1 | **Basics of Object oriented Programming (6)** | |
| 1.1 | Object oriented programming and its benefits | 1 |
| 1.2 | Object oriented programming concepts: Encapsulation, Information hiding and Abstraction, Generalization/Specialization and Polymorphism | 1 |
| 1.3 | Object oriented design: finding the Classes and their Responsibilities | 2 |
| 1.4 | Object oriented programming language: Java | 1 |
| 1.5 | Object oriented programming language: C++ | 1 |
| 2 | **Classes and Objects (6)** | |
| 2.1 | Instance fields and Methods-Constructors | 1 |
| 2.2 | Passing Arguments to a Method – Returning Value from a Method - Method overloading | 2 |
| 2.3 | Constructor overloading | 1 |
| 2.4 | Passing Arrays As Arguments to Methods | 1 |
| 2.5 | Passing Objects to Methods, Returning Objects from Methods | 1 |
| 3 | **Class collaborations and Polymorphism (6)** | |
| 3.1 | Object oriented Design: Class Collaborations | 1 |
| 3.2 | Aggregation –Composition | 1 |
| 3.3 | Chains of Inheritance | 1 |
| 3.4 | Overriding Super class methods | 1 |
| 3.5 | Abstract Classes and Abstract Methods | 1 |
| 3.6 | Interfaces | 1 |
| 4 | **I/O Handling and Exception Handling (5)** | |
| 4.1 | Binary files | 1 |
| 4.2 | Random-Access files | 1 |
| 4.3 | Object serialization | 1 |
| 4.4 | Exception handling | 2 |
| 5 | **Collection Framework (6)** | |

| | | |
|---|---|---|
| 5.1 | Introduction to java collections | 1 |
| 5.2 | Overview of java collection framework | 1 |
| 5.3 | Collection classes - Array List, Vector | 2 |
| 5.4 | Collection classes - Hash table, Stack | 2 |
| 6 | **Event-Driven Programming Concurrent Programming Network programming (7)** | |
| 6.1 | Frameworks | 1 |
| 6.2 | Text-related GUI components, other GUI components | 1 |
| 6.3 | Handling mouse events and button events | 1 |
| 6.4 | Thread life cycle and methods | 1 |
| 6.5 | Runnable interface | 1 |
| 6.6 | Thread Synchronization | 1 |
| 6.7 | Basics of network programming | 1 |

**Course Designer(s):**

1. Dr M.Vijayalakshmi, Professor, CSE – mviji@tce.edu
2. Mr S.Santhana Hari, Assistant Professor, CSE – sshcse@tce.edu

| 22CS340 | DATA STRUCTURES AND ALGORITHMS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

This course will cover various data structures and their operations for manipulating them. Students will learn how to organize the data so that, the data can be accessed and updated efficiently using computer programs.

## Prerequisite

22CS240 : Problem Solving and Programming

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply linked list including singly, double and circular list for solving problems | TPS3 | B | 70 |
| CO2 | Use linear data structure including stack, queue and deque operations to solve a given problem | TPS3 | B | 70 |
| CO3 | Choose appropriate binary non-linear data structure including binary search tree, AVL tree, splay tree for performing searching operations in trade-off with time complexity. | TPS4 | B | 70 |
| CO4 | Apply multiway non-linear data structure including B-tree and tries to solve problems | TPS3 | B | 70 |
| CO5 | Demonstrate the concepts of advanced data structures including heap in various applications | TPS3 | B | 70 |
| CO6 | Analyse linear, binary and hashing algorithms for searching including collision-resolving methods in hashing technique. | TPS4 | B | 70 |
| CO7 | Demonstrate the efficiency of sorting algorithms | TPS3 | B | 70 |
| CO8 | Explore methods for maintaining disjoint set data structure that supports union and find set operations | TPS3 | B | 70 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO2 | S | M | L | | L | | | M | M | M | | M | M | | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 3 | S | S | M | L | L | | | M | M | M | | M | M | L | M |
| CO 4 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO 5 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO 6 | S | S | M | L | L | | | M | M | M | | M | M | L | M |
| CO 7 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO 8 | S | M | L | | L | | | M | M | M | | M | M | | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| **CO** | **CAT1** | | | | | | **Assignment-1** | **CAT2** | | | | | | **Assignment-2** | **Terminal** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 4 | | 20 | | | | 20 | | | | | | | | 2 | | 10 | | | |
| CO2 | 2 | 5 | 20 | | | | 30 | | | | | | | | 2 | | 10 | | | |
| CO3 | 4 | | | 20 | | | 30 | | | | | | | | 2 | | | 10 | | |
| CO4 | | 5 | 20 | | | | 20 | | | | | | | | 2 | 2 | 10 | | | |
| CO5 | | | | | | | | 4 | | 20 | | | | 20 | 2 | 2 | 10 | | | |
| CO6 | | | | | | | | 4 | | | 20 | | | 30 | | 2 | | 10 | | |
| CO7 | | | | | | | | | 5 | 20 | | | | 30 | | 2 | 10 | | | |
| CO8 | | | | | | | | 2 | 5 | 20 | | | | 20 | | 2 | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**INTRODUCTION TO ABSTRACT DATA TYPES AND ANALYSIS:**
Abstract Data Types (ADT) - Basic concept of Data Structures - Performance measures for Data Structures - Time and Space Complexity Asymptotic Measures - Big-Oh, Omega, Theta.

**LINKED LISTS:**
Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists – Josephus Problem – Palindrome Checking.

**STACKS AND QUEUES:**
Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions - Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQue – Applications of Queues – Scheduling

**TREES:**
Tree ADT – Tree Terminologies – Tree Traversals – Tree representation and properties - Binary Tree ADT – Types of Binary Tree - Applications of Binary Tree - Expression trees – Priority Queue

(Heaps) – Binary Heap – Leftist Heap – Binomial Queue – Applications of Heap – Huffman Coding, Heap Sort.
Binary Search Tree ADT – AVL Trees – Red Black Trees – Splay Trees

**MULTIWAY SEARCH TREES:**
Multiway Search Trees - B-Tree - Tries - Standard Tries - Compressed Tries - Suffix Trees – Linear Construction of Suffix Trees - Application on Tries - Longest Prefix – Binary Tries (PATRICIA Structure) - Pattern Searching
**DISJOINT SETS:**
Disjoint-set operations - Representation – Smart union algorithms – Path Compression
**SEARCHING, SORTING AND HASHING TECHNIQUES**
Sorting - Insertion sort – Shell sort –. Merge Sort – External Sorting - The Simple Algorithm - Multiway Merge – Polyphase Merge - Replacement Selection. Searching – Linear Search – Binary Search - Hashing - Hash functions – Division Method, Multiplication Method, Mid-Square Method, Folding Method - Collision resolution and overflow handling techniques - Open Hashing (Separate Chaining) - Open Addressing / Closed Hashing - Linear, Quadratic, Double, Rehashing - Extendible Hashing

## Text Books

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007

## Reference Books & web resources

1. Langsam, Augenstein and Tanenbaum, Data Structures Using C and C++, 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.
3. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft ,Data Structures and Algorithms, 1st edition, Pearson, 2002.
4. Kruse, Data Structures and Program Design in C, 2nd Edition, Pearson Education, 2006.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **INTRODUCTION TO ABSTRACT DATA TYPES AND ANALYSIS** | |
| 1.1 | Review of elementary data types and structures in C | 1 |
| 1.2 | Abstract Data Types (ADT)-Basic concept of Data Structures-Performance measures for Data Structures | 1 |
| 1.3 | Time and Space Complexity Asymptotic Measures - Big-Oh, Omega, Theta. | 1 |
| **2** | **LINKED LISTS** | |
| 2.1 | Abstract Data Types (ADTs) – List ADT – Array-based implementation- Linked list implementation | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.2 | Singly linked lists – Circularly linked lists | 1 |
| 2.3 | Doubly-linked lists | 1 |
| 2.4 | Applications of lists – Polynomial ADT – Radix Sort | 1 |
| 2.5 | Multilists – Josephus Problem – Palindrome Checking. | 1 |
| **3** | **STACKS AND QUEUES** | |
| 3.1 | Stack ADT – Operations | 1 |
| 3.2 | Applications – Balancing Symbols – Evaluating arithmetic expressions- Infix to Postfix conversion – Function Calls | 1 |
| 3.3 | Queue ADT – Operations – Circular Queue | 1 |
| 3.4 | DeQue – Applications of Queues – Scheduling | 1 |
| **4** | **TREES** | |
| 4.1 | Tree ADT – Tree Terminologies – Tree Traversals – Tree Representation | 1 |
| 4.2 | Binary Tree ADT – Types of Binary Tree | 1 |
| 4.3 | Applications of Binary Tree - Expression trees | 1 |
| 4.4 | Priority Queue (Heaps) – Binary Heap- Leftist Heap – Binomial Queue | 1 |
| 4.5 | Applications of Heap – Huffman Coding, Heap Sort. | 1 |
| 4.6 | Binary Search Tree ADT – AVL Trees | 1 |
| 4.7 | Red Black Trees – Splay Trees | 1 |
| **5** | **MULTIWAY SEARCH TREES** | |
| 5.1 | Multiway Search Trees - B-Tree | 1 |
| 5.2 | Tries - Standard Tries - Compressed Tries | 1 |
| 5.3 | Suffix Tries – Ukkonen's Algorithm- Application on Tries - Longest Prefix – Binary Tries (PATRICIA Structure) - Pattern Searching | 2 |
| **6** | **SEARCHING, SORTING AND HASHING TECHNIQUES** | |
| 6.1 | Searching – Linear Search – Binary Search | 1 |
| 6.2 | Sorting –Insertion sort- Shell sort –. Merge Sort | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.3 | External Sorting - The Simple Algorithm - Multiway Merge - Replacement Selection | 1 |
| 6.4 | Hashing - Hash functions – Division Method, Multiplication Method | 1 |
| 6.5 | Mid-Square Method, Folding Method | 1 |
| 6.6 | Collision resolution and overflow handling techniques - Open Hashing (Separate Chaining) | 1 |
| 6.7 | Open Addressing / Closed Hashing - Linear, Quadratic, Double, Rehashing - Extendible Hashing | 1 |
| 7 | **GRAPHS** | |
| 7.1 | Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS | 2 |
| 7.2 | Applications - Connectivity, strong connectivity, bi-connectivity | 1 |
| 7.3 | Topological sort, Euler circuits | 1 |
| 7.4 | Minimum spanning tree-Kruskal's and Prim's algorithm | 1 |
| | **Total** | **36** |

## Course Designer(s):

1. Dr.M.K.KavithaDevi, Professor,CSE mkkdit@tce.edu
2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

| 22CS360 | OPERATING SYSTEMS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 3 | 0 | 2 | 4 |

## Preamble

This course has two components: a theory component is to teach the concepts and principles that underlie modern operating systems. Students will learn about processes and processor management, concurrency and synchronization, memory management schemes, filesystem, secondary storage management and security measures. The practical component of this course will relate theoretical principles with operating system implementation.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Practice the following terms in context of operating systems: Evolution, Types, Structure, Functions and components | TPS3 | 70 | 70 |
| CO2 | Choose the best design and evaluate the trade-offs of various modern operating systems | TPS3 | 70 | 70 |
| CO3 | Examine the given scenario to implement processor scheduling and synchronization algorithms | TPS4 | 70 | 70 |
| CO4 | Construct solutions for problems related to deadlocks in a multi-programmed operating system | TPS3 | 70 | 70 |
| CO5 | Develop appropriate solutions to solve problems related to primary and secondary memory management. | TPS3 | 70 | 70 |
| CO6 | Implement the disk allocation algorithms and identify the security measures for a given scenario | TPS3 | 70 | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | L | | M | M | L | L | L | M | L | M |
| CO2 | S | M | L | | | L | | L | L | L | L | L | M | L | L |
| CO3 | S | S | M | L | M | | L | L | M | L | L | L | M | L | L |
| CO4 | S | S | M | L | M | | L | L | M | L | L | L | M | L | L |
| CO5. | S | M | L | | M | | L | L | M | L | L | L | M | L | L |
| CO6 | S | M | L | | M | | L | L | M | L | L | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1(Theory Component) | | | | | | CAT 2(Theory Component) | | | | | | Model (Lab Component) | | | | OCR | | | | Terminal (Theory Component) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | | | | | | 100 | | | | | | 100 | | | | 100 | | | | 100 | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | 10 | | | | | | | | | | | | | | | | | | | 4 | 6 | | | | |
| CO2 | | 20 | | | | | | | | | | | | | | | | | | | 5 | 5 | | | | |
| CO3 | | | 40 | 30 | | | | | 20 | | | | | | 20 | | | | 20 | | | 5 | 10 | 5 | | |
| CO4 | | | | | | | | | 30 | | | | | | 20 | 10 | | | 20 | 10 | | 5 | 15 | | | |
| CO5 | | | | | | | | | 30 | | | | | | 30 | | | | 30 | | | 5 | 15 | | | |
| CO6 | | | | | | | | | 20 | | | | | | 20 | | | | 20 | | | 5 | 15 | | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.**

## Syllabus

**Introduction:** Role of OS, Types of OS - Batch Systems, Multiprogramming, Time Sharing, Distributed & Real time OS, System Architecture, System components - OS Services, System Calls, System Programs, System Design, Design Trade-offs.

**Process Management**: Concepts - Process status, Process description, Process model, Process Scheduling - Scheduler organization, pre-emptive and non-pre-emptive scheduler strategies, Scheduling algorithms - FCFS, SJF, SRTF, Priority Scheduling, Round Robin Scheduling, Multiple Processor scheduling, Thread Concepts and Multiple threaded OS.

**Process Synchronization and Deadlock**: Process Co-operation, Inter-process communication, Process Synchronization, Synchronization Issues, Critical Section problem, Mutual exclusion, Process Synchronization with semaphores. Deadlock - Conditions, Prevention, Avoidance and Recovery.

**Memory Management and File system:** Paging, Segmentation and Contiguous memory allocation, Virtual Memory - Demand Paging, Page replacement and Frame Allocation policies, Thrashing, File System - Concepts, Access Method, Directory Structure and File System Management.

**Disk management and Security**: Disk management - Disk Structure and Scheduling, File systems and operating system support for distributed systems, Security- Protection Goals, Access Control, Program threats, System threats.

**Advanced Operating Systems:** Needs & Design Goals – Distributed OS, Multiprocessor OS, Mobile OS, MAC OS.

## Learning Resources

1. AviSilberschatz, Peter Baer Galvin and Greg Gagne: Operating System Concepts, Ninth edition, John Wiley and Sons, 2012.

2. Advanced Concepts in Operating Systems, MukeshSinghal, Niranjan G. Shivaratri, Tata McGraw-Hill Edition 2001.

3. Andrew S. Tanenbaum, Albert S.WoodHull: Operating Systems, Design and Implementation, Fourth Edition, Prentice Hall, 2008.

4. Gary Nutt, "Operating Systems", Third Edition, Addison Wesley, 2004

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| **1** | **Introduction (7)** | | |
| 1.1 | Role of OS | 1 | CO1 |
| 1.2 | Types of OS | 2 | CO1 |
| 1.3 | System Architecture | 1 | CO1 |
| 1.4 | System components | 1 | CO1 |
| 1.5 | System Design | 1 | CO2 |
| 1.6 | Design Trade-offs | 1 | CO2 |
| **2** | **Process Management (10)** | | |
| 2.1 | Concepts - Process status, Process description, Process model | 2 | CO3 |
| 2.2 | Process Scheduling - Scheduler organization, pre-emptive and non-pre-emptive scheduler strategies | 2 | CO3 |
| 2.3 | Scheduling algorithms- FCFS, SJF, SRTF, Priority Scheduling, Round Robin Scheduling, Multiple Processor scheduling | 4 | CO3 |
| 2.4 | Thread Concepts and Multiple threaded OS | 2 | CO3 |
| **3** | **Process Synchronization and Deadlock (9)** | | |
| 3.1 | Process Co-operation | 1 | CO3 |
| 3.2 | Inter-process communication | 1 | CO3 |
| 3.3 | Process Synchronization | 1 | CO3 |
| 3.4 | Synchronization Issues | 1 | CO3 |
| 3.5 | Critical Section problem | 1 | CO3 |
| 3.6 | Mutual exclusion | 1 | CO3 |
| 3.7 | Semaphores | 1 | CO3 |
| 3.8 | Deadlock - Conditions, Prevention, Avoidance and Recovery. | 2 | CO4 |
| **4** | **Memory Management and File system (4)** | | |
| 4.1 | Paging | 1 | CO5 |
| 4.2 | Segmentation and Contiguous memory allocation | 1 | CO5 |
| 4.3 | Virtual Memory - Demand Paging, Page replacement and Frame Allocation policies, Thrashing | 1 | CO5 |
| 4.4 | File System - Concepts, Access Method, Directory Structure and File System Management | 1 | CO5 |
| **5** | **Disk management and Security (3)** | | |
| 5.1 | Disk Structure and Scheduling | 1 | CO6 |
| 5.2 | File systems and operating system support for distributed systems | 1 | CO6 |
| 5.3 | Security measures | 1 | CO6 |
| **6** | **Advanced Operating Systems (3)** | | |
| **6.1** | Needs & Design Goals – Distributed OS, Multiprocessor OS, Mobile OS, MAC OS. | 3 | CO2 |
| | **Total Hours** | **36** | |

**List of Experiments**

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| 1. | Experiment to implement the following CPU scheduling algorithms a) FCFS b) SJF c) Round Robin d) Priority | 4 | CO3 |
| 2. | Program to implement producer – consumer problem using semaphores | 2 | CO3 |
| 3. | Program to implement Dining-philosophers problem | 2 | CO3 |
| 4. | Program to implement InterProcess Communication Using Pipes | 2 | CO3 |
| 5. | Program to implement the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit. | 2 | CO4 |
| 6. | Program to implement Bankers Algorithm for Dead Lock Avoidance. | 2 | CO4 |
| 7. | Program to implement Bankers Algorithm for Dead Lock Prevention | 2 | CO4 |
| 8. | Simulate all page replacement algorithms a) FIFO b) LRU c) OPTIMAL | 2 | CO5 |
| 9. | Simulate all File Organization Techniques a) Single level directory b) Two level directory | 2 | CO5 |
| 10. | Simulate all file allocation strategies a) Sequential b) Indexed c) Linked. | 2 | CO5 |
| 11. | Program to simulate disk scheduling algorithms. a) FCFS b) SCAN c) C-SCAN | 2 | CO6 |
| | **Total Hours** | **24** | |

**Course Designers:**


1. Dr. K. NarasimhaMallikarjunan, Associate Professor, CSE arjunkambaraj@tce.edu
2. Ms. C.Santhiya ,Assistant Professor , CSE csit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS370** | **DATA STRUCTURES LAB** | PC | 0 | 0 | 2 | 1 |

## Preamble

With a dynamic learn-by-doing focus, this laboratory course encourages students to explore data structures by implementing them, a process through which students discover how data structures work and their applicability for toy problems. This course challenges students to exercise their creativity in both programming and analysis.

## Prerequisite

22CS240 : Problem Solving using Computers

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Construct and Implement the stack and queue functionality for suitable applications. | TPS3 | A | 75 |
| CO2 | Implement the operations in linked list data structure for suitable applications | TPS3 | A | 75 |
| CO3 | Implement appropriate binary and multiway search tree for performing searching operations, with an understanding of the trade-off between the time and space complexity | TPS3 | A | 75 |
| CO4 | Implement heap tree for various applications | TPS3 | A | 75 |
| CO5 | Show the avoidance of collisions in the hash tables using collision resolution techniques including open and closed hashing techniques. | TPS3 | A | 75 |
| CO6 | Analyse various internal sorting techniques | TPS3 | A | 75 |
| CO7 | Implement of disjoint set and analyse their performance. | TPS3 | A | 75 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |
| CO2 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |
| CO3 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |
| CO 5 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |
| CO 6 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |
| CO 7 | S | M | L | | M | L | L | L | L | L | L | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyse | | |
| Evaluate | | |
| Create | | |

## List of Experiments/Activities with CO Mapping

| Module No. | Topic | CO |
|---|---|---|
| 1 | Array and List implementation of Stack, Queue and Circular Queue ADTs | CO1 |
| 2 | Implementation of Evaluating Postfix Expressions, Infix to Postfix conversion using stack | CO1 |
| 3 | Implementation of Josephus Problem using DLL | CO1 |
| 4 | Implementation of Palindrome Checking using Stack and DLL | CO1 |
| 5 | Implementation of Singly Linked List | CO2 |
| 6 | Implementation of Polynomial Manipulation using Linked list | CO2 |
| 7 | Implementation of Binary Search Trees-operations and traversal. | CO3 |
| 8 | Implementation of AVL Trees | CO3 |
| 9 | Implementation of Heaps using Priority Queues | CO4 |
| 10 | Implementation of Open and Closed Hashing | CO5 |
| 11 | Implementation internal sorting algorithms | CO6 |
| 12 | Implementation of disjoint sets with smart union and path compression methods | CO7 |

## Learning Resources


1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007
3. Y. Langsam, M. J. Augenstein and A. N. Tanenbaum, “Data Structure Using C and C++”, Pearson Education, 2nd Edition, 2015.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022.


## Course Designer(s):


1. Dr.M.K.KavithaDevi, Professor,CSE mkkdit@tce.edu
2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

| 22CS380 | OBJECT ORIENTED PROGRAMMING LAB | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

**Preamble**

This syllabus is intended for the Computer science students and enables them to learn Object Oriented Programming and the design of computer solutions in a precise manner. The experiments emphasize on OOP concepts, Functions, Polymorphism, Inheritance, I/O, event- driven, concurrent and network programming. The intention is to provide sufficient depth in these topics to enable candidates to apply Object Oriented Programming approach to programming.

**Prerequisite**

Programming Fundamentals

**Course Outcomes**

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Construct Object oriented programs using methods and passing arrays, objects, and array of objects to them | TPS3 | B | 80 |
| CO2 | Demonstrate Compile-time and Run-time polymorphism using object oriented programs | TPS3 | B | 80 |
| CO3 | Illustrate the relationships between objects using inheritance hierarchies and aggregation | TPS3 | B | 80 |
| CO4 | Develop Object Oriented programs to handle data using Java Collections, Files and Object Serialization | TPS3 | B | 80 |
| CO5 | Develop Object Oriented programs to handle exceptions | TPS3 | B | 80 |
| CO6 | Develop Object Oriented programs to demonstrate event driven programming, concurrent programming and network programming. | TPS3 | B | 80 |

**Mapping with Programme Outcomes and Programme Specific Outcomes**

| Co s | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PO | PS | PS | PS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | O1 | O2 | O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO3 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO4 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO5 | S | M | L | | L | L | | L | M | M | | L | M | L | L |
| CO6 | S | M | L | | L | L | | L | M | M | | L | M | L | L |

S- Strong; M-Medium; L-Low

**Assessment Pattern: Cognitive Domain**

| **Cognitive Levels** | **Model Examination** | **Terminal Examination** |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyse | | |
| Evaluate | | |
| Create | | |

**List of Experiments with CO mapping**

| **Ex. No** | **Experiment** | **CO** |
|---|---|---|
| 1. | Develop Object Oriented Program for passing arguments to a method and returning value from a method | CO1 |
| 2. | Develop Object Oriented Program for passing arrays and objects as arguments to method and returning objects from methods | CO1 |
| 3. | Construct Object Oriented Program for method overloading and constructor overloading | CO2 |
| 4. | Demonstrate aggregation and composition using object-oriented program | CO3 |
| 5. | Develop Object Oriented Program to demonstrate inheritance and overriding super class methods | CO2, CO3 |
| 6. | Develop Object Oriented Program to demonstrate abstract base classes abstract methods | CO3 |
| 7. | Construct Object Oriented Program to demonstrate File handling and Object Serialization | CO4 |
| 8. | Develop Object Oriented Program for manipulation of data using Collections in Java | CO4 |
| 9. | Construct Object Oriented Program to demonstrate exception | CO5 |

| | | |
|---|---|---|
| | handling | |
| 10. | Develop event-driven programs using Java's delegation-based event model | CO6 |
| 11. | Develop concurrent programs using Java threads | CO6 |
| 12. | Develop network applications using Java sockets | CO6 |

**Learning Resources**


1. Herbert Schildt: "Java: The Complete Reference", Twelfth Edition, McGraw-Hill, 2021.
2. Tony Gaddis, "Starting Out with Java: From Control Structures through Objects", Sixth edition, Pearson Education Limited, 2016.
3. Bart Baesens, Aimee Backiel, SeppevandenBroucke, "Beginning Java Programming:The Object-Oriented Approach", John Wiley & Sons, 2015.
4. Kenneth L. Calvert and Michael J. Donahoo, "TCP/IP Sockets in Java: Practical Guide for Programmers", 2nd Edition. Elsevier, 2011.
5. Grady Booch, Robert Maksimchuk, Michael Engel, Bobbi Young, Jim Conallen, KelliHouston"Object Oriented Analysis and Design with Applications", Third Edition, 2012


**Course Designers:**


1. DrM.Vijayalakshmi, Professor, CSE – mviji@tce.edu
2. MrS.Santhana Hari, Assistant Professor, CSE – sshcse@tce.edu

**CURRICULUM AND DETAILED SYLLABI**

**FOR**

**B.E DEGREE (Computer Science and Engineering) PROGRAMME**

**FOURTH SEMESTER**

**FOR THE STUDENTS ADMITTED FROM THE**

**ACADEMIC YEAR 2023 - 2024 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

**FOURTH SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS410 | Discrete Mathematics | BSC | 3 | 1 | - | 4 |
| 22CS420 | Design and Analysis of Algorithms | PC | 3 | - | - | 3 |
| 22CS430 | Data Communication and Networks | PC | 3 | - | - | 3 |
| 22CS440 | Database Management Systems | PC | 3 | - | - | 3 |
| 22CS490 | Project Management | HSS | 3 | - | - | 3 |
| **THEORY CUM PRACTICAL** | | | | | | |
| 22CS450 | Web Programming | PC | 2 | - | 2 | 3 |
| 22EG660 | Professional Communication | HSS | - | 1 | 2 | 2 |
| **PRACTICAL** | | | | | | |
| 22CS470 | Databases Lab | PC | - | - | 2 | 1 |
| 22CS480 | Algorithms Lab | PC | - | - | 2 | 1 |
| **AUDIT COURSE** | | | | | | |
| 22CHAB0 | Constitution of India | AC | - | - | - | - |
| | | **Total** | **17** | **2** | **8** | **23** |

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**
**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**FOURTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS410 | Discrete Mathematics | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS420 | Design and Analysis of Algorithms | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CS430 | Data Communication and Networks | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CS440 | Database Management Systems | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22CS490 | Project Management | 3 | 40 | 60 | 100 | 27 | 50 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6 | 22CS450 | Web Programming | 3 | 50 | 50 | 100 | 22.5 | 50 |
| 7 | 22EG660 | Professional Communication | 3 | 50 | 50 | 100 | 22.5 | 50 |
| **PRACTICAL** | | | | | | | | |
| 8 | 22CS470 | Databases Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| 9 | 22CS480 | Algorithms Lab | 3 | 60 | 40 | 100 | 18 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

| 22CS410 | DISCRETE MATHEMATICS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | BSC | 3 | 1 | 0 | 4 |

## Preamble

A course in discrete mathematics elaborates discrete structures, which are the abstract mathematical structures used to represent discrete objects and relationships between these objects. These discrete structures include logic, predicate calculus, sets, functions, relations groups, rings and fields. An important problem–solving skill is the ability to count or enumerate objects. The discussion of enumeration in this course begins with basic techniques of counting. The general counting methods involve permutations and combinations and generating functions. These methods are very useful in constructing computer programs and in mastering many theoretical topics of computer science.

## Prerequisite

Nil

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the concepts of sets, functions and relations to solve the problems in the field of science and technology. | TPS3 | B | 80 |
| CO2 | Translate statements in english into logical expressions and verify theirequivalences. | TPS3 | B | 80 |
| CO3 | Introduce predicate calculus and apply logic rules of inference to check the validity of the propositional calculus, predicate calculus statements and to prove theorems. | TPS3 | B | 80 |
| CO4 | Apply the concept of recursion in recursive algorithims. | TPS3 | B | 80 |
| CO5 | Apply counting techniques to solve combinatorial problems | TPS3 | B | 80 |
| CO6 | Apply the concept of algebraic structures in coding theory. | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO2. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO3. | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO4 | S | M | L | | M | | | L | M | L | | M | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | S | M | L | | M | | | L | M | L | | M | M | L | L |
| CO6 | S | M | L | | M | | | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CAT 1 (%) | | | Assignment 1 (%) | | | CAT 2 (%) | | | Assignment 2 (%) | | | | | |
| TPS | 1<br>10 | 2<br>30 | 3<br>60 | 1<br>- | 2<br>- | 3<br>100 | 1<br>10 | 2<br>30 | 3<br>60 | 1<br>- | 2<br>- | 3<br>100 | 1<br>- | 2<br>30 | 3<br>70 |
| CO1 | 3 | 10 | 20 | - | - | 40 | - | - | - | - | - | - | | 6 | 12 |
| CO2 | - | 10 | 20 | - | - | 30 | - | - | - | - | - | - | | 3 | 12 |
| CO3 | - | 10 | 20 | - | - | 30 | - | - | - | - | - | - | | 3 | 12 |
| CO4 | 7 | - | - | - | - | - | 3 | - | 14 | - | - | 20 | | 3 | 10 |
| CO5 | - | - | - | - | - | - | 7 | 20 | 30 | - | - | 60 | | 12 | 12 |
| CO6 | - | - | - | - | - | - | - | 10 | 16 | - | - | 20 | | 3 | 12 |
| TOTAL | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |

## Syllabus

**Sets, Relations and Functions:**Set- subsets- set operations – cardinality of sets – Relations and their properties – Representing relations – Equivalence relations. Functions-One-one function - Onto function – Bijective function –Inverse function.

**Propositional calculus and Proof Techniques:** Propositional logic – Applications of propositional logic – propositional equivalences – predicates and quantifiers – Nested quantifier – rules of inferences -Introduction to proofs.

**Recursion:** Recurrence relations, Recursion: Introduction - Recursively defined functions - Recursively defined sets and structures – Structural and general induction – Recursive algorithms.

**Counting:** The basics of counting – The Pigeonhole principle, the generalized Pigeonhole principle – Permutations and Combinations - Applications of recurrence relations - Solving linear recurrence relations: Homogeneous and non-homogeneous – Generating functions – Solving recurrence relations using generating functions.

**Algebraic Structures:** The structure of Algebras- Semigroups, Monoids and Groups, Abelian groups – Homomorphisms – Normal subgroups and congruence relations – Rings, Integral domains and Fields – Quotient and Product algebras – Coding theory – Polynomial codes.

**Text Books**

1. Kenneth H. Rosen., "Discrete Mathematics and Its Applications", 8thEdition, McGraw hill publications, 2019.

**Reference Books& web resources**

1. T.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with application to Computer Science", Tata McGraw Hill, 2017.
2. Alan Tucker, "Applied Combinatorics", John Wiley & Sons, Incorporated, 2012.
3. Ralph P.Grimaldi, "Discrete and Combinatorial Mathematics, Pearson, 2006.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Sets, Relations and Functions** | |
| 1.1 | Set, Subsets set operations, cardinality of sets | 1 |
| 1.2 | Relations and their properties, Representing relations | 1 |
| | Tutorial | 1 |
| 1.3 | Equivalence relations | 2 |
| | Tutorial | 1 |
| 1.4 | Functions: one-one, onto, Bijective, inverse | 2 |
| **2** | **Propositional Calculus and Proof Techniques** | |
| 2.1 | Propositional logic | 1 |
| 2.2 | Applications of propositional logic | 2 |
| | Tutorial | 1 |
| 2.3 | Propositional equivalences | 2 |
| | Tutorial | 1 |
| 2.4 | Predicates and quantifiers | 1 |
| 2.5 | Nested quantifiers | 1 |
| 2.6 | Rules of inferences | 2 |
| 2.7 | Introduction to proofs | 2 |
| | Tutorial | 1 |
| **3** | **Recursion** | |
| 3.1 | Recurrence relations | 1 |
| 3.2 | Recursion: Introduction, recursively defined functions | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | Tutorial | 1 |
| 3.3 | Recursively defined sets and structures, Structural and general induction | 1 |
| 3.4 | Recursive algorithms | 1 |
| | Tutorial | 1 |
| **4** | **Counting** | |
| 4.1 | The basics of counting | 2 |
| 4.2 | The pigeonhole principle, generalized pigeonhole principle, applications of pigeonhole principle | 1 |
| | Tutorial | 1 |
| 4.3 | Permutations and combinations | 2 |
| | Tutorial | 1 |
| 4.4 | Applications of recurrence relations | 1 |
| 4.5 | Solving linear recurrence relations | 2 |
| | Tutorial | 1 |
| 4.6 | Generating functions – Introduction, solve recurrence relations using generating functions. | 2 |
| **5** | **Algebraic Structures** | |
| 5.1 | The structure of algebras | 1 |
| 5.2 | Semigroups, Monoids and Groups, Abelian groups | 1 |
| | Tutorial | 1 |
| 5.3 | Homomorphisms, Normal subgroups, congruence relations | 1 |
| 5.4 | Rings, integral domains and fields, Quotient and product algebras | 1 |
| 5.6 | Coding theory and polynomial codes | 1 |
| | Tutorial | 1 |
| | **Total** | **48** |

## Course Designer(s):


1. Dr. C. S. Senthilkumar kumarstays@tce.edu
2. Dr. P. Victor pvmat@tce.edu
3. Dr. P. Krishnapriya pkamat@tce.edu

| 22CS420 | DESIGN AND ANALYSIS OF ALGORITHMS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

Algorithm design and analysis provide the theoretical backbone of computer science. On completion of this course students will be able to: i) Determine the asymptotic time complexity of algorithms ii) Write rigorous correctness proofs for algorithms iii) Use different paradigms of problem solving to illustrate efficient ways of solving a given problem

## Prerequisite

- 22CS240: Problem Solving and Programming
- 22CS340: Data Structures and Algorithms

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify the problem and its complexity using frameworks like recurrences and amortized analysis. | TPS3 | B | 75 |
| CO2 | Apply graph algorithms to solve problems and analyze their efficiency. | TPS3 | B | 75 |
| CO3 | Analyze algorithm design techniques like divide and conquer, dynamic programming to solve problems. | TPS4 | B | 75 |
| CO4 | Apply design principles for developing solutions using greedy algorithm approaches. | TPS3 | B | 75 |
| CO5 | Use the state space tree method like backtracking and branch & bound techniques for solving problems. | TPS4 | B | 75 |
| CO6 | Determine the significance of NP complete problems and approximation algorithms. | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | S | M | L | | | | | L | M | M | | M | M | | M |
| CO2 | S | M | L | | | | | L | M | M | | M | M | | M |
| CO3 | S | S | M | L | | | | L | M | M | | M | M | | M |
| CO4 | S | M | L | | | | | L | M | M | | M | M | | M |
| CO5 | S | S | M | L | | | | L | M | M | | M | M | | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | S | M | L | | | | | L | M | M | | M | M | | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Assignment-1 | CAT2 | | | | | | Assignment-2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 8 | 5 | 20 | | | | 30 | | | | | | | | 6 | | 10 | | | |
| CO2 | 8 | 5 | 20 | | | | 30 | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 4 | 10 | | 20 | | | 40 | | | | | | | | 2 | 5 | | 10 | | |
| CO4 | | | | | | | | 8 | 5 | 20 | | | | 30 | 2 | 5 | 10 | | | |
| CO5 | | | | | | | | 4 | 10 | | 20 | | | 40 | 2 | 5 | | 10 | | |
| CO6 | | | | | | | | 8 | 5 | 20 | | | | 30 | 6 | | 10 | | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.**

## Syllabus

**INTRODUCTION:**

**Algorithm analysis:** Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – **Amortized Analysis**: Aggregate, Accounting and Potential Method – **Recurrence relation:** substitution method, recursion tree method, Master Theorem – **Searching and sorting algorithms analysis:** linear search, binary search and Insertion sort, heap sort.

**GRAPH ALGORITHMS**

**Elementary Graph algorithms:** Representations of graphs - Breadth-first search - Depth-first search - Topological sort - Strongly connected components - **Minimum spanning tree**: Kruskal's and Prim's algorithm, **Shortest path:** Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm **Network flow:** Flow networks - Ford-Fulkerson method – **Matching:** Maximum bipartite matching

**ALGORITHM DESIGN TECHNIQUES**

**Divide and Conquer methodology:** Find maximum and minimum numbers - Merge sort - Quick sort – Strassen's Matrix Multiplication Algorithm – Karatsuba integer multiplication Algorithm. **Dynamic programming:** Elements of dynamic programming — Matrix-chain multiplication -— Optimal Binary Search Trees – Knapsack Problem. **Greedy Technique:** Elements of the greedy strategy - Activity-selection problem — Huffman Trees – Knapsack Problem.

**STATE SPACE SEARCH ALGORITHMS**

**Backtracking:** n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph coloring problem **Branch and Bound:** Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem

**NP-COMPLETE ALGORITHMS**

**Tractable and intractable problems:** Polynomial time algorithms – Polynomial time verification - Venn diagram representation – NP algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3- CNF problem

## Text Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, SartajSahni, SanguthevarRajasekaran “Computer Algorithms/C++” Orient Blackswan, 2nd Edition, 2019.

## Reference Books & web resources

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, “Design and Analysis of Algorithms”, Oxford university press, 2014.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **INTRODUCTION** | |
| 1.1 | Time and space complexity- Asymptotic Notations and its properties Best case, Worst case and average case analysis | 1 |
| 1.2 | Amortized Analysis: Aggregate, Accounting and Potential Method with example | 1 |
| 1.3 | Recurrence relation: substitution method, Master Theorem | 2 |
| 1.4 | Searching: linear search, binary search and Interpolation Search | 1 |
| 1.5 | Pattern search: The naïve string matching algorithm | 1 |
| 1.6 | Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm | 1 |
| 1.7 | Sorting: Insertion sort – heap sort | 1 |
| **2** | **GRAPH ALGORITHMS** | |
| 2.1 | Shortest path: Bellman-Ford algorithm | 1 |
| 2.2 | Dijkstra’s algorithm - Floyd-Warshall algorithm | 2 |
| 2.3 | Network flow: Flow networks - Ford-Fulkerson method | 1 |
| 2.4 | Matching: Maximum bipartite matching | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **3** | **ALGORITHM DESIGN TECHNIQUES** | |
| 3.1 | Divide and Conquer methodology: Finding maximum and minimum - Merge sort, Quick sort | 2 |
| 3.2 | Strassen’s Matrix Multiplication Algorithm – Karatsuba integer multiplication Algorithm | 2 |
| 3.3 | Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication | 1 |
| 3.4 | Optimal Binary Search Trees – Knapsack Problem | 2 |
| 3.5 | Greedy Technique: Elements of the greedy strategy - Activity-selection problem | 1 |
| 3.6 | Huffman Trees – Knapsack Problem | 2 |
| **4** | **STATE SPACE SEARCH ALGORITHMS** | |
| 4.1 | Backtracking: n-Queens problem - Hamiltonian Circuit Problem | 1 |
| 4.2 | Subset Sum Problem – Graph coloring problem | 1 |
| 4.3 | Branch and Bound: Solving 15-Puzzle problem - Assignment problem | 2 |
| 4.4 | Knapsack Problem - Travelling Salesman Problem | 1 |
| **5** | **NP-COMPLETE AND APPROXIMATION ALGORITHMS** | |
| 5.1 | Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation | 1 |
| 5.2 | NP algorithms - NP-hardness and NP-completeness | 1 |
| 5.3 | Bin Packing problem - Problem reduction: TSP – 3-CNF problem | 2 |
| 5.4 | Approximation Algorithms: Travelling Salesman Problem | 1 |
| | Total | 36 |

**Course Designer(s):**


1. Dr.M.K.KavithaDevi, Professor,CSE — mkkdit@tce.edu
2. Mrs.RajaLavanya, Assistant Professor,CSE — rlit@tce.edu

| 22CS430 | DATA COMMUNICATION AND NETWORKS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

This course on Computer Network provides an introduction to the basic concepts in networks, reference models, layers, protocols, switching, routing and applications that use Computer Networks. This course introduces the concepts in Computer Networks with emphasis to different layers and the functionality of TCP/IP protocol suite. At the end of the course, the students should have an understanding of the basic principles and practice of Computer Networking.

## Prerequisite

22CS220 Electronics and Digital Systems

## Course Outcomes

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

| CO | Course Outcome Statement | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the operation of network applications with an understanding of the network models, switching techniques and layered architecture. | TPS2 | 70 | 85 |
| CO2 | Illustrate the concepts for transmission, and multiplexing techniques. | TPS3 | 70 | 80 |
| CO3 | Solve flow and error control issues in the data link layer, using appropriate techniques. | TPS3 | 70 | 80 |
| CO4 | Identify the performance implications of multiple access protocols. | TPS3 | 70 | 80 |
| CO5 | Construct routing and forwarding solutions for packet switching networks, with an understanding of the router architectures, algorithms and protocols. | TPS3 | 70 | 80 |
| CO6 | Identify the performance of transport layer protocols under given scenario. | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | - | | | | | | | | | | M | | |
| CO2 | S | M | L | | L | | | L | L | L | | M | M | | L |
| CO3 | S | M | L | | L | | | L | L | L | | M | M | | L |
| CO4 | S | M | L | | L | | | L | L | L | | M | M | | L |
| CO5 | S | M | L | | L | | | L | L | L | | M | M | | L |
| CO6 | S | M | L | L | L | | | L | L | L | | M | M | L | L |

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 20 | | | | | | 20 | | | | | 5 | 20 | | | | |
| CO2 | 10 | 10 | 20 | | | | | | | | | | 5 | 5 | 10 | | | |
| CO3 | | 10 | 20 | | | | | | | | | | | 5 | 10 | | | |
| CO4 | | | | | | | | 20 | 20 | | | | | 10 | 10 | | | |
| CO5 | | | | | | | | | 20 | | | | | | 10 | | | |
| CO6 | | | | | | | | | | 20 | | | | | | 10 | | |

| CO | Assignment 1 | | | | | | Assignment 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | | | | | | | | | | | |
| CO2 | | | | | | | | | | | | |
| CO3 | | | 100 | | | | | | | | | |
| CO4 | | | | | | | | | | | | |
| CO5 | | | | | | | | | 50 | | | |
| CO6 | | | | | | | | | | 50 | | |

## Syllabus

**Network Models** - The OSI Model - TCP/IP Protocol Suite - OSI versus TCP/IP
**Switching** - Circuit-Switched Networks - Packet Switching, Structure of a Switch, Switching and TCP/IP Layers
**Network Types**: WAN, MAN, LAN, WLAN - Infrastructured and Ad hoc networks
**Physical Layer** – Transmission techniques, Multiplexing - TDM, FDM, WDM
**Datalink Layer**: Framing, Error Detection and Correction: Types of Errors - Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction - Data link Control - Media Access Control (MAC): CSMA/CD, CSMA/CA– Channelization: FDMA, TDMA, CDMA
**Network Layer** - Connecting Devices: Hubs, Link-Layer Switches, Routers – Routing and Forwarding: Distance-Vector Routing, Link-State Routing - Performance Metrics: Delay, Throughput, Packet Loss, Congestion Control - Addressing: Internet Protocol, IPV6,IPV4 Addresses: Classful Addressing, Classless Addressing – Internet Control Message Protocol (ICMP) - Address Resolution Protocol (ARP) - RARP
**Transport Layer**: Transmission Control Protocol, User Datagram Protocol
**Presentation Layer:** Encryption/Decryption, Authentication, Translation
**Application Layer:** FTP - TELNET HTTP- Secure Shell (SSH) - Domain Name System (DNS)

## Text Book

1. Data Communications and Networking, 5th Edition, BehrouzForouzan, Mc Graw Hill, 2017

## Reference Books& web resources

1. Computer Networks: A Systems Approach, Larry L. Peterson, Bruce S. Davie, Elsevier, Mar 2011
2. Computer Networking: A Top-Down Approach featuring the Internet, 6th edition, James F. Kurose, Pearson Education India, 2013.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Hours | Course Outcome |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1. | **Network Models** | | |
| 1.1 | The OSI Model - TCP/IP Protocol Suite - OSI versus TCP/IP | 2 | CO1 |
| 2 | **Switching** | | |
| 2.1 | Circuit-Switched Networks | 1 | CO1 |
| 2,2 | Packet Switching, Structure of a Switch, Switching and TCP/IP Layers | 1 | CO1 |
| 3 | **Network Types** | | |
| 3.1 | WAN, MAN, LAN | 1 | CO1 |
| 3.2 | WLAN - Infrastructured and Ad hoc networks | 1 | CO1 |
| | **Physical Layer** | | |
| 4.1 | Transmission techniques | 1 | CO2 |
| 4.2 | TDM, FDM, WDM | 2 | CO2 |
| 5 | **Datalink Layer** | | |
| 5.1 | Framing | 1 | CO3 |
| 5.2 | Error Detection and Correction - Types of Errors, Error Detection, Cyclic Redundancy Check, Checksum, Forward Error Correction | 2 | CO3 |
| 5.3 | Datalink Control | 2 | CO4 |
| 5.4 | Media Access Control (MAC): CSMA/CD(Ethernet), CSMA/CA, Controlled Access | 1 | CO4 |
| 5.5 | Channelization: FDMA, TDMA, CDMA | 2 | CO4 |
| 6 | **Network Layer** | | |
| 6.1 | Connecting Devices: Hubs, Link-Layer Switches, Routers | 2 | CO5 |
| 6.2 | Routing and Forwarding-Distance-Vector and Link-State Routing | 2 | CO5 |
| 6.3 | Performance Metrics : Delay, Throughput, Packet Loss, Congestion Control | 2 | CO5 |
| 6.4 | Addressing: Internet Protocol –IPV6, IPV4 Addresses: Classful Addressing, Classless Addressing | 2 | CO5 |
| 6.5 | Internet Control Message Protocol(ICMP), Address Resolution Protocol (ARP), RARP | 2 | CO5 |
| 7 | **Transport Layer** | | |
| 7.1 | Transmission Control Protocol | 2 | CO6 |
| 7.2 | User Datagram Protocol | 1 | CO6 |
| 8 | **Presentation Layer** | | |
| 8.1 | Encryption/Decryption | 1 | CO1 |
| 8.2 | Authentication, Translation | 1 | CO1 |
| 9 | **Application Layer** | | |
| 9.1 | FTP | 1 | CO1 |
| 9.2 | TELNET | 1 | CO1 |
| 9.3 | HTTP,Secure Shell (SSH) | 1 | CO1 |
| 9.4 | Domain Name System (DNS) | 1 | CO1 |
| | Total | 36 | |

**Course Designer(s):**

1. Dr.C.Senthilkumar, Asso.Prof., CSE cskcse@tce.edu
2. Dr.G.S.R.EmilSelvan, APCSE emil@tce.edu

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **22CS440** | **DATABASE MANAGEMENT SYSTEMS** | Category | L | T | P | Credit |
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

This course provides the students to understand the various concepts and functionalities of Database Management Systems. It includes various data models to store & retrieve data and the use of query languages, the effective designing of relational database, creating storage and access structures. Also, the students will learn about the concepts of transaction management, concurrency mechanisms and recovery procedures. This course also introduces about different forms of NoSQL databases.

## Prerequisite

22CS340 – Data Structures and Algorithms

## Course Outcomes

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

| | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Develop data models such as Entity Relationship (ER) model and Relational model for a given application requirement. (Apply) | TPS3 | B | 85 |
| CO2 | Manipulate relational database using Relational languages and PL/SQL sub programs. (Apply) | TPS3 | B | 85 |
| CO3 | Design normalized databases for a given application by incorporating various constraints and normal forms. (Apply) | TPS3 | B | 85 |
| CO4 | Construct data structures like indexes and hash tables to support fast retrieval of data and explain query processing and optimization methods. (Apply) | TPS3 | B | 85 |
| CO5 | Make use of different forms of transactions, concurrency control and recovery mechanisms to maintain data consistency in a multi user environment. (Apply) | TPS3 | B | 85 |
| CO6 | Demonstrate NoSQL models for building the databases. (Apply) | TPS3 | B | 85 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | L | | M | M | M | | M | M | L | L |
| CO2. | S | M | L | | M | L | | M | M | M | | M | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | L |
| CO4. | S | M | L | | | | | | M | M | | M | M | | L |
| CO5. | S | M | L | | L | | | | M | M | | M | M | | L |
| CO6. | S | M | L | | L | L | | | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | Assignment 1 | | | CAT2 | | | Assignment 2 | | | Terminal | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** |
| CO1 | 5 | 10 | 15 | | | 20 | | | | | | | 1 | 5 | 10 |
| CO2 | 5 | 10 | 25 | | | 60 | | | | | | | 2 | 5 | 15 |
| CO3 | 5 | 10 | 15 | | | 20 | | | | | | | 2 | 5 | 10 |
| CO4 | | | | | | | 5 | 10 | 25 | | | 45 | 2 | 5 | 10 |
| CO5 | | | | | | | 5 | 10 | 25 | | | 45 | 2 | 5 | 10 |
| CO6 | | | | | | | 5 | 5 | 10 | | | 10 | 1 | 5 | 5 |
| Total | 15 | 30 | 55 | | | | 15 | 25 | 60 | | | | 10 | 30 | 60 |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to database and Data Models:** Purpose of database system, System Architecture, Components of DBMS, Data Models – ER model, Relational model - Concept of relation, Constraints, Mapping ER model to Relational Model

**Relational Languages -** Relational algebra, Structured Query Language - DDL, DML – Set operations, Aggregate Functions., Nested Subqueries. Intermediate SQL – Joins, Views, Index, Transactions, Integrity Constraints, Authorization. Advanced SQL – Introduction to PL/SQL – Procedures, Functions and Triggers, Accessing SQL from Programming Languages, Recursive Queries.

**Database design**: Decomposition, Functional Dependencies - Closure set of FD's for key identification, Decomposition – Lossless decomposition, Normal forms – 1NF, 2NF, 3NF, Dependency Preserving – BCNF, Multivalued Dependencies and 4NF, Join dependencies and 5NF.

**Transaction and Concurrency control** - Transaction concepts, Concurrent Execution, Serializability, Concurrency Control - Lock based protocol, Deadlock handling. Recovery System - Log-based Recovery, Recovery with Concurrent Transaction.

**Data Storage and structures**: RAID levels, Database Compression, De-Duplication, File Organization - Indexing – Ordered Index - B+ tree – properties, insertion and deletion, Hashing - Static and dynamic hashing.
**Query Processingand Optimization** Basics of query processing and optimization.

**No SQL databases:** CAP Theorem – Document Based systems – Key value Stores – Column Based Systems – Graph Databases. **Database Security:** Security issues – Access control based on privileges – Role Based access control – SQL Injection

## Text Book

1. Silberschatz, A, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, 2019.

## Reference Books & web resources

1. RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 7thEdition, Pearson/Addisionwesley, 2016
2. C. J. Date, A. Kannan and S. Swamynathan, “An Introduction to Database Systems”, 8thed, Pearson Education, 2006
3. Raghu Ramakrishnan, “Database Management Systems”, Third Edition, McGraw Hill, 2002.
4. Pramod J. Sadalage, Martin Fowler, “NoSQL Distilled - A Brief Guide to the Emerging World of Polyglot Persistence”, Pearson Education, 2012.
5. Andreas Meier, Michael Kaufmann, “ SQL& NoSQL Databases - Models, Languages, Consistency Options and Architectures for Big Data Management” , Springer Fachmedien Wiesbaden, 2019.
6. https://nptel.ac.in/courses/106105175 (Database Management System, IIT Kharagpur)
7. https://nptel.ac.in/courses/106/106/106106220

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to database and Data Models (5)** | |
| 1.1 | Purpose of database system | 1 |
| 1.2 | System Architecture, Components of DBMS | |
| 1.3 | Data Models – ER model | 1 |
| 1.4 | Relational model - Concept of relation, Constraints | 1 |
| 1.5 | Mapping ER model to Relational Model | 2 |
| **2** | **Relational Languages (9)** | |
| 2.1 | Relational algebra | 1 |
| 2.2 | Structured Query Language - DDL, DML | 1 |
| 2.3 | Set operations, Aggregate Functions | 1 |
| 2.4 | Nested Subqueries | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.5 | Intermediate SQL – Joins, Views, Index | 1 |
| 2.6 | Transactions, Integrity Constraints, Authorization | 1 |
| 2.7 | Advanced SQL – Introduction to PL/SQL – Procedures, Functions and Triggers | 2 |
| 2.8 | Accessing SQL from Programming Languages | 1 |
| 2.9 | Recursive Queries | |
| **3** | **Database design (6)** | |
| 3.1 | Decomposition – Lossless decomposition | 1 |
| 3.2 | Functional Dependencies - Closure set of FD's for key identification | 1 |
| 3.3 | Normal forms – 1NF, 2NF, 3NF | 1 |
| 3.4 | Dependency Preserving – BCNF, Multivalued Dependencies and 4NF | 2 |
| 3.5 | Join dependencies and 5NF | 1 |
| **4** | **Transaction and Concurrency control (6)** | |
| 4.1 | Transaction concepts | 1 |
| 4.2 | Concurrent Execution, Serializability | 2 |
| 4.3 | Concurrency Control - Lock based protocol, Deadlock handling | 2 |
| 4.4 | Recovery System - Log-based Recovery, Recovery with Concurrent Transaction | 1 |
| **5** | **Data Storage and structures (6)** | |
| 5.1 | RAID levels | 1 |
| 5.2 | Database Compression, De-Duplication | |
| 5.3 | File Organization - Indexing – Ordered Index | 1 |
| 5.4 | B+ tree – properties , insertion, deletion | 2 |
| 5.5 | Hashing - Static and dynamic hashing | 1 |
| 5.6 | **Query Processingand Optimization -** Basics of query processing and optimization | 1 |
| **6** | **Introduction to No SQL databases (4)** | |
| 6.1 | Introduction – CAP Theorem | 1 |
| 6.2 | Document Based systems – Key value Stores | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.3 | Column Based Systems – Graph Databases | 1 |
| 6.4 | Database Security: Security issues – Access control based on privileges, Role Based access control – SQL Injection | 1 |
| | **Total** | **36** |

## Course Designer(s):

1. Dr.B.Subbulakshmi bscse@tce.edu
2. Mr. M. Sivakumar mskcse@tce.edu

| 22CS450 | WEB PROGRAMMING |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 2 | 0 | 2 | 3 |

## Preamble

This course provides the basic principles and techniques used for developing Web based application. The objective of the course is to make students to study client side and server side programming language concepts. This course provides semi structured representation of data and transport data using XML related technologies. This course provides the techniques used for creating, publishing and consuming a web service in a web based application

## Prerequisite

Programming Fundamentals

## Course Outcomes

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

| CO | Course Outcome 1 (CO1) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Model web pages using HTML and DHTML (Apply) | TPS3 | A | 80 |
| CO2 | Demonstrate client side scripting which interact with users (Apply) | TPS3 | A | 80 |
| CO3 | Build user interfaces using React.(Apply) | TPS3 | A | 80 |
| CO4 | Illustrate multi-tier applications using JSP (Apply) | TPS3 | A | 80 |
| CO5 | Illustrate multi-tier applications using Node JS and Express framework (Apply) | TPS3 | A | 80 |
| CO6 | Develop web application using XML related technologies. (apply) | TPS3 | A | 80 |

## Mapping with Programme Outcomes

| Cos | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | - | | | | | | | | | M | L | L |
| CO2 | S | M | L | - | M | | L | L | L | L | | L | M | L | L |
| CO3 | S | M | L | - | M | | L | L | L | L | | L | M | L | L |
| CO4 | S | M | L | - | M | | L | L | L | L | L | L | M | L | L |
| CO5 | S | M | L | - | M | | L | L | L | L | | L | M | L | L |
| CO6 | S | M | L | - | M | | L | L | L | L | L | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1(Theory Component) | | | | | | CAT2(Theory Component) | | | | | | Model (Lab Component) | | | OCR | | | Terminal(Theory Component) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | | | | | | 100 | | | | | | 100 | | | 100 | | | 100 | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **1** | **2** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | | 10 | | | | | | | | | | | | 10 | | | 10 | 2 | 4 | 10 | | | |
| CO2 | 10 | 10 | 10 | | | | | | | | | | | | 20 | | | 20 | 2 | 4 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 20 | | | 20 | 4 | 4 | 10 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | | 20 | | | 20 | 4 | 4 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 10 | | | | | | 20 | | | 20 | 4 | 4 | 10 | | | |
| CO6 | | | | | | | 10 | 20 | 20 | | | | | | 10 | | | 10 | 4 | | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Web page design:** HTML5: headers, Linking, Images, Image map, meta elements, frameset, HTML forms, cascading style sheet., DHTML: object model, Event model, Two tier and Three tier architecture, J2EE architecture, HTTP request types.

**Client-side programming:** Java script: introduction, control statements, functions, objects. Event handling. JQuery: HTML and DOM manipulation, HTML event methods, AJAX.

**Building User Interface:** React –API, Classes, Arrow Function, Form, List, Sass Styling

**Server-Side programming:** JSP introduction, programming, Servlets - Introduction, Architecture, Programming with database connectivity.

**JavaScript on Server:** Node.js – Node JS HTTP Module, File system, URL Module, Events, Upload files, Introduction to the Express framework – Server-side rendering with Templating Engines – Static Files - async/await - Fetching JSON from Express.

**XML:** XML basics, DTD, XML Schema, XML Parser, XPATH, XMLQuery.

## Text Book

1. David Flanagan, “Java Script: The Definitive Guide”, O’Reilly Media, Inc, 7th Edition, 2020
2. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN:978-1-119-36656-0, 2019
3. Deitel and Deitel, “Internet and World Wide Web How to Program”, Prentice Hall of India, Fifth Edition, 2018.
4. Paul J.Deitel and Harvey M.Deitel, “AJAX, Rich Internet Applications, and Web Development for Programmers”, Pearson Education, First Edition, 2009.
5. Alex Banks, Eve Porcello, "Learning React", O’Reilly Media, Inc, 2nd Edition, 2020

6. Marc Wandschneider, “Learning Node”, Addison-Wesley Professional, 2nd Edition, 2016

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Web page design:** | |
| 1.1 | HTML5: headers, Linking, Images, Image map, meta elements, frameset, HTML forms, cascading style sheet., | 1 |
| 1.2 | DHTML: object model, Event model, Two tier and Three tier architecture, J2EE architecture, HTTP request types. | 1 |
| **2** | **Client-side programming:** | |
| 2.1 | Java script: introduction, control statements, functions, objects. Event handling. | 1 |
| 2.2 | JQuery: HTML and DOM manipulation, HTML event methods, AJAX, | 2 |
| **3** | **Building User Interface:** | |
| 3.1 | React –Classes, Arrow Function, Form, | 2 |
| 3.2 | List, Sass Styling | 1 |
| **4** | **Server-Side programming** | |
| 4.1 | JSP introduction, programming, | 1 |
| 4.2 | Servlets - Introduction, Architecture, | 2 |
| 4.3 | Programming with database connectivity. | 2 |
| **5** | **Javascript on Server:** | |
| 5.1 | Node.js – Node JS HTTP Module, | 1 |
| 5.2 | File system, URL Module, | 1 |
| 5.3 | Events, Upload files, | 1 |
| 5.4 | Introduction to the Express framework | 1 |
| 5.5 | Server-side rendering with Templating Engines | 1 |
| 5.6 | Static Files - async/await, Fetching JSON from Express | 2 |
| **6** | **XML:** | |
| 6.1 | XML basics, DTD, XML Schema, | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.2 | XML Parser, XPATH, XMLQuery | 2 |
| | Total | 24 |

**List of Experiments:**

| S. No. | Experiments | CO mapping | No. of Periods |
|---|---|---|---|
| 1. | Implement Client-side form design and validation. | CO1 | 2 |
| 2. | Create a Webpage to handle Events and Objects using Java Script. | CO2 | 2 |
| 3. | Develop application to demonstrate applications of JQuery and Ajax. | CO2 | 4 |
| 4. | Develop client-side application using React API | CO3 | 4 |
| 5. | Develop a multitier application using JSP | CO4 | 4 |
| 6. | Illustrate multi-tier applications using Node JS and Express framework | CO5 | 4 |
| 7. | Implement a program for DOM to Process XML File | CO6 | 4 |
| | | Total | 24 |

**Course Designer(s):**

1. Mr. M. Siva Kumar, mscse@tce.edu
2. Dr. M. Vijayalakshmi, mviji@tce.edu

| 22CS470 | DATABASES LAB |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 0 | 0 | 2 | 1 |

## Preamble

This course aims at facilitating the student to design database applications for the real world problems and perform operations such as creation, manipulation and maintenance of databases using RDBMS tools. It facilitates the students to access databases through high level languages using appropriate APIs. This course also enables students to work with NoSQL databases and execute basic query operations over it.

## Prerequisite

Concepts of Databases

## Course Outcomes

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

| | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Create Entity Relationship and Relational models for the given real-world application. | TPS3 | A | 75 |
| CO2 | Design normalized database using various constraints. | TPS3 | A | 75 |
| CO3 | Construct relational database and manipulate them using simple and complex queries in SQL | TPS3 | A | 75 |
| CO4 | Create and use different database objects like Index, View, Sequence, abstract data types , Varray and Nested table using SQL | TPS3 | A | 75 |
| CO5 | Develop sub programs like Procedure, Functions, Triggers and Package using Pl/SQL and manipulate the database through these programs | TPS3 | A | 75 |
| CO6 | Develop a complete database application using higher level language through JDBC /ODBC | TPS3 | A | 75 |
| CO7 | Develop NoSQL database and demonstrate execution of simple queries on it. | TPS3 | A | 75 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | L | | M | M | M | | L | M | L | M |
| CO2. | S | M | L | | M | L | | M | M | M | | L | M | L | M |
| CO3. | S | M | L | | S | L | | M | M | M | | L | M | M | M |
| CO4. | S | M | L | | S | | | M | M | M | | L | M | M | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5. | S | M | L | | S | L | | M | M | M | | L | M | M | M |
| CO6. | S | M | L | | S | L | | M | M | M | | L | M | M | M |
| CO7. | S | M | L | | M | L | | M | M | M | | L | M | L | M |

S- Strong; M-Medium; L-Low

**Assessment Pattern: Cognitive Domain**

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyse | | |
| Evaluate | | |
| Create | | |

**List of Experiments/Activities with CO Mapping**

| Module No. | Topic | Course Outcomes |
|---|---|---|
| 1. | Analyse the database application and create relational databases using normalization principles. | CO1 |
| 2. | Add the necessary integrity constraints to relational databases and practice with DCL commands. | CO2 |
| 3. | Manipulate the database using simple SQL Queries and practice with TCL commands such as COMMIT, ROLLBACK and SAVEPOINT commands | CO3 |
| 4. | Manipulate the database using Complex SQL Queries | CO3 |
| 5. | Practice with different database objects and complex data types such as BLOB, CLOB, NCLOB, BFILE | CO4 |
| 6. | Practice with PL/SQL blocks, programming constructs and composite data types in PL/SQL | CO5 |
| 7. | Develop sub programs such as procedures, functions with cursors and demonstrate exceptions using PL/SQL. | CO5 |
| 8. | Create Packages and Triggers using PL/SQL | CO5 |
| 9. | Develop a web application with database connectivity | CO6 |
| 10. | Demonstrate NoSQL database models and execute queries. | CO7 |
| 11. | Demonstration of a web application and Report submission | CO1..CO6 |

Students can take any real time application, create databases and execute queries over it. The application demonstration can be shown at the end of the lab. The sample applications can be:

1. College Management System
2. Railway Reservation System
3. Hospital Management System
4. Inventory Management System
5. Library Management System

**Learning Resources**

1. https://www.w3schools.com/sql
2. https://www.tutorialspoint.com/sql/index.htm
3. https://practice.geeksforgeeks.org/tag-page.php?tag=SQL
4. https://www.hackerrank.com/domains/sql
5. https://www.hackerearth.com/practice/

**Course Designers:**

| | | |
|---|---|---|
| 1. | Mr. M.Sivakumar | mskcse@tce.edu |
| 2. | Dr.B.Subbulakshmi | bscse@tce.edu |

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS480** | **ALGORITHMS LAB** | PC | 0 | 0 | 2 | 1 |

## Preamble

The objective of this laboratory course is to enable students to solve algorithmic problems by choosing and/or designing efficient data structures and algorithms to meet the problem constraints and implementing the algorithm in C/C++ and Python.

## Prerequisite

- 22CS240: Problem Solving and Programming
- 22CS340: Data Structures and Algorithms
- 22CS370: Data Structures Lab

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Determine the time complexity of various sorting and searching techniques. | TPS3 | A | 70 |
| CO2 | Apply graph algorithms to solve problems and analyze their efficiency. | TPS3 | A | 70 |
| CO3 | Make use of divide and conquer algorithm design techniques like to solve problems | TPS4 | A | 70 |
| CO4 | Use of dynamic programming algorithm design techniques to solve problems | TPS3 | A | 70 |
| CO5 | Identify the problem and design the algorithm using greedy techniques. | TPS3 | A | 70 |
| CO6 | Use the state space tree method for solving problems | TPS4 | A | 70 |

## Mapping with Programme Outcomes

| **COs** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **P O 5** | **P O 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PS O1** | **PS O2** | **PS O3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C( | S | M | L | | M | M | M | M | S | M | M | M | M | M | M |
| CO2. | S | M | L | | M | M | M | M | S | M | M | M | M | M | M |
| CO3 | S | S | M | L | M | M | M | M | S | M | M | M | M | M | M |
| CO4 | S | M | L | | M | M | M | M | S | M | M | M | M | M | M |
| CO5 | S | M | L | | M | M | M | M | S | M | M | M | M | M | M |
| CO6 | S | S | M | L | M | M | M | M | S | M | M | M | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyse | | |
| Evaluate | | |
| Create | | |

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| | **Searching and Sorting Algorithms** | |
| 1 | Implement Linear Search and Binary search. Analyse their worst-case performance by determine the time required to search for an element. Repeat the experiment for different values of n (in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be searched and plot a graph of the time taken versus n. | CO1 |
| 2 | Sort a given set of elements using the Insertion sort and Merge sort methods and determine the time required to sort the elements. Repeat the experiment for different values of n (in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be sorted and plot a graph of the time taken versus n. | CO1 |
| | **Graph Algorithms** | |
| 3 | For a given unweighted / uniform weighted connected graph, implement (a) BFS to find single source shortest path (b) DFS to detect cycle | CO2 |
| 4 | From a given vertex in a weighted connected graph, develop a program to find the shortest paths. | CO2 |
| 5 | From a given vertex in a weighted connected graph, implement a program to find the minimum spanning tree. | CO2 |
| 6 | Compute the transitive closure of a given directed graph using Warshall's algorithm. | CO2 |
| | **Algorithm Design Techniques** | |
| 7 | Develop a program to find out the maximum and minimum numbers in a given list of n numbers using the divide and conquer technique. | CO3 |
| 8 | Implement Merge sort and Quick sort methods to sort an array of elements and determine the time required to sort. Repeat the experiment for different values of n ((in the range 100 to 100000, which is stored in a separate file), the number of elements in the list to be sorted and plot a graph of the time taken versus n. | CO3 |
| 9 | Implement matrix chain multiplication using dynamic programming | CO4 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 10 | Implementation of 0/1 knapsack problem using knapsack problem | CO4 |
| 11 | Implementation of fractional knapsack problem using greedy algorithm and analyse its performance for various item selection strategies | CO5 |
| 12 | Develop Huffman codes using greedy approach. | CO5 |
| | **State Space Search Algorithms** | |
| 13 | Implement N Queens / Hamiltonian Circuit Problem / Subset Sum Problem / Graph coloring problem using Backtracking approach. | CO6 |
| 14 | Implement Assignment problem / Knapsack Problem / Travelling Salesman Problem using Branch and Bound technique | CO6 |

## Learning Resources


1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.
4. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
5. https://www.hackerrank.com/domains/algorithms
   https://www.codechef.com/wiki/tutorials
6. Steven S. Skiena, The Algorithm Design Manual, Second Edition, Springer,2010


## Course Designer(s):


1. Dr.M.K.KavithaDevi, Professor,CSE mkkdit@tce.edu
2. Mrs.RajaLavanya, Assistant Professor,CSE rlit@tce.edu

**22CS490** **PROJECT MANAGEMENT**

| Category | L | T | P | Credit |
|---|---|---|---|---|
| HSS | 3 | 0 | 0 | 3 |

## Preamble

This course develops students the principles underlying effective project management, providing the knowledge, skills, and framework necessary to manage a real project in the workplace.

## Prerequisite

Nill

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Suggest an organizational structure for managing projects within the organisation | TPS3 | 70 | 85 |
| CO2 | Develop a project communication plan by defining its scope, priorities, and responsibility matrices | TPS3 | 70 | 85 |
| CO3 | Construct a work breakdown structure for a given business cases and derive a project network information. | TPS3 | 70 | 85 |
| CO4 | Develop a project schedule using critical path method and to develop a Gantt chart using any project management tool | TPS3 | 70 | 85 |
| CO5 | Develop a reschedule for a project based on constraints. Develop a suitable risk response based on the assessment. | TPS3 | 70 | 85 |
| CO6 | Plan and implement a team-project for developing a complete project schedule using Project management tools like Open Projects, MS project management. | TPS4 | 70 | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | | | S | S | S | S | S | M | M | S |
| CO2 | S | M | L | | S | | | S | S | S | S | S | M | M | S |
| CO3 | S | M | L | | S | | | S | S | S | S | S | M | M | S |
| CO4 | S | M | L | | S | | | S | S | S | S | S | M | M | S |
| CO5 | S | M | L | | | | | S | S | S | S | S | M | M | S |
| CO6 | S | S | M | L | S | | | S | S | S | S | S | S | M | S |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | CAT 2 | | | Assignment 1 | | | | Assignment 2 | | | | Terminal Examination | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **1** | **2** | **3** | **3** | **4** | **5** | **6** | **3** | **4** | **5** | **6** | **1** | **2** | **3** |
| **CO1** | 5 | 9 | | - | - | - | - | - | - | - | - | - | - | - | 4 | 7 | - |
| **CO2** | 6 | 12 | 25 | - | - | - | - | - | - | - | - | - | - | - | 4 | 7 | - |
| **CO3** | 6 | 12 | 25 | - | - | - | - | - | - | - | - | - | - | - | 4 | 7 | 15 |
| **CO4** | - | - | - | 8 | 16 | 25 | - | - | - | - | | - | - | - | 4 | 7 | 15 |
| **CO5** | - | - | - | 9 | 17 | 25 | - | - | - | - | | - | - | - | 4 | 7 | 15 |
| **CO6** | - | - | - | | | | 100 | - | - | - | 100 | - | - | - | - | - | - |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Modern Project Management**
The Project Management Body Of Knowledge (PMBOK), 10 Knowledge Areas, The Project Life Cycle, Organization Structure and Project Management, Organizing Projects within the functional organization, Matrix organisation and projectized organisation, Choosing the right project management structure.

**Project Initiation**
Project Scope, and Checklist, Project Priorities, Work Breakdown Structure Development, WBS coding, Responsibility Matrices in WBS, Project Communication Plan, Project Estimations

**Agile Project Management**, Differences between managing a project versus developing a product, Scrum - Defining the Product Vision and Product Roadmap, Planning Releases and Sprints.

**Project Planning**
Developing the Project Network, WBS to Project Network, Network Computation Process Networks Activity on Arrow, Activity-on-Node, Forward Pass, Earliest Times , Backward Pass—Latest Times, Use of Lags, Lag Relationships, Laddering

**Resource optimization**, Scheduling Resources and Costs, Resource Scheduling Problem, Time-Constrained Project, Resource-Constrained Projects. **Managing Risk**, Risk Management Process, Risk Identification, Assessment, and Response Development.

**Conflict management**, **Project Closure**, Types of Project Closure, Final Report, Post-Implementation Evaluation.

## Text Books

1. Erik W. Larson, Clifford F. Gray, "Project Management The Managerial Process", McGraw-Hill/Irwin, Seventh Edition, 2018.
2. Mark C. Layton, Steven J Ostermiller, and Dean J. Kynaston "Agile Project Management For Dummies" John Wiley & Sons, Inc 3rd Edition 2020

**Reference Books & web resources**


1. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Seventh Edition and The Standard for Project Management", 2021
2. Jack R. Meredith, Samuel J. Mantel, Jr., "Project management A Managerial Approach"., John Wiley & Sons, Inc. Tenth Edition,2017
3. Harold kerzner , "Project Management A systems approach to Planning, scheduling, And controlling", Tenth edition, John Wiley & Sons, Inc.2009
4. Harold kerzner , "Project management best practices achieving global excellence", Fourth edition, John Wiley & Sons, Inc.2018
5. A Guide to the Project Management Body of Knowledge ( PMBOK® Guide )—Fifth Edition, Project Management Institute.
6. Harold Koontz, Heinz weihrich "Essentials of Management", Tata McGraw-Hill Education, 2006 - Management


**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods | CO |
|---|---|---|---|
| 1 | **Modern Project Management** | | |
| 1.1 | The Project Management Body Of Knowledge (PMBOK), 10 Knowledge Areas, | 1 | CO1 |
| 1.2 | The Project Life Cycle, | 1 | CO1 |
| 1.3 | Organization Structure and Project Management, Organizing Projects within the functional organization, | 2 | CO1 |
| 1.4 | Matrix organisation and projectized organisation, | 2 | CO1 |
| 1.5 | Choosing the right project management structure, | 2 | CO1 |
| 2 | **Project Initiation** | | |
| 2.1 | Project Scope and Checklist, Project Priorities. | 2 | CO2 |
| 2.2 | Work Breakdown Structure Development, WBS coding | 1 | CO3, CO6 |
| 2.3 | ,Responsibility Matrices in WBS, Project Estimations | 2 | CO2, CO6 |
| 2.4 | Project Communication Plan. | 1 | CO2, |
| **Assignment 1** | | | CO6 |
| 3.1 | **Agile Project Management**, Differences between managing a project versus developing a product, | 1 | CO3 |
| 3.2 | Scrum -.Defining the Product Vision and Product Roadmap, Planning Releases and Sprints. | 2 | CO3, CO6 |
| 4 | **Project Planning** | | |
| 4.1 | Developing the Project Network, WBS to Project Network, | 1 | CO3, CO6 |

| Module No. | Topic | No. of Periods | CO |
|---|---|---|---|
| | **Continuous Assessment Test – I** | | |
| 4.2 | Network Computation Process Networks Activity on Arrow. | 2 | CO4 |
| 4.3 | Activity-on-Node, Forward Pass, Earliest Times , Backward Pass—Latest Times | 2 | CO4 |
| 4.4 | Use of Lags, Laddering. Lag Relationships. | 1 | CO4 |
| 4.5 | Gantt chart using a project management tool | 2 | CO6 |
| 5 | **Resource optimization** | | |
| 5.1 | **Scheduling Resources** and Costs, Resource Scheduling Problem, | 2 | CO5 |
| 5.2 | Time-Constrained Project, Resource-Constrained Projects. | 1 | CO5 |
| 5.3 | Managing Risk**, Risk Management** Process. | 2 | CO5 |
| 5.4 | Risk Identification, Assessment, and Response Development. | 2 | CO5 |
| **Assignment 2** | | | CO6 |
| 6.1 | **Conflict management**, **Project Closure**, Types of Project Closure, | 2 | CO5 |
| 6.2 | Final Report, Post-Implementation Evaluation. | 2 | CO5 |
| **Continuous Assessment Test – 2** | | | |

**Course Designer(s):**

1. Dr. N. Shivakumar APCSE shiva@tce.edu
2. Dr. S. Prasanna APCSE sprcse@tce.edu

# CURRICULUM AND DETAILED SYLLABI

## FOR

## B.E DEGREE (Computer Science and Engineering) PROGRAMME

## FIFTH SEMESTER

## FOR THE STUDENTS ADMITTED FROM THE

## ACADEMIC YEAR 2023 - 2024 ONWARDS

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

**FIFTH SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS510 | Modelling and Optimization | ES | 3 | - | - | 3 |
| 22CS520 | Theory of Computation | ES | 3 | - | - | 3 |
| 22CS530 | Artificial Intelligence | PC | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22XXGX0 | Interdisciplinary Elective | OE | 3 | - | - | 3 |
| **THEORY CUM PRACTICAL** | | | | | | |
| 22CS560 | Software Engineering | PC | 3 | - | 2 | 4 |
| **PRACTICAL** | | | | | | |
| 22CS570 | Network Programming Lab | PC | - | - | 2 | 1 |
| 22CS580 | Artificial Intelligence Lab | PC | - | - | 2 | 1 |
| **PROJECT COURSE** | | | | | | |
| 22CS590 | Project - I | PW | - | - | 6 | 3 |
| **Total** | | | **18** | **-** | **12** | **24** |

BS : Basic Science Courses
PC : Professional Core Courses
ES : Engineering Science Courses
PW : Project Work

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**

**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**FIFTHSEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS510 | Modelling and Optimization | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS520 | Theory of Computation | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CS530 | Artificial Intelligence | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22XXGX0 | Interdisciplinary Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| **THEORY CUM PRACTICAL** | | | | | | | | |
| 6 | 22CS560 | Software Engineering | 3 | 50 | 50 | 100 | 22.5 | 50 |
| **PRACTICAL** | | | | | | | | |
| 7 | 22CS570 | Network Programming Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| 8 | 22CS580 | Artificial Intelligence Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| **PROJECT COURSE** | | | | | | | | |
| 9 | 22CS590 | Project - I | 3 | 40 | 60 | 100 | 27 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS510** | **MODELLING AND OPTIMIZATION** | ES | 3 | 0 | 0 | 3 |

## Preamble

Optimization is a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources. Attention is given primarily to techniques applicable to problems in linear and non-linear programming. Modelling refers analysis tool and design tool for various systems. Mathematical models are constructed to solve some real life problem.

## Prerequisite

Nil

## Course Outcomes

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

| COs | Course Outcome | TCE Proficiency Scale | Expected Proficiency | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Solve linear programming problems using graphical technique. | TPS3 | B | 65 |
| CO2 | Solve linear programming problems using simplex algorithm. | TPS3 | B | 65 |
| CO3 | Solve linear programming problem using semi definite optimization. | TPS3 | B | 65 |
| CO4 | Solve unconstrained Non-Linear Programming Problems (NLPP) using appropriate techniques. | TPS3 | B | 65 |
| CO5 | Solve constrained Non-Linear Programming Problems (NLPP) using appropriate techniques. | TPS3 | B | 65 |
| CO6 | Construct Mathematical models and solve problems related to science and technology | TPS3 | B | 65 |

S- Strong; M-Medium; L-Low

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | | L | | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | | L | | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | S | M | L | | | L | | M | M | M | | M | M | L | M |
| CO6 | S | M | L | | | L | | M | M | M | | M | M | L | M |

## Assessment Pattern

| CO | Assessment 1 | | | | | | Assessment 2 | | | | | | Terminal | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CAT 1 (%) | | | Assignment 1 | | | CAT 2 (%) | | | Assignment 2 | | | | | |
| TPS | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| CO1 | - | 10 | 14 | - | - | 20 | - | - | - | - | - | - | - | - | 10 |
| CO2 | 5 | 10 | 23 | - | - | 40 | - | - | - | - | - | - | - | 6 | 12 |
| CO3 | 5 | 10 | 23 | - | - | 40 | - | - | - | - | - | - | - | 6 | 12 |
| CO4 | - | - | - | - | - | | 3 | 10 | 20 | - | - | 35 | - | 6 | 12 |
| CO5 | - | - | - | - | - | | 3 | 10 | 20 | - | - | 35 | - | 6 | 12 |
| CO6 | - | - | - | - | - | | 4 | 10 | 20 | - | - | 30 | - | 6 | 12 |
| TOTAL | 10 | 30 | 60 | - | - | 100 | 10 | 30 | 60 | - | - | 100 | - | 30 | 70 |

## Syllabus

**Linear programming:** Introduction to LPP – Graphical LP solution (Extreme point solution method) – Special cases in Linear programming. The Simplex algorithm (maximization case only) - Unrestricted variables, Degeneracy- Alternative Optimal Solutions, Unbounded solutions, Infeasible solution- - Dual Simplex Method.

**Semi definite optimization**: Introduction to primal and dual LPP - From linear to semidefinite optimization – spectrahedra - Projected spectrahedra – Primal SDP formulation- optimality solutions for SDP - Properties of Spectrahedra - Conic Programming - Strong Duality.

**Non-Linear Programming:** Introduction **-** Unconstrained Optimization techniques: One-Dimensional minimization methods: Fibonacci method, Golden selection method – Multivariable optimization: Steepest Descent method and Broyden–Fletcher–Goldfarb–Shanno method(BFGS) – Constrained Optimization techniques: Multivariable Optimization with Equality constrains: Lagrange Multipliers Method - Multivariable optimization with inequality constrains: Kuhn-Tucker conditions - Graphical Solution Method.

**Modelling:** Introduction to mathematical modelling –- Graph Based Models: Introduction to graphs and graph models. Matrix based model: Represent the data using curve of best fit using least square method. Linear Programming Models: Formulation of LPP model.

## Text Books

1. J.K.Sharma., “Operations Research Theory and Applications”, 6th Edition, Trinity Press, India, 2017.
2. G.Blekherman, Pablo.A.Parrilo, R. Thomas., “Semidefinite Optimization and Convex Algebraic Geometry”, SIAM Publisher, 2012.
3. S.S.Rao., “Engineering Optimization Theory & Practice”, Fourth edition, John Wiley & sons publications, 2009.

4. Kenneth H. Rosen., “Discrete Mathematics and Its Applications”, 8th Edition, McGraw hill publications, 2019.
5. Steven J. Leon., “Linear Algebra with Application” Ninth Edition, Pearson, 2015.


## Reference Books & web resources


1. Frederick S.Hillier and Gerald J. Lieberman., “ Introduction to Operations research” Tenth edition, Mc GrawHill Education, 2015.
2. Hamdy A. Taha, “Operations Research - An Introduction”, Tenth Edition, Pearson, 2017.
3. J. Nocedal and S. Wright, “Numerical optimization”, Second Edition, Springer, 2006.
4. Radhika Ranjan Roy, “Handbook of SDP for Multimedia Session Negotiations”, Kindle Edition, (2018)


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Linear programming** | |
| 1.1 | Introduction to LPP | 1 |
| 1.2 | Graphical LP solution (Extreme point solution method) | 2 |
| 1.3 | Special cases in Linear programming | 1 |
| 1.4 | The Simplex algorithm (maximization case only) | 2 |
| 1.5 | Unrestricted variables, Degeneracy | 1 |
| 1.6 | Alternative optimal Solutions, Unbounded solutions, Infeasible solution | 2 |
| 1.7 | Dual simplex method | 2 |
| **2** | **Semi definite optimization** | |
| 2.1 | Introduction to primal and dual LPP | 1 |
| 2.2 | From linear to semidefinite optimization – spectrahedra - Projected spectrahedra | 1 |
| 2.3 | Primal SDP formulation | 1 |
| 2.4 | optimality solutions for SDP | 1 |
| 2.5 | Properties of Spectrahedra - Conic Programming | 1 |
| 2.6 | Strong Duality | 2 |
| **3** | **Non-Linear Programming** | |
| 3.1 | Unconstrained Optimization One-Dimensional: Fibonacci method | 1 |
| 3.2 | Golden search method | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.3 | Unconstrained Optimization Multi variable: Steepest Descent method | 2 |
| 3.4 | BFGS method, Introduction to LBFGS method | 2 |
| 3.5 | Constrained Optimization Equality Constrains: Lagrange Multiplier Method | 2 |
| 3.6 | Constrained Optimization inequality Constrains: Kuhn-Tucker conditions. | 2 |
| 3.7 | Constrained Optimization inequality Constrains: Graphical method. | 2 |
| **4** | **Modelling** | |
| 4.1 | Introduction to mathematical modelling | 1 |
| 4.2 | Linear programming model: Formulation of LPP model | 1 |
| 4.3 | Graphs and Graph based models: Introduction to graphs and graph models | 2 |
| 4.4 | Matrix based Models: Represent the data using curve of best fit using least square method | 2 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr. C. S. Senthilkumar kumarstays@tce.edu
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3. Dr. P. Krishnapriya pkamat@tce.edu

| 22CS520 | THEORY OF COMPUTATION | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | ES | 3 | 0 | 0 | 3 |

## Preamble

This syllabus on "Theory of Computations" is designed to introduce students to the fundamental concepts and applications of automata theory, formal languages, and computability. The syllabus emphasizes the basics of automata theory, including finite automata, regular expressions, and context-free grammars, and provides an overview of the fundamental concepts of computability theory, including Turing machines and the Church-Turing thesis. The modules in the syllabus reflect an approach to problem-solving via automata theory, and the syllabus focuses on the strategies, techniques, and limitations in solving computational problems. The goal is to equip students with the knowledge and skills required to work with automata theory and apply it in their respective fields, including computer science, mathematics, and related disciplines.

## Prerequisite

- Nil

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Design Finite Automata machines for given problems | TPS3 | B | 80 |
| CO2 | Find regular expressions and language for any given Finite Automata machines | TPS3 | B | 80 |
| CO3 | Implement Pushdown Automata for given Context Free language and generate the strings of a given context-free languages using its grammar | TPS3 | B | 80 |
| CO4 | Construct Turing machine for any given computational problem | TPS3 | B | 80 |

| | | | | |
|---|---|---|---|---|
| CO5 | Differentiate between decidable and undecidable problems based on the complexity of problems when solved using these machines | TPS4 | B | 80 |
| CO6 | Examine the hierarchy of classes of problems or formal languages (regular, context-free, context-sensitive, decidable, and undecidable) | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | | | M | L | L | | M | M | | M |
| CO2 | S | M | L | | L | | | M | L | L | | M | M | | M |
| CO3 | S | M | L | | L | | | M | L | L | | M | M | | M |
| CO4 | S | M | L | | L | | | M | L | L | | M | M | | M |
| CO5 | S | S | M | L | M | L | | M | L | L | | M | S | L | M |
| CO6 | S | S | M | L | M | L | | M | L | L | | M | S | L | M |

**S- Strong; M-Medium; L-Low**

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 10 | 10 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO2 | 5 | 10 | 10 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 5 | 10 | 10 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO4 | 5 | 10 | 10 | | | | 5 | 10 | 20 | | | | 2 | 5 | 10 | | | |
| CO5 | | | | | | | 5 | 10 | | 20 | | | 2 | 5 | | 10 | | |
| CO6 | | | | | | | | 10 | | 20 | | | | 5 | | 10 | | |
| **Total** | 20 | 40 | 40 | | | | 10 | 30 | 20 | 40 | | | 10 | 30 | 40 | 20 | | |

| **CO** | **Assignment 1** | | | | | | **Assignment 2** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | | 20 | | | | | | | | | |
| CO2 | | | 30 | | | | | | | | | |
| CO3 | | | 20 | | | | | | | | | |
| CO4 | | | 30 | | | | | | 40 | | | |
| CO5 | | | | | | | | | | 30 | | |
| CO6 | | | | | | | | | | 30 | | |
| **Total** | | | 100 | | | | | | 40 | 60 | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Automata and Regular Expressions** Need for automata theory - Introduction to formal proof Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA – Minimization of DFAs

**Regular Expressions and Languages** Regular expression – Regular Languages- Equivalence of Finite Automata and regular expressions– Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

**Context Free Grammar and Push Down Automata** Types of Grammar - Push Down Automata (PDA): Definition – Moves - Instantaneous descriptions -Languages of pushdown automata – Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG – Deterministic Pushdown Automata.

**Normal Forms and Turing Machines** Normal forms for CFG – Simplification of CFG- Chomsky Normal Form (CNF) and Greibach NormalForm (GNF) – Pumping lemma for CFL – Closure properties of Context Free Languages –Turing Machine: Basic model – definition and representation – Instantaneous Description – Language acceptance by TM

**Undecidability** Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems - P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem- 3-CNF SAT problems.

**Unconventional Computing** - Membrane Computing, DNA Computing, Quantum Computing Models

## Text Books


1. Hopcroft J.E., Motwani R. & Ullman J.D., "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008.
2. John C Martin , "Introduction to Languages and the Theory of Computation", 4th Edition,Tata McGraw Hill, 2011.


## Reference Books


1. Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation",2nd Edition, Prentice Hall of India, 2015.
2. Peter Linz, "An Introduction to Formal Language and Automata", 6th Edition, Jones & Bartlett, 2016.
3. K.L.P.Mishra and N.Chandrasekaran, "Theory of Computer Science: Automata Languages and Computation", 3rd Edition, Prentice Hall of India, 2006.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Automata and Regular Expressions** | **(6)** |
| 1.1 | Need for automata theory - Introduction to formal proof – Finite Automata (FA) | 1 |
| 1.2 | Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) | 1 |
| 1.3 | Equivalence between NFA and DFA – Finite Automata with Epsilon transitions | 1 |
| 1.4 | Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves | 1 |
| 1.5 | Conversion of NFA into DFA – Minimization of DFAs | 2 |
| **2** | **Regular Expressions and Languages** | **(6)** |
| 2.1 | Regular expression – Regular Languages | 1 |
| 2.2 | Equivalence of Finite Automata and regular expressions | 2 |
| 2.3 | Proving languages to be not regular (Pumping Lemma) | 2 |
| 2.4 | Closure properties of regular languages. | 1 |
| **3** | **Context Free Grammar and Push Down Automata** | **(6)** |
| 3.1 | Types of Grammar | 2 |
| 3.2 | Push Down Automata (PDA): Definition – Moves | 1 |

| | | |
|---|---|---|
| 3.3 | Instantaneous descriptions -Languages of pushdown automata | 1 |
| 3.4 | Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG - Deterministic Pushdown Automata | 2 |
| **4** | **Normal Forms and Turing Machines** | **(6)** |
| 4.1 | Normal forms for CFG – Simplification of CFG | 1 |
| 4.2 | Chomsky Normal Form (CNF) and Greibach Normal Form (GNF) | 2 |
| 4.3 | Pumping lemma for CFL – Closure properties of Context Free Languages | 1 |
| 4.4 | Turing Machine: Basic model – definition and representation | 1 |
| 4.5 | Instantaneous Description – Language acceptance by TM | 1 |
| **5** | **Undecidability** | **(6)** |
| 5.1 | Unsolvable Problems and Computable Functions –PCP-MPCP-Recursive and recursively enumerable languages | 2 |
| 5.2 | Properties - Universal Turing machine | 1 |
| 5.3 | Tractable and Intractable problems | 1 |
| 5.4 | P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem- 3-CNF SAT problems. | 2 |
| **6** | **Unconventional Computing** | **(6)** |
| 6.1 | Membrane Computing, , | 2 |
| 6.2 | DNA Computing | 2 |
| 6.3 | Quantum Computing Models | 2 |

**Course Designer(s):**

1. Dr.K.Sundarakantham, Professor, CSE kskcse@tce.edu
2. Mr. S.Santhana Hari, AP, CSE sshcse@tce.edu

| 22CS530 | ARTIFICIAL INTELLIGENCE | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

This course introduces the basic concepts and techniques of Artificial Intelligence. Artificial intelligence is the sub-area of computer science devoted to creating software and hardware to get computers to do things that would be considered intelligent as if people did them. This course will help the students to gain generic problem-solving skills that have applicability to a wide range of real-world problems. Students can learn how machines can engage in problem-solving, reasoning, learning, and interaction.

## Prerequisite

Students are expected to have

- Basic Programming knowledge in Python
- Knowledge of search algorithms like BFS, DFS
- Graph data structures

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Demonstrate a fundamental understanding of the history of artificial intelligence (AI) and its foundations | TPS2 | B | 80 |
| CO2 | Interpret AI problems as a state space representation and solve using AI techniques like searching and game playing | TPS3 | B | 75 |
| CO3 | Construct knowledge representations using logic to facilitate inference in the given problem domain | TPS3 | B | 75 |
| CO4 | Formulate solutions for problems involving uncertain inputs or outcomes | TPS3 | B | 75 |
| CO5 | Apply basic principles of AI in solutions that require problem solving by learning | TPS3 | B | 75 |
| CO6 | Examine real-world problems and apply suitable AI techniques to develop intelligent systems | TPS4 | B | 75 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | L | | L | | | | M | M | L | L |
| CO2 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO3 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO4 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO5 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO6 | S | S | M | L | M | L | | M | L | L | | M | S | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | | | | Assignment 1 | | | CAT 2 | | | | | | Assignment 2 | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | 2 | 5 | | - | - | - |
| CO2 | 10 | 10 | 25 | - | - | - | - | - | 50 | - | - | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO3 | - | 10 | 25 | - | - | - | - | - | 50 | - | - | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | 30 | | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | 30 | | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | - | - | - | 10 | - | - | 20 | - | - | - | - | - | 40 | | 5 | | 20 | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction**: Turing Test – Intelligent Agents, Characteristics of Intelligent Agents – Environments properties – Future of AI – Typical AI problems – Problem-Solving Approach to Typical AI problems.

**Problem-Solving Methods:** Search Strategies – Informed Search – Local Search – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation, Backtracking Search – Game Playing – Optimal Decisions in Games, Alpha - Beta Pruning – Stochastic games.

**Knowledge Representation:** First Order Predicate Logic – Unification – Forward Chaining – Backward Chaining – Resolution. Rule-Based Systems – Rete Graph. Classical planning.

**Uncertain knowledge and Reasoning:** Quantifying Uncertainty – Acting under Uncertainty – Inference using Full Joint Distributions – Bayes' rule. Probabilistic Reasoning – Bayesian Models – Relational and First-Order Probability Models – Time and Uncertainty.

**Learning:** Learning from Examples – Supervised Learning – Reinforcement Learning.

**Case study:** Large Language models - ChatGPT, Computer Vision, Automation.

## Reference Books

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 4th Edition, Prentice Hall, Feb 2020.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
3. Elain Rich and Kevin Knight, "Artificial Intelligence ", Tata McGraw Hill, Third Edition, 2008.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education, 2002.
5. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, organ Kaufmann, 2011.
6. NPTEL Lectures

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures | CO Mapped |
|---|---|---|---|
| 1 | **Introduction** (5) | | |
| 1.1 | Turing Test – Intelligent Agents | 1 | CO1 |
| 1.2 | Characteristics of Intelligent Agents – Environments properties – Future of AI | 2 | CO1 |
| 1.3 | Typical AI problems – Problem-Solving Approach to Typical AI Problems | 2 | CO1 |
| 2 | **Problem-Solving Methods** (9) | | |
| 2.1 | Search Strategies – Informed Search | 2 | CO2 |
| 2.2 | Local Search – Searching with Partial Observations | 2 | CO2 |
| 2.3 | Constraint Satisfaction Problems | 2 | CO2 |

| | | | |
|---|---|---|---|
| | Constraint Propagation, Backtracking Search | | |
| 2.4 | Game Playing – Optimal Decisions in Games<br>Alpha - Beta Pruning | 2 | CO2 |
| 2.5 | Stochastic Games | 1 | CO2 |
| 3 | **Knowledge Representation** (5) | | |
| 3.1 | First-Order Predicate Logic | 1 | CO3 |
| 3.2 | Unification – Forward Chaining<br>Backward Chaining – Resolution | 1 | |
| 3.3 | Rule-Based Systems | 1 | CO3 |
| 3.4 | Rete Graph | 1 | CO3 |
| 3.5 | Classical planning | 1 | CO3 |
| 4 | **Uncertain Knowledge and Reasoning** (8) | | |
| 4.1 | Quantifying Uncertainty | 1 | CO4 |
| 4.2 | Acting under Uncertainty | 1 | CO4 |
| 4.3 | Inference using Full Joint Distributions | 1 | CO4 |
| 4.4 | Bayes' rule | 1 | CO4 |
| 4.5 | Probabilistic Reasoning | 1 | CO4 |
| 4.6 | Bayesian models | 1 | CO4 |
| 4.7 | Relational and First-Order Probability Models | 1 | CO4 |
| 4.8 | Time and Uncertainty | 1 | CO4 |
| 5 | **Learning** (5) | | |
| 5.1 | Learning from Examples | 1 | CO5 |
| 5.2 | Supervised Learning | 2 | CO5 |
| 5.3 | Reinforcement Learning | 2 | CO5 |
| | **Mini Project Reviews** | 4 | CO6 |

| | | | |
|---|---|---|---|
| | **Total Hours** | **36** | |

**Course Designer(s):**


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2. Dr. M.Suguna mscse@tce.edu

**22CS560 SOFTWARE ENGINEERING**

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 3 | 0 | 2 | 4 |

## Preamble

The main purpose of this course is to impart knowledge on various models (interaction, context models etc.) and processes that are used by professionals in the field of software engineering. This course focuses on architecture patterns and various software engineering methodologies for designing , Planning and developing the software. Consequently, student's take up a group project, working through a number of stages for the development of software.

## Prerequisite

21CS490 Project management

## Course Outcomes

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

| | | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain various software development process and management techniques. | TPS2 | B | 90 |
| CO2 | Design system boundaries using activity diagrams and Use case diagrams. | TPS3 | B | 85 |
| CO3 | Design interactions between actors and the system and between system components using Sequence diagrams, Class diagrams and State diagrams. | TPS3 | B | 85 |
| CO4 | To design a system considering the key issues in Components, architectural patterns for distributed systems and Software as a service | TPS3 | B | 85 |
| CO5 | Build a project report as a team which contains the requirement specification, plan, schedule and designdocuments | TPS3 | B | 85 |
| CO6 | Estimate the list of activities, users, milestone for a project and develop a project plan using Gantt chart tool | TPS4 | B | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | M | L | | | | | | | L | L | L | L | M | | L |
| **CO2** | S | M | L | | S | M | M | M | M | M | L | L | M | L | M |
| **CO3** | S | M | L | | | | M | M | M | M | L | L | M | L | M |
| **CO4** | S | M | L | | | | M | M | M | M | L | L | M | L | M |
| **CO5** | S | M | L | | S | M | M | M | M | S | S | S | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO6** | S | S | M | L | S | | S | S | S | S | S | S | M | L | M |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| **CO** | **CAT 1** | | | | **CAT 2** | | | | **Terminal Examination** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** |
| **CO1** | 7 | 16 | | | | | | | 4 | 10 | | |
| **CO2** | 7 | 16 | 20 | | | | | | 4 | 10 | | |
| **CO3** | 6 | 18 | 20 | | | | | | 4 | 10 | 15 | |
| **CO4** | | | | | 10 | 25 | 15 | | 4 | 10 | 15 | |
| **CO5** | | | | | 10 | 25 | | | 4 | 10 | | |
| **CO6** | | | | | | | | 15 | | | | 10 |

| **CO** | **LAB MODEL TEST** | | | | | | **OCR** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | | | | | | | | | | | |
| CO2 | | | 10 | | | | | | 10 | | | |
| CO3 | | | 20 | | | | | | 20 | | | |
| CO4 | | | | | | | | | | | | |
| CO5 | | | 50 | | | | | | 50 | | | |
| CO6 | | | | 20 | | | | | | 20 | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

**Syllabus**

**Software process models**

Professional software development- Software engineering ethics- Process activities - Software Life cycle- Iterative, Spiral, Prototyping-Agile method- Agile developing techniques- Agile project management

**System Modelling**

Functional and non- functional requirements- Software Requirement Specification - Developing Context models, Interaction models, Structural models and Behavioural models- Architectural patterns, Application architectures- -Object oriented design- Design patterns.

**Software Project Planning**

Software pricing, Plan-driven development, Project scheduling, requirements to activities, activities to Gantt chart Agile planning Software Reuse- Risk Management

**Component based Software Engineering**

Components and component models- CBSE processes- Component composition

**Distributed Software Engineering**

Distributed systems- Client-server computing- Architectural patterns for distributed systems-Software as a service

**Reliability Engineering**

Fault tolerance Architectures- Programming for reliability- Secure systems design and programming- Secure testing and assurance-.

**Lab Content**:

- Develop a mini project for a real world problem in which a software solution can be obtained (ateam of 3 members) and do the following.
- Collect requirements for the chosen problem
- Model the system through interaction, structural diagrams and develop softwarearchitecture.
- Develop the system partially through Test Driven Development with unit test.

**Sample case-studies:**

- An embedded control system for a personal insulin pump

This case study discusses the control software for a personal insulin pump, which is used by diabetics to mimic the function of the pancreas and hence control the level of glucose (sugar) in their blood.

- The iLearn digital learning environment

The iLearn system is a digital learning environment used to support learning in schools with students from age 4 to 18. It is intended to replace an existing system (Glow) that was specially built for the purpose and which includes its own applications for e-mail, etc.

- The Mentcare system

This case study focuses on the requirements for a system that I have called the Mentcare system,which is a real system (although that is not its real name) which was used in a number of UK hospitals, including hospitals in Scotland.

- Wilderness weather station

This case study is based on the software for a wilderness weather station that collects weather information in remote areas that do not have local infrastructure (power, communications, roads, etc.).

**Reference Books & web resources**

1. Ian Sommerville , "Software Engineering" , 10th Edition,John Wiley and sons,2015.

2. Orit Hazzan, Yael Dubinsky, “Agile software engineering”, Springer,2014
3. The Unified Modeling Language Reference Manual, James Rumbaugh, Ivar Jacobson, Grady Booch, 2nd Edition, Addison Wesley,2005.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Lectures | Course Outcome |
|---|---|---|---|
| 1 | **Software process models** | | |
| 1.1 | Professional software development- Software engineering ethics- Process activities- Coping withchange- Process Improvement | 2 | CO1 |
| 1.2 | Software Life cycle models- Iterative, Spiral and Prototyping models | 2 | CO1 |
| 1.3 | Agile method- Agile developing techniques- Agileproject management- Scaling Agile methods | 2 | CO1 |
| 2 | **System Modelling** | | |
| 2.1 | Functional and non- functional requirements. | 2 | CO3 |
| 2.2 | Software Requirement Specification. | 2 | CO3 |
| 2.3 | Developing Context models, Interaction models. | 2 | CO3 |
| 2.4 | Structural models and Behavioral models. | 2 | CO3 |
| 2.5 | Architectural patterns, Application architectures. | 2 | CO3 |
| 2.6 | Object oriented design- Design patterns. | 2 | CO3 |
| | Continuous Assessment Test 1 | | |
| 3 | **Software Project Planning** | | |
| 3.1 | Software pricing, Plan-driven development. | 2 | CO4 |
| 3.2 | Project scheduling, requirements to activities, activities to Gantt chart | 2 | CO4 |
| 3.3 | Agile planning Software Reuse- Risk Management | 2 | CO1 |
| | | | |
| 4 | **Component based Software Engineering** | | |
| 4.1 | Components and component models | 2 | CO2 |
| 4.2 | CBSE processes- Component composition | 2 | CO2 |
| 5 | **Distributed Software Engineering** | | |
| 5.1 | Distributed systems- Client-server computing- | 2 | CO2 |
| **5.2** | Architectural patterns for distributed systems-Software as a service | **2** | |
| 6 | **Reliability Engineering** | | |
| 6.1 | Fault tolerance Architectures- Programming for reliability | 2 | CO2 |
| 6.2 | Secure systems design and programming | 1 | |
| 6.3 | Secure testing and assurance | 1 | CO2 |
| | | 36 | |

| Module No. | Topic | No. of Lectures | |
|---|---|---|---|
| 1 | Develop a mini project for a real world problem in which a software solution can be obtained (a teamof 3 members) and do the following, Collect requirements for the chosen problem | 4 | CO6 |
| 2 | Develop Software Requirements specification | **4** | CO6 |

| | | | | |
|---|---|---|---|---|
| | document | | | |
| 3 | Develop contex level models and software tarchitecture. | 4 | CO6 | |
| 4 | Model the system through structural diagrams | 4 | CO6 | |
| 5 | Model the system through interaction diagrams | 4 | CO6 | |
| 6 | Propose a project plan Using gantt chart. | 4 | CO4 | |

**Course Designer(s):**

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2. Dr. S. Prasanna APCSE sprcse@tce.edu

| 22CS570 | NETWORK PROGRAMMING LAB |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PC | 0 | 0 | 2 | 1 |

## Preamble

Universal connectivity is realized through Computer Networks. It is important to gain knowledge on the hardware requirements and functioning of Computer Networks. This course provides insight into the working of network protocols and their characteristics.

## Prerequisite

Object oriented programming

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Perform Configuration of networking components and installing device drivers and build a Local Area Network | TPS3 | A | 85 |
| CO2 | Perform port scanning and identify IP and MAC Address. | TPS3 | A | 85 |
| CO3 | Implement client server communication using socket programming | TPS3 | A | 85 |
| CO4 | Perform DNS server host name identification and resolve given host name | TPS3 | A | 85 |
| CO5 | Implement File transfer and RMI. | TPS3 | A | 85 |
| CO6 | Simulate a network topology using CISCO Packet tracer | TPS3 | A | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |
| CO6. | S | M | L | | L | - | - | M | M | M | | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern: Cognitive Domain

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |

| | | |
|---|---|---|
| Apply | 100 | 100 |
| Analyze | | |
| Evaluate | | |
| Create | | |

**List of Experiments/Activities with CO Mapping**

1. Establishment of a LAN: Preparation of network cables and installation and configuration of network.
2. Perform network commands like NETSTAT, NSLOOKUP, TRACERT, ARP, IPCONFIG and verify their need and usage
3. Develop a program to identify your machine's host name and IP address
4. Develop a program to locate the next hop router's IP address and MAC address
5. Develop a program to find which port is currently used, by scanning the port.
6. Develop a program to obtain local DNS server's host name and IP address and resolve a given host name.
7. Develop a program to illustrate a simple client/server communication and Time server.
8. Develop a program to implement ECHO and PING commands and time server.
9. Develop a program to implement a file transfer using TCP..
10. Develop a program to implement a file transfer using UDP.
11. Develop a program to implement Remote Method Invocation.
12. Simulate a network for the given specification using CISCO Packet tracer

**Learning Resources**

1. Data Communications and Networking, 5th Edition, BehrouzForouzan, Mc Graw Hill, 2017.
2. Computer Networks: A Systems Approach, Larry L. Peterson, Bruce S. Davie, Elsevier, Mar 2011
3. Computer Networking: A Top-Down Approach featuring the Internet, 6th edition, James F. Kurose, Pearson Education India, 2013.

**Course Designers:**

1. Dr.C.Senthilkumar ,Associate Professot, CSE, cskcse@tce.edu
2. Dr.G.S.R.EmilSelvan , AssIstant Professot, CSE emil@tce.edu

| 22CS580 | ARTIFICIAL INTELLIGENCE LAB | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Preamble

The laboratory course will facilitate the Students to apply the concept of artificial intelligence for different problems like eight queens, travelling salesperson problem using machine learning libraries, Python, LISP and PROLOG. These experiments are aimed at imparting a practical exposure to the students to gain generic problem solving skills that have applicability to a wide range of real-world problems. Students can learn how machines can engage in problem solving, reasoning, learning, and interaction.

## Prerequisite

- Fundamentals of Python programming

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Formulate the given problem as PEAS description | TPS3 | A | 75 |
| CO2 | Implement Heuristic search algorithms to solve given state space representable AI Problems | TPS3 | A | 75 |
| CO3 | Solve given 2-ply game using Min-max algorithm and optimize using alpha-beta pruning | TPS3 | A | 75 |
| CO4 | Represent the given Constraint Satisfaction Problem as Constraint graph and solve using Backtracking, forward checking or arc consistency | TPS3 | A | 75 |
| CO5 | Construct rule based systems for any application using logic programming language | TPS3 | A | 75 |
| CO6 | Examine the given use case and develop an intelligent system using suitable learning approach | TPS4 | A | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | S | M | L | | M | L | | S | S | S | | M | M | L | M |
| CO 2 | S | M | L | | M | L | | S | S | S | | M | M | L | M |
| CO 3 | S | M | L | | M | L | | S | S | S | | M | M | L | M |
| CO 4 | S | M | L | | M | L | | S | S | S | | M | M | L | M |
| CO 5 | S | M | L | | M | L | | S | S | S | | M | M | L | M |
| CO 6 | S | S | M | L | M | L | | S | S | S | L | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern: Cognitive Domain

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 80 | 80 |
| Analyze | 20 | 20 |
| Evaluate | | |
| Create | | |

**List of Experiments/Activities with CO Mapping**

| Sl.No | Experiments | CO |
|---|---|---|
| 1. | Select an AI problem and formulate it as PEAS description | CO1 |
| 2. | Implement A*search strategy to reach goal state in the given application | CO2 |
| 3. | Implement Local search strategy to reach goal state in the given application | CO2 |
| 4. | Solve 2-ply games like Alpha Go using APIs | CO3 |
| 5. | Solve Constraint Satisfaction Problems like Crypt arithmetic problem, Water jug problem, etc.. | CO4 |
| 6. | Construct knowledge base for the given use case and apply inference in First Order Logic | CO5 |
| 7. | Solve classification problem using Bayesian models | CO6 |
| 8. | Implement Cart-Pole with Reinforcement learning | CO6 |
| 9. | Make use of suitable Large AI models in Language / Vision / Control with Prompt Engineering for the given application (Mini-Project) | CO6 |

**Learning Resources**


1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
3. Elain Rich and Kevin Knight, “Artificial Intelligence ", Tata McGraw Hill, Third Edition, 2008


**Course Designers:**


1. Dr. K. Sundarakantham (kskcse@tce.edu)
2. Dr. M. Suguna (mscse@tce.edu)

| 22CS590 | PROJECT – I |
|---|---|

| Category | | L | T | P | Credit |
|---|---|---|---|---|---|
| Project | | - | - | 6 | 3 |

## GUIDELINES FOR PROJECT COURSES

In the curriculum of 2022 B.E./B.Tech. Programmes, 12 credits have been assigned for **Project work in the specific discipline**. The curriculum was designed based on around 4 focus/broad areas. This has been split into 4 project courses namely Project I, Project II, Project III and Project IV in semesters 5,6, 7 and 8 respectively.

**Choice of Focus Areas:** HoDs are requested to provide choice for the students to choose one of the broad/focus areas to carry out project work in 5, 6, 7 and 8th semesters. The number of students in each broad/focus areas shall be based on the faculty and infrastructure availability.

**Project Continuity and Switching:** The students shall be given a big project in the chosen broad/focus area so that it can be spread over all four semesters with specific outcomes at each semester. In case, a student wants to switch from one focus area to other area. It has to be approved by the Head of the Department and project coordinator.

**Internal Marks:** Three reviews shall be conducted in each semester to monitor the progress of the project. Review 1; 10 Marks, Review 2: 15 Marks, Review 3: 15 Marks. Total = 40 Marks

**Viva Voce Examinations:** For external examinations, HoD shall appoint two examiners in each focus/broad area to conduct the Viva Voce examination in semesters 5. 6 and 7. Project guides are also one of the examiners, along with the two examiners appointed by the HoD. External exam will be conducted for 60 Marks.

**Final Viva Voce Examination:** In 8th Semester, Viva Voce will be conducted by an external examiner, HoD/HoD Nominee as internal examiner and Project Guides. External exam will be conducted for 60 Marks.

This structured approach ensures that students engage in a comprehensive project experience throughout their undergraduate studies, with regular monitoring of progress and formal evaluation through viva voce examinations. It also allows for flexibility by permitting students to switch focus areas with appropriate approvals.

# CURRICULUM AND DETAILED SYLLABI

## FOR

## B.E DEGREE (Computer Science and Engineering) PROGRAMME

## SIXTH SEMESTER

## FOR THE STUDENTS ADMITTED FROM THE

## ACADEMIC YEAR 2023 - 2024 ONWARDS

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**

**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

**SIXTH SEMESTER**

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS610 | Cryptography and Network Security | PC | 3 | - | - | 3 |
| 22CS620 | Distributed Computing | PC | 3 | - | - | 3 |
| 22CS630 | Compiler Design | PC | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22XXGX0 | Basic Science Elective | OE | 3 | - | - | 3 |
| **PRACTICAL** | | | | | | |
| 22CS670 | Distributed Computing Lab | PC | - | - | 2 | 1 |
| **PROJECT COURSE** | | | | | | |
| 22CS690 | Project - II | PW | - | - | 6 | - 3 |
| **Total** | | | **18** | **-** | **8** | **22** |

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
PW : Project work

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**

**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2022-23 onwards)

**SIXTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS610 | Cryptography and Network Security | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS620 | Distributed Computing | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CS630 | Compiler Design | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 6 | 22XXGX0 | Basic Science Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| **PRACTICAL** | | | | | | | | |
| 7 | 22CS670 | Distributed Computing Lab | 3 | 60 | 40 | 100 | 18 | 50 |
| **PROJECT COURSE** | | | | | | | | |
| 8 | 22CS690 | Project - II | 3 | 40 | 60 | 100 | 27 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

| 22CS610 | CRYPTOGRAPHY AND NETWORK SECURITY | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

## Preamble

Cryptography is the science of information and communication security. This course will discuss common security weaknesses, vulnerabilities, attack methods and mitigation approaches in network security. The focus of the course is on confidentiality, data integrity and non-repudiation. Real time applications of cryptographic primitives are addressed.

## Prerequisite

- Discrete Mathematics
- Basic knowledge in Computer Networks

## Course Outcomes

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

| CO. No | Course Outcomes (COs) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Demonstrate the fundamental theory of modern cryptography. | TPS3 | B | 85 |
| CO2 | Demonstrate the mathematical foundations of security mechanisms. | TPS3 | B | 85 |
| CO3 | Encrypt and Decrypt messages using Private key cryptosystems. | TPS3 | B | 85 |
| CO4 | Encrypt and Decrypt messages using Public key cryptosystems. | TPS3 | B | 85 |
| CO5 | Ensure authentication and data integrity security services through signing and hashing mechanisms. | TPS3 | B | 85 |
| CO6 | Examine the strength of any cryptographic algorithm and design a variant for given requirements. | TPS4 | B | 85 |
| CO7 | Describe the application of cryptographic algorithms in real world protocols | TPS2 | B | 90 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | L | L | L | | M | M | L | L |
| CO2 | S | M | L | | L | | | L | L | L | | M | M | | L |
| CO3 | S | M | L | | L | L | | L | L | L | | M | M | L | L |
| CO4 | S | M | L | | L | L | | L | L | L | | M | M | L | L |
| CO5 | S | M | L | | L | L | | L | L | L | | M | M | L | L |
| CO6 | S | S | M | L | L | | | M | M | M | | M | M | L | M |
| CO7 | M | L | | | M | L | | | | | | M | L | L | |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | | | | Assignment 1 | | | | CAT 2 | | | | | | Assignment 2 | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | 5 | 5 | 15 | - | - | - | - | - | 20 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | 10 | - | - | - |
| **CO2** | 5 | 5 | 15 | - | - | - | - | - | 30 | - | 5 | - | - | - | - | - | - | - | 10 | - | 2 | 5 | 10 | - | - | - |
| **CO3** | - | 5 | 25 | - | - | - | - | - | 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | - | - | 25 | - | - | - | - | - | 25 | - | 2 | - | 15 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | - | - | 25 | - | - | - | - | - | 25 | - | - | - | 15 | - | - | - |
| **CO6** | - | 5 | - | 15 | - | - | - | - | - | 20 | - | - | - | 20 | - | - | - | - | - | 10 | - | 5 | - | 10 | - | - |
| **CO7** | - | - | - | - | - | - | - | - | - | - | 5 | 20 | - | - | - | - | - | 30 | - | - | 4 | 5 | - | - | - | - |

## Syllabus

**Introduction:** Security attacks and threats, OSI Security Architecture – mechanisms and services. Need for perfect secrecy, Shannon's theory - Classical encryption techniques, Modular Arithmetic – Hill cipher, Common attacks on Cryptosystems – CPA, CCA, Side channel attack. Semantic Security and Message Indistinguishability.

**Block cipher Mechanisms**: Feistal network - Data Encryption Standard, Introduction to Finite Fields: Groups - Rings and Fields - Galois Fields, Advanced Encryption Standard, Block cipher modes operation. **Stream Cipher Mechanisms**: One-time pad, Pseudo Random Number Generation algorithms, RC4 Stream Cipher.

**Public Key Encryption**: Introduction to Number Theory- Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality. Public key ciphers - RSA Cryptosystem, Elliptic Curve Cryptography. **Key Management**: Diffie Hellman Key Exchange, Distribution of public keys.

**Data Integrity:** One-way function, Message Authentication Codes, Hash function - SHA algorithm. **Non-Repudiation:** Digital Signature – provably secure signature schemes, Zero knowledge protocols.

**Real world applications:** Authentication Application – Kerberos, Electronic Mail Security – PGP, IP Security - IP Security Architecture. Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction, Blockchain architecture.

**Reference Books& web resources**


1. William Stallings, Cryptography and Network Security: Principles and Practice, Global Edition, Pearson Education, 2022.
2. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security,Mc Graw Hill, 2015.
3. Douglas R. Stinson and Maura B. Paterson, Cryptography: Theory and Practice, Fourth edition, CRC Press, Taylor and Francis Group, 2019.
4. https://www.coursera.org/learn/crypto offered by Dan Boneh - Professor, Computer Science, Stanford University.


**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Introduction (8)** | |
| 1.1 | Security attacks and threats | 1 |
| 1.2 | OSI Security Architecture - Mechanisms and services | 1 |
| 1.3 | Need for perfect secrecy - Shannon's theory | 1 |
| 1.4 | Classical encryption techniques | 2 |
| 1.5 | Modular Arithmetic - Hill cipher | 1 |
| 1.6 | Common attacks on Cryptosystems-<br>CPA, CCA, Side channel attack | 1 |
| 1.7 | Semantic Security and Message Indistinguishability | 1 |
| **2** | **Block cipher Mechanisms (5)** | |
| 2.1 | Feistal network - Data Encryption Standard | 1 |
| 2.2 | Introduction to Finite Fields - Galois Fields | 1 |
| 2.3 | Advanced Encryption Standard | 2 |
| 2.4 | Block cipher modes of operation | 1 |

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **3** | **Stream Cipher Mechanisms (3)** | |
| 3.1 | One-time pad | 1 |
| 3.2 | Pseudo Random Number Generation algorithms | 1 |
| 3.3 | RC4 Stream Cipher | 1 |
| **4** | **Public Key Encryption (5)** | |
| 4.1 | Introduction to Number Theory | 1 |
| 4.2 | Prime Numbers, Fermat's and Euler's Theorem,<br>Testing for Primality | 1 |
| 4.3 | Public key ciphers - RSA Cryptosystem | 1 |
| 4.4 | Elliptic Curve Arithmetic | 1 |
| 4.5 | Elliptic Curve Cryptography | 1 |
| **4.6** | **Key Management (3)** | |
| 4.6.1 | Diffie Hellman Key Exchange - ECDSA | 2 |
| 4.6.2 | Distribution of public keys | 1 |
| **5** | **Data Integrity (4)** | |
| 5.1 | One-way function | 1 |
| 5.2 | Message Authentication Codes | 1 |
| 5.3 | Hash function - SHA algorithm | 2 |
| | **Non-Repudiation (3)** | |
| 5.4 | Digital Signature – provably secure signature schemes | 2 |
| 5.5 | Zero knowledge protocols | 1 |
| **6** | **Real world applications (5)** | |
| 6.1 | Authentication Application – Kerberos | 1 |
| 6.2 | Electronic Mail Security – PGP, IP Security - IP Security Architecture | 1 |

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 6.3 | Web Security- Secure Socket Layer and Transport layer, Secure Electronic Transaction | 2 |
| 6.4 | Blockchain Architecture | 1 |
| | **Total Hours** | **36** |

**Course Designers:**


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2. Dr.M.P.Ramkumar ramkumar@tce.edu

| 22CS620 | DISTRIBUTED COMPUTING | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PC | 3 | 0 | 0 | 3 |

**Preamble**

This course will cover both fundamental concepts in distributed computing and discuss system designs enabling distributed applications. The objectives of the course include: In-depth understanding of core concepts of distributed computing, including study of both abstract concepts and practical techniques for building system support for distributed applications

**Prerequisite**

- 22CS360 Operating Systems (Theory cum Practical)
- 22CS430 Data Communication and Networks
- 22CS570 Network Programming Lab

**Course Outcomes**

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

| CO No. | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Illustrate the design principles and architectures for distributed systems. | TPS2 | B | 85 |
| CO2 | Implement distributed algorithms for concurrent task termination (Apply) | TPS3 | B | 80 |
| CO3 | Practice Mutual Exclusion and deadlock detection algorithms that reveals concurrent programming error (Apply) | TPS3 | B | 80 |
| CO4 | Use appropriate protocols in a set of servers involving distributed Transaction (Apply) | TPS3 | B | 80 |
| CO5 | Apply, Recovery and Check pointing techniques for Fault tolerant distributed systems. (Apply) | TPS3 | B | 80 |
| CO6 | Examine distributed system issues to handle and process large data volumes through appropriate tools (Analyze) | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | | | | | | | L | L | | |
| CO2. | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO3 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO4 | S | M | L | | | | | M | M | M | | M | M | | M |
| CO5 | S | M | L | | | | | M | M | M | | M | M | | M |
| CO6 | S | S | M | L | M | L | | M | M | M | L | M | S | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 50 | - | - | - | - | - | - | - | - | 5 | 12 | - | - | - |
| CO3 | 5 | 5 | 30 | - | - | - | 50 | - | - | - | - | - | - | - | - | 5 | 12 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | - | - | - | - | 40 | - | 5 | 12 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 50 | - | - | - | 40 | - | 5 | 12 | - | - | - |
| CO6 | - | - | - | - | - | - | - | - | 10 | - | 20 | - | - | 20 | - | 5 | - | 12 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction** – Distributed System Models and Enabling Technologies, Multi/Many-Core Computing, Memory System Parallelism for Data Intensive and Data-Driven Applications, Goals and Challenges in Distributed System

**Logical Time and Global State** – Clock Synchronization, Logical Clocks -Global State and Snapshot Recording Algorithm -Message ordering and group communication: Message ordering paradigms -- Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system.

**Distributed Mutex And Deadlock** – Distributed mutual exclusion algorithms - Ricart–Agrawala algorithm -- Quorum-based mutual exclusion algorithms -- Token-based algorithms -- Suzuki–Kasami's broadcast algorithm; Deadlock detection in distributed systems: System model – Models of deadlocks -- Knapp's classification of distributed deadlock detection algorithms -- Mitchell and Merritt's algorithm for the single resource model -- Chandy–Misra–Haas algorithm –AND,OR Models

**Distributed Transaction and Recovery –** Flat and nested distributed Transactions-Atomic Commit protocols-Concurrency Control- Transaction with replicated data-- Consensus and agreement algorithms -- Checkpointing and rollback recovery: Issues in failure recovery -- Checkpoint-based recovery -- Log based rollback recovery - coordinated checkpointing algorithm -- asynchronous checkpointing and recovery.

**Distributed File Systems** – Name Services - File Models, File Accessing Models, File-sharing Semantics, File-caching Schemes, File Replication,- Sun's network file system, Andrews file system-Naming- Directory services.- Security:Techniques **Case Study**: Peer to Peer Computing-Distributed Object Based System, Distributed Web Based System, Distributed Coordinated System

**Text Book**

1. Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.

**Reference Books & web resources**

1. M. Van Steen, A.S. Tanenbaum, Distributed Systems, Third Edition, CreateSpace Independent Publishing Platform, 2017.
2. Garg VK. Elements of distributed computing. John Wiley & Sons, 2002.
3. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007
4. Liu M.L., —Distributed Computing, Principles and Applications‖, Pearson Education, 2004
5. Fokkink W. Distributed algorithms: an intuitive approach, Second Edition, MIT Press, 2018.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Distributed System Models and Enabling Technologies | 1 |
| 1.2 | Multi/Many-Core Computing | 1 |
| 1.3 | Memory System Parallelism for Data Intensive and Data-Driven Applications | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 1.4 | Goals and Challenges in Distributed System | 1 |
| **2** | **Logical Time and Global State** | |
| 2.1 | Clock Synchronization, Logical Clocks | 2 |
| 2.2 | Global State and Snapshot Recording Algorithm | |
| 2.3 | Message ordering and group communication: Message ordering paradigms | 2 |
| 2.4 | Asynchronous execution with synchronous communication – Synchronous program order on an asynchronous system | 2 |
| **3** | **Distributed Mutex And Deadlock** | |
| 3.1 | Distributed mutual exclusion algorithms -Lamport's algorithm -- Ricart–Agrawala algorithm | 2 |
| 3.2 | Quorum-based mutual exclusion algorithms -- Maekawa's algorithm -- Token-based algorithms -- Suzuki–Kasami's broadcast algorithm | 2 |
| 3.3 | Deadlock detection in distributed systems: System model – Models of deadlocks | 1 |
| 3.4 | Knapp's classification of distributed deadlock detection algorithms | 1 |
| 3.5 | Mitchell and Merritt's algorithm for the single resource model -- Chandy–Misra–Haas algorithm – AND,OR Models | 3 |
| **4** | **Distributed Transaction and Recovery** | |
| 4.1 | Flat and nested distributed Transactions-Atomic Commit protocols-Concurrency Control | 2 |
| 4.2 | Transaction with replicated data-- Consensus and agreement algorithms | 2 |
| 4.3 | Checkpointing and rollback recovery: Issues in failure recovery --Checkpoint-based recovery -- Log based rollback recovery | 1 |
| 4.4 | Coordinated checkpointing algorithm -- asynchronous checkpointing and recovery. | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | | |
| **5** | **Distributed File Systems** | |
| 5.1 | File Models, File Accessing Models, File-sharing Semantics, File-caching Schemes | 2 |
| 5.2 | File Replication,- Sun's network file system, Andrews file system | 2 |
| 5.3 | Naming- Directory services.- Security:Techniques | 2 |
| **6** | **Case Study** | |
| 6.1 | Peer to Peer Computing,Distributed Object Based System, Distributed Web Based System, Distributed Coordinated System | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS630** | **COMPILER DESIGN** | PC | 3 | 0 | 0 | 3 |

## Preamble

The objective of this course is to learn basic principles and advanced techniques of compiler design. It focuses on general phases of a compiler such as lexical analysis, syntactic analysis, semantic analysis, abstract syntax tree and code-generation as well as basic optimizations.

## Prerequisite

- 22CS520 - Theory of Computation

## Course Outcomes

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

| No. | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the role of compilers for converting the high level language to machine level language and summarize the phases of compilers | TPS2 | B | 80 |
| CO2 | Exhibit the working of lexical analyser for recognizing the tokens of a given language | TPS3 | B | 75 |
| CO3 | Demonstrate different types of parsers to perform the syntax analysis. | TPS3 | B | 75 |
| CO4 | Construct Syntax directed definition and dependency graph with type checking | TPS3 | B | 75 |
| CO5 | Make use of runtime memory elements for storage allocation strategies which includes procedure calls, variable allocation and memory allocation | TPS3 | B | 75 |
| CO6 | Develop intermediate code generators to translate the source code to an intermediate code using register allocation. | TPS3 | B | 75 |
| CO7 | Devise algorithms for generating target code by analysing different code optimization techniques | TPS4 | B | 75 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | L | L | | L | | | | M | M | L | L |
| CO2. | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO3 | S | M | L | | M | L | | M | L | L | | M | M | M | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO5 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO6 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO7 | S | S | M | L | M | L | | M | L | L | | M | S | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| **CO** | **CAT1** | | | | | | **CAT2** | | | | | | **Terminal** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 10 | | | | | | | | | | | 3 | 5 | | | | |
| CO2 | 5 | 10 | 15 | | | | | | | | | | 3 | 5 | 5 | | | |
| CO3 | 5 | 10 | 15 | | | | | | | | | | 3 | 5 | 5 | | | |
| CO4 | 5 | 10 | 10 | | | | | | | | | | 3 | 5 | 10 | | | |
| CO5 | | | | | | | 5 | 10 | 20 | | | | 3 | 5 | 10 | | | |
| CO6 | | | | | | | 5 | 10 | 20 | | | | | 5 | 10 | | | |
| CO7 | | | | | | | | 10 | | 20 | | | | 5 | | 10 | | |
| **Total** | 20 | 40 | 40 | | | | 10 | 30 | 40 | 20 | | | 15 | 35 | 40 | 10 | | |

| **CO** | **Assignment 1** | | | | | | **Assignment 2** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | | | | | | | | | | | | |
| CO2 | | | 30 | | | | | | | | | |
| CO3 | | | 30 | | | | | | | | | |
| CO4 | | | 40 | | | | | | | | | |
| CO5 | | | | | | | | | 40 | | | |
| CO6 | | | | | | | | | 40 | | | |
| CO7 | | | | | | | | | | 20 | | |
| **Total** | | | 100 | | | | | | 80 | 20 | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Compiler structure:** The analysis-synthesis model of compilation, various phases of a compiler, and tool-based approach to compiler construction.

**Lexical analysis:** interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams.
**Syntax analysis:** Review on CFGs, ambiguity, associativity, precedence, top-down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom-up parsing, LR parsers (SLR, LALR, CLR).
**Syntax-directed definitions:** inherited and synthesized attributes, dependency graph, evaluation order, bottom-up and top-down evaluation of attributes, L- and S-attributed definitions, Circularity disambiguation.
**Type checking:** Type system, type expressions, structural and name equivalence of types, type resolution, type conversion, overloaded functions, operators, polymorphic functions.
**Run time system:** storage organization, activation tree, activation record, stack allocation of activation records, parameter passing mechanisms.
**Intermediate code generation:** Intermediate representations, translation of declarations, assignments, control flow, boolean expressions, and procedure calls, Backpatching.
**Code generation and instruction selection:** Issues, basic blocks, flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGs, peephole optimization, code optimization for machine architectures, Sethi-Ullman algorithm and Aho-Johnson dynamic programming algorithms, code generator generators. Case study on COOL compiler.

**Text Books**

1. A.V. Aho, R. Sethi, J.D. Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education, Second Edition, 2014.
2. AW Appel, M Ginsburg, Modern Compiler Implementation in C, Cambridge University Press, 2004.

**Reference Books & Web resources**

1. K Cooper, L Torczon, Engineering a Compiler, 2nd Ed., Morgan Kaufmann, 2011
2. Michael L Scott, Programming Language Pragmatics, 3rd Ed., Morgan Kaufmann, 2009
3. Santanu Chattopadhyay, “Compiler Design”, PHI Learning Pvt. Ltd., 2015.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Compiler structure (2)** | |
| 1.1 | Analysis-synthesis model of compilation, Phases of a compiler | 1 |
| 1.2 | Tool-based approach to compiler construction | 1 |
| **2** | **Lexical analysis (3)** | |
| 2.1 | Interface with input, parser, and symbol table | 1 |
| 2.2 | Token, lexeme and patterns, Difficulties in lexical analysis, Error reporting | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.3 | Implementation. Regular definition, Transition diagrams. | 1 |
| **3** | **Syntax analysis (8)** | |
| 3.1 | Review on CFGs, ambiguity, associativity | 1 |
| 3.2 | Precedence, top-down parsing | 1 |
| 3.3 | Recursive descent parsing | 1 |
| 3.4 | Transformation on the grammar, predictive parsing, bottom-up parsing | 2 |
| 3.5 | LR parsers (SLR, LALR, CLR). | 3 |
| **4** | **Syntax-directed definitions (4)** | |
| 4.1 | Inherited and synthesized attributes, dependency graph | 2 |
| 4.2 | Evaluation order, bottom-up and top-down evaluation of attributes, L- and S-attributed definitions, Circularity disambiguation | 2 |
| **5** | **Type checking (3)** | |
| 5.1 | Type system, type expressions, structural and name equivalence of types, type resolution, type conversion | 2 |
| 5.2 | Overloaded functions and operators, polymorphic functions | 1 |
| **6** | **Run time system (4)** | |
| 6.1 | Storage organization, activation tree, activation record | 2 |
| 6.2 | Stack allocation of activation records, parameter passing mechanisms | 2 |
| **7** | **Intermediate code generation (5)** | |
| 7.1 | Intermediate representations | 1 |
| 7.2 | Translation of declarations, assignments | 2 |
| 7.3 | Translation of control flow, boolean expressions, and procedure calls, Backpatching | 2 |
| **8** | **Code generation and instruction selection (7)** | |
| 8.1 | Issues, basic blocks, and flow graphs, | 1 |
| 8.2 | Register allocation, code generation, DAG representation of programs, code generation from DAGs | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 8.3 | Peephole optimization, code optimization for machine architectures, Sethi-Ullman algorithm and Aho-Johnson dynamic programming algorithms | 2 |
| 8.4 | code generator generators, Case study on COOL compiler. | 2 |
| | **Total** | **36** |

**Course Designer(s):**


1. Dr.K.Sundarakantham kskcse@tce.edu
2. Dr.B.Subbulakshmi bscse@tce.edu

| 22CS670 | DISTRIBUTED COMPUTING LAB | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PC | 0 | 0 | 2 | 1 |

## Preamble

This Practical course will enable students clearly understands broad range of concepts related to distributed computing including architecture, programming paradigms, algorithms and other applications of distributed computing.

## Prerequisite

- 22CS360 Operating Systems (Theory cum Practical)
- 22CS430 Data Communication and Networks
- 22CS570 Network Programming Lab

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency (%) | Expected Attainment Level (%) |
|---|---|---|---|---|
| CO1 | Design an Application programming Interface for multi-processing and multi programing environment. (Apply) | TPS3 | A | 85 |
| CO2 | Demonstrate a framework for a concurrent system using logical time and global state. (Apply) | TPS3 | A | 85 |
| CO3 | Implement Mutual Exclusion and deadlock detection algorithms in Distributed Systems. (Apply) | TPS3 | A | 85 |
| CO4 | Implement File sharing, caching and accessing mechanism in Distributed File systems. (Apply) | TPS3 | A | 85 |
| CO5 | Design distributed Object Based systems (Apply) | TPS3 | A | 85 |
| CO6 | Design distributed Web Based systems (Apply) | TPS3 | A | 85 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |
| CO2 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |
| CO3 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |
| CO4 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |
| CO5 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |
| CO6 | S | M | L | | M | M | L | S | S | S | | M | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern: Cognitive Domain

| Cognitive Levels | Model Examination | Terminal Examination |
|---|---|---|
| Remember | | |
| Understand | | |
| Apply | 100 | 100 |
| Analyze | | |
| Evaluate | | |
| Create | | |

**List of Experiments/Activities with CO Mapping**

| Sl.No | Experiments | CO |
|---|---|---|
| 1. | Implementation of application programming interface with OpenMP pogramming | CO1 |
| 2. | Implementation of application programming interface with MPI programming | CO1 |
| 3. | Implementation of functioning of Logical and Vector clock. | CO2 |
| 4. | Implementations of Distributed Mutual exclusion algorithm | CO3 |
| 5. | Implementation of Non Token/ Token based algorithm in Distributed system | CO3 |
| 6. | Implementation of the Distributed Deadlock Detection algorithm | CO3 |
| 7. | Implementation of Hadoop –Map Reduce Programming | CO4 |
| 8. | Implementation of Implement ‘RPC’ mechanism for accessing methods of remote systems | CO5 |
| 9. | Implement CORBA mechanism by using C++ program at one end and Java Program on the other | CO5 |
| 10. | Implement Web Service for an web application | CO6 |

**Learning Resources**


1. Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems: Concepts and Design, Fifth Edition, Pearson Education, 2017.
3. M. Van Steen, A.S. Tanenbaum, Distributed Systems, Third Edition, CreateSpace Independent Publishing Platform, 2017.
4. Garg VK. Elements of distributed computing. John Wiley & Sons, 2002.
5. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007


**Course Designers:**


1. Dr.R. Leena Sri (rlsit@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

# CURRICULUM AND DETAILED SYLLABI

## FOR

## B.E DEGREE (Computer Science and Engineering) PROGRAMME

## SEVENTH and EIGHTH SEMESTERS

## FOR THE STUDENTS ADMITTED FROM THE

## ACADEMIC YEAR 2023 - 2024 ONWARDS

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

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**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programmes**
**COURSES OF STUDY**
(For the candidates admitted from 2023-24 onwards)

## SEVENTH SEMESTER

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CS710 | Engineering Economics | HSS | 3 | - | - | 3 |
| 22CS720 | Human Computer Interaction | ESC | 2 | - | - | 2 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| **PROJECT COURSE** | | | | | | |
| 22CS790 | Project - III | PW | - | - | 6 | 3 |
| **Total** | | | **17** | **-** | **6** | **20** |

## EIGHTH SEMESTER

| Course Code | Name of the Course | Category | No. of Hours / Week | | | credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| **THEORY** | | | | | | |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| 22CSPX0 | Programme Elective | PE | 3 | - | - | 3 |
| **PROJECT COURSE** | | | | | | |
| 22CS890 | Project - IV | PW | - | - | 6 | 3 |
| **Total** | | | **6** | **-** | **6** | **9** |

BSC : Basic Science Courses
PC : Professional Core Courses
ESC : Engineering Science Courses
PW : Project Work

L : Lecture
T : Tutorial
P : Practical

**Note**:
1 Hour Lecture is equivalent to 1 credit
1 Hour Tutorial is equivalent to 1 credit
2 Hours Practical is equivalent to 1 credit

**THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015**
**B.E. / B.Tech. Degree Programme**
**SCHEME OF EXAMINATIONS**
(For the candidates admitted from 2023-24 onwards)

**SEVENTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CS710 | Engineering Economics | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CS720 | Human Computer Interaction | 3 | 40 | 60 | 100 | 27 | 50 |
| 3 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 4 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 5 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 6 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| **PROJECT COURSE** | | | | | | | | |
| 7 | 22CS790 | Project - III | 3 | 40 | 60 | 100 | 27 | 50 |

**EIGHTH SEMESTER**

| S.No. | Course Code | Name of the Course | Duration of Terminal Exam. in Hrs. | Marks | | | Minimum Marks for Pass | |
|---|---|---|---|---|---|---|---|---|
| | | | | Continuous Assessment * | Terminal Exam ** | Max. Marks | Terminal Exam | Total |
| **THEORY** | | | | | | | | |
| 1 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| 2 | 22CSPX0 | Programme Elective | 3 | 40 | 60 | 100 | 27 | 50 |
| **PROJECT COURSE** | | | | | | | | |
| 3 | 22CS890 | Project - IV | 3 | 40 | 60 | 100 | 27 | 50 |

* CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS710** | **ENGINEERING ECONOMICS** | HSS | 3 | 0 | 0 | 3 |

## Preamble

Efficient functioning of any business organization would enable it to provide goods/services at a lower price. In the process of managing organizations, the managers at different levels should take appropriate economic decisions which will help in minimizing investment, operating and maintenance expenditures besides increasing the revenue, savings and such other gains of the organization. These can be achieved through Engineering Economics which deals with the methods that enable one to make economic decisions towards minimizing costs and/or maximizing benefits to business organizations. The required techniques and methods are discussed in this course. Also, AI is becoming more and more important in making an impact on economic and finance theories. Hence, a few case studies are also discussed.

## Prerequisite

Nil

## Course Outcomes

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

| CO | Course Outcomes | **TCE Proficiency Scale** | **Expected Proficiency in %** | **Expected Attainment Level %** |
|---|---|---|---|---|
| CO1 | Determine the cut off production volume for a company to make profit by performing break even analysis with an understanding of various costs involved. | TPS3 | A | 70 |
| CO2 | Make investment decisions by applying interest formulas | TPS3 | A | 70 |
| CO3 | Choose the best project option from among a set of competing alternatives. | TPS3 | A | 70 |
| CO4 | Perform replacement / maintenance analysis to minimize the maintenance cost in an organization | TPS3 | A | 70 |
| CO5 | Perform depreciation accounting to obtain the book value of an asset. | TPS3 | A | 70 |
| CO6 | Build machine learning models for aiding economic policy design with a comprehension of the impact of AI in economic and finance theories. | TPS3 | A | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | | | | L | M | M | M | L | L | | M |
| CO2. | S | M | L | | | | | L | M | M | M | L | L | | M |
| CO3 | S | M | L | | | | | L | M | M | M | L | L | | M |
| CO4 | S | M | L | | | | | L | M | M | M | L | L | | M |
| CO5 | S | M | L | | | | | L | M | M | M | L | L | | M |
| CO6 | S | M | L | | L | L | | L | M | M | M | M | L | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | CAT2 | | | ASSIGNMENT 1 | | | ASSIGNMENT 2 | | | TERMINAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| **CO1** | 5 | | 16 | | | | | | 20 | | | | 3 | | 8 |
| **CO2** | 5 | 10 | 30 | | | | | | 45 | | | | 2 | 5 | 15 |
| **CO3** | | 10 | 24 | | | | | | 35 | | | | | 5 | 12 |
| **CO4** | | | | 5 | | 16 | | | | | | 20 | | 5 | 12 |
| **CO5** | | | | 5 | 10 | 30 | | | | | | 45 | 2 | 5 | 15 |
| **CO6** | | | | | 10 | 24 | | | | | | 35 | 3 | | 8 |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Economics:** Flow in an Economy- Law of Supply and Demand - Concept of Engineering Economics- Types of Efficiency- Definition and Scope of Engineering Economics - Elements of Costs- Other Costs/Revenues- Marginal Cost- Marginal Revenue- Sunk Cost- Opportunity Cost- Break-Even Analysis - Profit/Volume Ratio (P/V Ratio)- Application in make or buy decision.

**Interest Formulas and Their Applications:** Introduction -Time Value of Money- Interest Formulas - Single-Payment Compound Amount Single-Payment Present Worth Amount - Equal-Payment Series Compound Amount - Equal Payment Series Sinking Fund- Equal-Payment Series Present Worth Amount- Equal-Payment Series Capital Recovery Amount - Uniform Gradient Series Annual Equivalent Amount -Effective Interest Rate.

**Comparison of Project Alternatives:** Present worth method - Future worth method - Annual equivalent method - Rate of return method.

**Replacement and Maintenance Analysis:** Introduction - Types of Maintenance - Types of Replacement Problem - Determination of Economic Life of an Asset - Replacement of Existing Asset with a New Asset - Capital Recovery with Return- Concept of Challenger and Defender.

**Depreciation:** Introduction- Methods of Depreciation - Straight Line Method of Depreciation - Declining Balance Method of Depreciation - Sum-of-the-Years-Digits Method of Depreciation - Sinking Fund Method of Depreciation - Service Output Method of Depreciation.

**Application of Machine Learning in Economics:** Types of machine learning- Use Cases- Case Studies on prediction of real estate prices, market basket analysis and economic growth.

**Text Book**

Panneerselvam R, Engineering Economics, PHI Learning Private Limited; 2nd edition, 2013.

**Reference Books & web resources**

1. Chan S Park, Contemporary Engineering Economics, Pearson, 5th edition, 2015.

2. NPTEL course on Engineering Economic Analysis - https://nptel.ac.in/courses/112107209

3. Sendhil Mullainathan and Jann Spiess, Machine Learning: An applied Econometric Approach , *Journal of Economic Perspectives-Volume 31, Number 2-Spring 2017-Pages 87–106*

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Economics:** | |
| 1.1 | Flow in an Economy- Law of Supply and Demand - Concept of Engineering Economics-Types of Efficiency-Definition and Scope of Engineering Economics | 1 |
| 1.2 | Elements of Costs- Other Costs/Revenues- Marginal Cost- Marginal Revenue- Sunk Cost- Opportunity Cost | 1 |
| 1.3 | Break-Even Analysis-Profit/Volume Ratio (P/V Ratio) | 1 |
| 1.4 | Application in make or buy decision. | 1 |
| **2** | **Interest Formulas and Their Applications:** | |
| 2.1 | Introduction -Time Value of Money- Interest Formulas - Single-Payment Compound Amount- Single-Payment Present Worth Amount . | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.2 | Equal-Payment Series Compound Amount - Equal Payment Series Sinking Fund- Equal-Payment Series Present Worth Amount- Equal-Payment Series Capital Recovery Amount . | 4 |
| 2.3 | Uniform Gradient Series - Annual Equivalent Amount - Effective Interest Rate. | 2 |
| **3** | **Comparison of Project Alternatives:** | |
| 3.1 | Present worth method - Future worth method. | 3 |
| 3.2 | Annual equivalent method - Rate of return method. | 3 |
| **4** | **Replacement and Maintenance Analysis:** | |
| 41 | Introduction - Types of Maintenance - Types of Replacement Problem - Determination of Economic Life of an Asset | 3 |
| 4.2 | Replacement of Existing Asset with a New Asset - Capital Recovery with Return- Concept of Challenger and Defender. | 3 |
| 5 | **Depreciation:** | |
| 5.1 | Introduction- Methods of Depreciation - Straight Line Method of Depreciation - Declining Balance Method of Depreciation. | 4 |
| 5.2 | Sum-of-the-Years-Digits Method of Depreciation - Sinking Fund Method of Depreciation - Service Output Method of Depreciation. | 4 |
| 6 | **Application of Machine Learning in Economics:** | |
| 6.1 | Types of machine learning- Use Cases | 1 |
| 6.2 | Case Studies on prediction of real estate prices, market basket analysis and economic growth. | 3 |
| | Total | 36 |

**Course Designer(s):**

C.Sridharan, Associate Professor of Computer Science and Engineering, cscse@tce.edu

| | | | | | | |
|---|---|---|---|---|---|---|
| **22CS720** | **HUMAN COMPUTER INTERACTION** | **Category** | **L** | **T** | **P** | **Credit** |
| | | ES | 2 | 0 | 0 | 2 |

## Preamble

The objective of this course is to introduce the basic theories and concepts of human-computer interaction (HCI). Through a thinking process, students will gain knowledge in components of human perception, cognition, and learning as they apply to the design, implementation, and evaluation of interfaces.

## Prerequisite

NIL

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Acquire fundamental concepts of computer component functions regarding interaction with human and vice versa | TPS2 | B | 85 |
| CO2 | Choose the appropriate standards for HCI systems preferred by the user | TPS3 | B | 80 |
| CO3 | Categorize the given problem and design the interface using suitable interaction styles | TPS4 | B | 80 |
| CO4 | Using the interface to assess the extent and accessibility of the system functionality | TPS3 | B | 80 |
| CO5 | Apply evaluation strategies and validate the interfaces to meet ethical standards | TPS3 | B | 80 |
| CO6 | Design and implement usable and engaging interfaces | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | | | | | | L | | |
| CO2 | S | M | L | | | | | | | | | L | M | | |
| CO3 | S | S | M | L | M | L | L | M | L | L | L | L | M | M | M |
| CO4 | S | M | L | | L | | | M | L | L | | L | M | L | L |
| CO5 | S | M | L | | L | | | M | L | L | | L | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | S | M | L | | L | | | M | L | L | | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 5 | - | - | - | - |
| CO2 | 5 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO3 | 10 | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | 15 | 70 | - | - | - | - | - | - | - | - | 2 | 5 | | 20 | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | 5 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | - | 70 | - | - | - | - | 5 | 10 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Foundations:** History-Goals-Tools - User-oriented approach-Interface- Elements and methods - Relationship between HCI and AI.
**Requirements:** Components - Characteristics - Usability- Understandability – Correctness - Completeness- Scalability and Concurrency-Problems in Multi-Portal Systems - Error handling.
**Design:** Basics - User Focus – Scenarios – Navigation – Layout and Menu design - Usability Engineering - Design Rules – Interaction Models – Ergonomics - HCI Patterns - Perceptions and experiences of using AI – Cognitive Design Models using AR/VR.
**Evaluation:** Principles - Expert Reviews – Usability and Acceptance Testing – Evaluation of Spastic Devices Interaction Panels.

**Visualization**: Basics-Attention and overreliance on AI- Ambiguity in human intent and communication- Interpretability and Explainability - Interactive visualization – Understanding model behaviour.
**Ethics and Safety**: Ethics- Fairness and Equity- Privacy- Transparency-Bias- Reliability and Trustworthiness.
Case Study –Web Design Interface, Conversational AI and Explainable AI

## Reference Books & web resources


1. Alan Dix, Janet E.Finlay, Gregory D.Abowd, Russell Beale , “Human- Computer Interaction” (3rd Edition), Prentice-Hall, Inc, 2009, ISBN : 0130461091.
2. B. Shneiderman; Designing the User Interface, Addison Wesley, 5th Edition, 2014.
3. John M.Carrol, “Human Computer Interaction in the New Millenium”, Pearson Education, 2002.
4. Don Norman, “The Design of Everyday Things”, First Edition, Basic Books, 2013.
5. Henry A.Kissinger, Eric Schmidt, Daniel Huttenlocher, “ The Age of A.I : and our Human Future” , John Murray, 2021, ISBN: 1529375975
6. http://cs.brown.edu/courses/cs295-7/

7. http://www.cs.tufts.edu/~jacob/250bci/
8. https://courses.isds.tugraz.at/hci/hci.pdf
9. http://iitg.ac.in/uelab/courses.html

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Foundations (2)** | |
| 1.1 | History | 1 |
| 1.2 | Goals | |
| 1.3 | Tools | |
| 1.4 | User-oriented approach | 1 |
| 1.5 | Interface | |
| 1.6 | Elements and methods | |
| 1.7 | Relationship between HCI and AI | |
| **2** | **Requirements (3)** | |
| 2.1 | Components | 1 |
| 2.2 | Characteristics | |
| 2.3 | Usability | 1 |
| 2.4 | Understandability | |
| 2.5 | Correctness | |
| 2.6 | Completeness | |
| 2.7 | Scalability and Concurrency | |
| 2.8 | Problems in Multi-portal Systems | 1 |
| 2.9 | Error handling | |
| **3** | **Design (7)** | |
| 3.1 | Basics | 1 |
| 3.2 | User Focus | |
| 3.3 | Scenarios | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.4 | Navigation | |
| 3.5 | Layout and Menu design | 2 |
| 3.6 | HCI in Software Process | |
| 3.7 | Usability Engineering | 1 |
| 3.8 | Design Rules | |
| 3.9 | Interaction Models | |
| 3.10 | Ergonomics | 1 |
| 3.11 | HCI Patterns | |
| 3.12 | Perceptions and experiences of using AI | |
| 3.13 | Cognitive Design Models using AR/VR | 2 |
| **4** | **Evaluation (3)** | |
| 4.1 | Principles | 1 |
| 4.2 | Expert Reviews | |
| 4.3 | Usability and Acceptance testing | 2 |
| 4.4 | Evaluation of Spastic Devices Interaction Panels | |
| **5** | **Visualization (4)** | |
| 5.1 | Attention and overreliance on AI | 1 |
| 5.2 | Ambiguity in human intent and communication | 1 |
| 5.3 | Interpretability and Explainability | 1 |
| 5.4 | Interactive visualization | |
| 5.5 | Understanding model behaviour | 1 |
| **6** | **Ethics and Safety (2)** | |
| 6.1 | Ethics | 1 |
| 6.2 | Fairness and Equity | |
| 6.3 | Privacy | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.4 | Transparency | 1 |
| 6.5 | Bias | |
| 6.6 | Reliability and Trustworthiness | |
| | Case Study –Web design Interface, Conversational AI and Explainable AI | 3 |
| | **Total** | **24** |

**Course Designer(s):**


1. Dr.M.Suguna, Assistant Professor,CSE mscse@tce.edu
2. Ms.C.Santhiya, Assistant Professor, CSE csit@tce.edu

# CURRICULUM AND DETAILED SYLLABI

**FOR**

# B.E DEGREE (Computer Science and Engineering) PROGRAMME

## PROGRAMME ELECTIVES

**FOR THE STUDENTS ADMITTED FROM THE**

**ACADEMIC YEAR 2023 - 2024 ONWARDS**

**THIAGARAJAR COLLEGE OF ENGINEERING**

(A Government Aided ISO 9001-2008 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41

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| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPA0** | **DATA MINING** | PSE | 3 | 0 | 0 | 3 |

## Preamble

This course aims at facilitating the student to understand the concepts of data warehousing and various techniques involved in mining the data. It helps the students to learn about constructing and querying over data warehouse, preparing data for analysis, concepts and methodology of different data mining techniques. Students can also learn and practice the applications of data mining algorithms over different types of data.

## Prerequisite

- Knowledge in Databases

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Construct a data warehouse for the given requirements and execute various OLAP operations on the data warehouse. | TPS3 | B | 80 |
| CO2 | Identify suitable data pre-processing methods to extract insights from the given data. | TPS3 | B | 80 |
| CO3 | Generate association rules using frequent pattern mining algorithms from the given dataset. | TPS3 | B | 80 |
| CO4 | Employ different classification and prediction algorithms to build analytical models for real-life problems. | TPS3 | B | 80 |
| CO5 | Develop clusters using appropriate clustering methods to handle outliers present in the given data set. | TPS3 | B | 80 |
| CO6 | Use suitable mining algorithms to extract insights from different types of data such as text, web, and sequence data. | TPS3 | B | 80 |
| CO7 | Experiment with various data mining techniques using modern tools such as Orange, Rapid Miner, Weka. | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO2 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO3 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO5 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO6 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO7 | S | S | M | L | M | M | | M | M | M | M | M | S | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 10 | 20 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO2 | 5 | 10 | 10 | | | | | | | | | | | 5 | 10 | | | |
| CO3 | 10 | 10 | 20 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO4 | | | | | | | 10 | 10 | 20 | | | | 2 | 5 | 10 | | | |
| CO5 | | | | | | | 5 | 10 | 20 | | | | 2 | 5 | 10 | | | |
| CO6 | | | | | | | 5 | 10 | 10 | | | | 2 | 10 | 5 | | | |
| CO7 | | | | | | | | | | | | | | | | | | |
| **Total** | **20** | **30** | **50** | | | | **20** | **30** | **50** | | | | **10** | **35** | **55** | | | |

| CO | Assignment I | | | | | | Assignment II | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | | | 20 | | | | | | | | | |
| CO2 | | | 30 | | | | | | | | | |
| CO3 | | | 30 | | | | | | | | | |
| CO4 | | | | | | | | | 30 | | | |
| CO5 | | | | | | | | | 30 | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | | | | | | | | | 20 | | | |
| CO7 | | | | 20 | | | | | | 20 | | |
| **Total** | | | **80** | **20** | | | | | **80** | **20** | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Data warehousing and OLAP:** Data warehousing architecture and Implementation, ETL process, OLTP, OLAP, ROLAP, MOLAP, SQL support for OLAP, OLAP operations Multidimensional data model – Data cubes computation methods, Attribute oriented induction, Schema structures – star, snowflake, galaxy schemas, concept hierarchy.

**Data Mining and KDD Process -**: Data Mining basics, KDD process, Mining on different types of data and patterns, Related technologies, Applications and Issues in data mining. **Data Pre-processing:** Data objects and attribute types, Data Cleaning, Data Integration, Data Reduction, Data Transformation, and Discretization.

**Mining Frequent Patterns, Associations, and Correlations**: Concepts, Frequent pattern mining methods - Apriori and FP-Growth algorithm, mining using vertical data format, closed and maximal patterns - Pattern evaluation methods -Pattern mining in multilevel, multidimensional space.

**Classification**: Decision tree Induction - Bayesian classification–Rule-based classification, Support vector machines, K-NN classifier, Associative Classification - Model evaluation methods

**Clustering**: Cluster Analysis, measuring data similarity and dissimilarity, Partition based Methods: K-Means, K-Medoids, Hierarchical Methods: AGNES, DIANA, BIRCH, Density-based Methods: DBSCAN, Model-based clustering – COBWEB, Outlier Analysis - Outlier detection methods.

**Other mining methods:** Sequential Pattern Mining – SPADE, GSP, Text Mining – Pre-processing, Text classification, and clustering, Web Mining – Web Structure, Web content, and Web usage mining, Overview of data stream mining.

**CO7 will be evaluated by the Mini project.**

**Guidelines for the Mini-project:**

**Group formation**: Students are split into project groups with around 3 members in each group. A team can execute the project with various data mining algorithms and improve the efficiency of the algorithm by pre-processing methods using any of the data mining software like Orange, Weka and Rapid Miner etc. At the end of the semester, the team members have to present their project, submit their report and share their lessons learned/best practices with other teams.

Some of the activities may include: (but not limited to)

- ✓ Application identification and data set collection
- ✓ Select relevant data mining algorithms to extract knowledge from the data set.
- ✓ Design a diagram of knowledge extraction from raw data.
- ✓ Results and performance analysis for the chosen data mining technique.
- ✓ Documentation

Some of the Mini-project titles may include: (but are not limited to)

- ✓ e-governance
- ✓ Health care
- ✓ Banking
- ✓ University data analysis
- ✓ Social media

## Text Books


1. Jiawei Han, MichelineKamber, Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Elsevier,2011.
2. Arun K. Pujari, "Data Mining Techniques", Second Edition, University Press, 2013.


## Reference Books


1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. Ian H.Witten, Eibe Frank, Mark.A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Elsevier, Fourth Edition, 2016.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", Prentice Hall India Learning Private Limited, Third Edition, 2014.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lecture Hours |
|---|---|---|
| **1** | **Data warehousing and OLAP (6)** | |
| 1.1 | Data warehousing concepts and architecture, Implementation | 1 |
| 1.2 | ETL process, OLTP, OLAP, ROLAP, MOLAP, SQL support for OLAP, OLAP operations | 2 |
| 1.3 | Multidimensional data model – Data cube computation methods, Attribute oriented induction | 2 |
| 1.4 | Schema structures – star, snowflake, galaxy schemas, concept hierarchy | 1 |
| **2** | **Data Mining and KDD Process, Data Pre-processing (6)** | |
| 2.1 | Data Mining Basics, KDD process, Mining on different types of data and patterns | 1 |
| 2.2 | Related technologies, Applications and issues in data mining | 1 |
| 2.3 | **Data Pre-processing:** Data objects and attribute types, Data Cleaning | 1 |
| 2.4 | Data Integration and Data Reduction | 2 |
| 2.5 | Data Transformation, Data discretization | 1 |
| **3** | **Mining Frequent Patterns, Associations, and Correlations(6)** | |
| 3.1 | Concepts, Frequent pattern mining methods - Apriori algorithm | 2 |
| 3.2 | FP-Growth Algorithm, Mining using vertical data format, closed and maximal patterns | 2 |
| 3.3 | Pattern evaluation methods | 1 |
| 3.4 | Pattern mining in multilevel, multidimensional space | 1 |
| **4** | **Classification (7)** | |

| | | |
|---|---|---|
| 4.1 | Decision tree Induction | 2 |
| 4.2 | Bayesian classification | 1 |
| 4.3 | Rule-based classification, Support vector machines | 2 |
| 4.4 | K-NN classifier , Associative Classification | 1 |
| 4.5 | Model evaluation methods | 1 |
| **5** | **Clustering(7)** | |
| 5.1 | Cluster Analysis, measuring data similarity and dissimilarity, Partition-based Methods: K-Means, K-Medoids | 2 |
| 5.2 | Hierarchical Methods: AGNES, DIANA, BIRCH | 1 |
| 5.3 | Density-based Methods: DBSCAN | 1 |
| 5.4 | Model-based clustering – COBWEB | 2 |
| 5.5 | Outlier Analysis, Outlier detection methods | 1 |
| **6** | **Other mining methods (4)** | |
| 6.1 | Sequential Pattern Mining – SPADE, GSP | 1 |
| 6.2 | Text Mining – Pre-processing, Text classification, and clustering | 1 |
| 6.3 | Web Mining – Web Structure, Web content, and Web usage mining | 1 |
| 6.4 | Overview of data stream mining | 1 |
| | **Total Hours** | **36** |

**Course Designer(s):**

1. Dr.B.Subbulakshmi, AP,CSE bscse@tce.edu
2. Dr.M.Nirmala Devi, AP,CSE mnit@tce.edu

**22CSPB0 INTERACTIONS DESIGN FOR XR**

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PSE | 3 | 0 | 0 | 3 |

**Preamble**

Students will able to create a virtual environment and interact with it using devices, including the concepts and technologies for VR interaction.

**Prerequisite**

NIL

**Course Outcomes**

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

| CO Number | Course Outcome Statement | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Create 3D graphics objects and to lay them out to create an environment. | TPS3 | B | 75 |
| CO2 | Interact with a VR world, including the concepts and technologies of VR interaction. | TPS3 | B | 70 |
| CO3 | Build simple, interactive mobile applications with augmented reality functions. | TPS3 | B | 70 |
| CO4 | Develop a walkthrough for a model and view it on a mobile. | TPS3 | B | 70 |
| CO5 | Discuss the applications of VR in Business, Manufacturing, Architecture and Construction and Entertainment | TPS3 | B | 70 |
| CO6 | Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR. | TPS4 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | S | M | | | S | S | | M | M | M | L |
| CO2 | S | M | L | | S | M | | | S | S | | M | M | M | L |
| CO3 | S | M | L | | S | M | | | S | S | | M | M | M | L |
| CO4 | S | M | L | | S | M | | | S | S | | M | M | M | L |
| CO5 | S | M | L | | S | M | | | S | S | | M | M | M | L |
| CO6 | S | S | M | L | S | M | | | S | S | | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 20 | | | | | | | | | | | 4 | 10 | | | | |
| CO2 | | 20 | 10 | | | | | | | | | | 4 | 10 | | | | |
| CO3 | | 20 | 20 | | | | | | | | | | 4 | 10 | | | | |
| CO4 | | | | | | | 10 | 20 | 15 | | | | 4 | | 15 | | | |
| CO5 | | | | | | | 10 | 20 | 15 | | | | 4 | | 15 | | | |
| CO6 | | | | | | | | | | 10 | | | | | | 10 | | |

| CO | ASSIGNMENT 1 | ASSIGNMENT2 |
|---|---|---|
| | | |

| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | | | | | | |
| CO2 | | 50 | | | | | | | | | | |
| CO3 | | | 50 | | | | | | | | | |
| CO4 | | | | | | | | | 50 | | | |
| CO5 | | | | | | | | | | | | |
| CO6 | | | | | | | | | | 50 | | |

*Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**AR VR, XR ENVIRONMENTS** Virtual environments, Requirements for VR, benefits of Virtual reality, Augmented Reality, Computer-Generated Worlds, Defining Position and Orientation, The Three I's of Virtual Reality, WEB3, 5G and other technologies. Metaverse - 3D virtual space where humans can experience.

**Representing the Virtual World** Understanding the Human Senses and Their Relationship to Output / Input Devices. Component Technologies of Head-Mounted Displays, Augmenting Displays, Fully Immersive Displays, Sensors for Tracking Position, Orientation, and Motion, Devices to Enable Navigation

**Visual Perception & Rendering -** Creating a 3D Model, Drawing Lines, Shapes, and 3D Objects, drawing and design models, anchoring, scaling, and rotating of models, Immersive Walking through a model, jump/ walkthrough the models. Mobile Walkthrough.

**AR applications –** Building AR experience and build as android application, transform the objects in your scene, Modify the virtual environment, Load and display 3D models, Load and play audio and video.

**Business and Manufacturing** Using Augmented Reality for advertising, virtual prototyping system, the cave to examine the aesthetics of an automobile interior. **science and technology virtual** wind tunnel, telepresence. **Education Applications**, Tangible Skills development in Education, Knowledge Acquisition, and Concept Formation.

**Case study:**
Create components, integrate color or textures, use the 3D Warehouse to import images.
create a VR walk-through of your Sketch Up Model an AR application to move a character off its marker and control it's animation.

## Text Books

1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, “Developing Virtual Reality Applications”, 2017.

2. Matjaz Mihelj, Domen Novak, Samo Begus, "Virtual Reality Technology and Applications", 1st Edition, Springer Netherlands, 2014.
3. Grigore C. Burdea, Philip Coiffet, “Virtual Reality Technology”, 2nd Edition, Wiley India, 2006

## Reference Books & web resources

1. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, 2003.
2. John Vince, "Introduction in Virtual Reality", Springer, 2004.
3. Gerard Jounghyun Kim, "Designing Virtual Reality Systems, the Structured Approach" Springer London, 2005. Course Contents and Lecture Schedule
4. Steve Aukstakalnis, “Practical Augmented Reality”, Addision Wesley 2017.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Hours |
|---|---|---|
| 1 | **AR VR, XR ENVIRONMENTS** | |
| 1.1 | Virtual environments, Requirements for VR, | 1 |
| 1.2 | benefits of Virtual reality, Augmented Reality, Computer-Generated Worlds, | 1 |
| 1.3 | Defining Position and Orientation, The Three I's of Virtual Reality, A Short History of Early Virtual Reality, | 1 |
| 1.4 | WEB3, 5G and other technologies. | 1 |
| 1.5 | Metaverse - 3D virtual space where humans can experience. | 1 |
| 2 | **Representing the Virtual World** | |
| 2.1 | Understanding the Human Senses and Their Relationship to Output / Input Devices. | 1 |
| 2.2 | Component Technologies of Head-Mounted Displays, | 1 |
| 2.3 | Augmenting Displays, Fully Immersive Displays, | 1 |
| 2.4 | Sensors for Tracking Position, | 1 |
| 2.5 | Orientation, and Motion, Devices to Enable Navigation | 1 |
| 3 | **Visual Perception & Rendering** | |
| 3.1 | Creating a 3D Model, Drawing Lines, Shapes, | 2 |
| 3.2 | 3D Objects, drawing and design models, | 2 |

| | | |
|---|---|---|
| 3.3 | anchoring , scaling , and rotating of models, | 1 |
| 3.4 | Immersive Walking through a model, jump/ walkthrough the models | 1 |
| 4.1 | **AR applications** Building AR experience and build as android application | 2 |
| 4.2 | transform the objects in your scene, Modify the virtual environment, | 2 |
| 4.3 | Load and display 3D models, | 2 |
| 4.4 | Design an Augmented Reality experience that can be used to visualize products and narratives, at any time from your mobile phone | 2 |
| 5.1 | **Business and Manufacturing** Using Augmented Reality for advertising | 1 |
| 5.2 | virtual prototyping system, the cave to examine the aesthetics of an automobile interior. | 1 |
| 5.3 | **science and technology** virtual wind tunnel, telepresence. | 1 |
| 5.4 | **Education Applications**, Tangible Skills development in Education, Knowledge Acquisition, and Concept Formation | 1 |
| | **Lab activities** | |
| 1 | Create 3D objects and transforms to lay out a 3D scene | 2 |
| 2 | Create a VR walk-through of your SketchUp Model | 2 |
| 3 | An AR application to move a character off its marker and control its animation. | 4 |
| | **Total** | 36 |

**Course Designer(s)**

1. Dr.N.Shivakumar AP/CSE shiva@tce.edu
2. Mrs.G.Bhavani AP/CSE gbicse@tce.edu

| **22CSPC0** | **CLOUD COMPUTING** |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PSE | 3 | 0 | 0 | 3 |

## Preamble

This course provides a strong foundation of knowledge on Cloud Computing concepts and services, facilitating the usage of Cloud based services and tools in application development and deployment. Students will able to learn how to build, deploy and manage container-based applications on cloud.

## Prerequisite

NIL

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Utilize the main concepts, key technologies, strengths and limitations to understand cloud computing environment | TPS3 | B | 80 |
| CO2 | Choose suitable cloud architectures, delivery and deployment models for the given scenario | TPS3 | B | 80 |
| CO3 | Identify the virtualization technology that enhance cloud computing | TPS3 | B | 80 |
| CO4 | Categorize and demonstrate the concept of containerization using Docker | TPS3 | B | 80 |
| CO5 | Illustrate the data availability, data replication, and data footprint reduction techniques of cloud storage services | TPS3 | B | 80 |
| CO6 | Examine cloud environment using cloudsim | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | | | | | | | L | M | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 2 | S | M | L | | | | | | L | L | | L | M | | L |
| CO 3 | S | M | L | | M | | | L | L | L | | L | M | L | L |
| CO 4 | S | M | L | | M | | | L | L | L | | L | M | L | L |
| CO 5 | S | M | L | | | | | | L | L | | L | M | | |
| CO 6 | S | S | M | L | M | L | | L | L | L | L | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 5 | 10 | - | - | - | - | - | - | - | - | - | - | - | 30 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO2 | 5 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | - | 30 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO3 | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | - | 40 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 5 | 5 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | 15 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 15 | 30 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 10 | 5 | 10 | - | - | - | - | - | - | - | - | - | 15 | 05 | 25 | - | - | - | 5 | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction**: Cloud components - Essential characteristics - Architectural and Technological Influences – Benefits – Limitations - Policies - Comparing cloud providers with traditional IT service providers.

**Architecture, Services and Models**: Architecture - NIST Cloud Computing Reference Model, Utility Computing and Federated Computing - Services: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) - Challenges and risks in cloud adoption- Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds-Capex Vs OpEx in cloud.

**Data Center and Virtualization**: IT Service management - Design considerations – Scalability, On-demand services – Energy efficiency- Components and Benefits of Virtualization - Types of Virtualizations (Storage and Desktop) – VM Provisioning and Migration.

**Containerization:** Overview – Virtualization Vs Containers - Features -Components-Creating Containerized Services - Managing Containers - Orchestration in docker-Cluster management in Kubernetes.

**Cloud Security and Storage**: Security concerns in cloud computing- Cloud data security- Security patterns and Architectural elements- Cloud storage services and functionalities- Storage system architectures- Data Footprint Reduction Techniques.

**Cloud Applications:** Simulating a cloud environment using cloudsim, Case Study - Use cases of Cloud in various domains.

**Text Book**

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, “Cloud Computing: Concepts, Technology & Architecture”,Prentice Hall Service Technology Series, 2013.
2. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies,2009.

**Reference Books & web resources**

1. John Rittinghouse, James Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press 2010.
2. Greg Schulz, “Cloud and Virtual Data Storage Networking”, CRC Press, 2012.
3. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies,2009.
4. https://www.edx.org/learn/cloud-computing.
5. https://www.coursera.org/browse/information-technology/cloud-computing
6. https://docs.docker.com/

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction (3)** | |
| 1.1 | Cloud components | 1 |
| 1.2 | Essential characteristics | |

| | | |
|---|---|---|
| 1.3 | Architectural and Technological Influences | |
| 1.4 | Benefits | 1 |
| 1.5 | Limitations | |
| 1.6 | Policies | |
| 1.7 | Comparing cloud providers with traditional IT service providers. | 1 |
| **2** | **Architecture, Services and Models (6)** | |
| 2.1 | NIST Cloud Computing Reference Model | 1 |
| 2.2 | Utility and Federated Computing Architecture | 1 |
| 2.3 | Services-SaaS, PaaS and IaaS | 1 |
| 2.4 | Challenges and risks in cloud adoption | 1 |
| 2.5 | Cloud deployment models- Public clouds, Private clouds, Community clouds, Hybrid clouds | 1 |
| 2.6 | Capex Vs OpEx in cloud | 1 |
| **3** | **Data Center and Virtualization (9)** | |
| 3.1 | IT Service management | 1 |
| 3.2 | Design considerations | 1 |
| 3.3 | Scalability | 1 |
| 3.4 | On-demand services | 1 |
| 3.5 | Energy efficiency | |
| 3.6 | Components and Benefits of Virtualization | 1 |
| 3.7 | Types of Virtualizations | 2 |
| 3.8 | VM Provisioning and Migration | 2 |
| **4** | **Containerization (9)** | |
| 4.1 | Overview | 1 |
| 4.2 | Virtualization Vs Containers | 1 |
| 4.3 | Features | |

| | | |
|---|---|---|
| 4.4 | Components | 1 |
| 4.5 | Creating Containerized Services | 1 |
| 4.6 | Managing Containers | 1 |
| 4.7 | Orchestration in docker | 2 |
| 4.8 | Cluster management in Kubernetes | 2 |
| **5** | **Cloud Security and Storage (5)** | |
| 5.1 | Security concerns in cloud computing | 1 |
| 5.2 | Cloud data security | |
| 5.3 | Security patterns and Architectural elements | 1 |
| 5.4 | Cloud storage services and functionalities | 1 |
| 5.5 | Storage system architectures | 1 |
| 5.6 | Data Footprint Reduction Techniques | 1 |
| **6** | **Cloud Applications (4)** | |
| 6.1 | Simulating a cloud environment using cloudsim | 2 |
| 6.2 | Case Study - Use cases of Cloud in various domains | 2 |
| | **Total** | **36** |

**Course Designer(s):**

1. C.Santhiya, Assistant Professor, CSE csit@tce.edu

**22CSPD0 KERNEL PROGRAMMING**

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PSE | 3 | 0 | 0 | 3 |

## Preamble

This course introduces the fundamental design of kernel components in structuring the operating system. The course is structured on a widely used open source operating system Linux. The students will get a chance to reinforce concepts in the working of a "real" operating system. The idea is to learn and explore a full-fledged operating system and to use it for kernel-based modifications.

## Prerequisite

- Basic Knowledge of Operating Systems

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Show the role of kernel in the booting process and initialization of operational computer system | TPS3 | B | 80 |
| CO2 | Configure and tune the kernel daemon and networking service | TPS3 | B | 80 |
| CO3 | Utilize the system calls and libraries of Linux kernel to perform system related tasks | TPS3 | B | 80 |
| CO4 | Construct Synchronization solutions to achieve consistent access to shared resource | TPS3 | B | 80 |
| CO5 | Construct and Configure the interrupt handlers of Linux kernel | TPS3 | B | 80 |
| CO6 | Examine and infer the file system organization and design of kernel modules | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | | | L | M | M | | L | M | L | L |
| CO2 | S | M | L | | M | L | | L | M | M | | L | M | L | L |
| CO3 | S | M | L | | M | L | | L | M | M | | L | M | L | L |
| CO4 | S | M | L | | M | L | | L | M | M | | L | M | L | L |
| CO5 | S | M | L | | M | L | | L | M | M | | L | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | S | S | M | L | M | L | | L | M | M | | L | S | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 10 | 10 | - | - | - | - | - | - | - | - | - | 2 | 5 | 6 | - | - | - |
| CO2 | 5 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 15 | 25 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO3 | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | 15 | 25 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 5 | 5 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | 5 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 15 | 30 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | - | 15 | 30 | - | - | - | 2 | 5 | 12 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Basics of Kernel:** Overview of Kernel - Linux kernel design and modes of operation, Boot Process – Boot Loaders and Loading of Kernel – Case study: Initialization of the Linux Kernel.

**Linux Kernel services and networking:** Daemon Services, Service Configuration and tuning, Networking devices - The TCP/IP protocol stack communication- Obtaining System IP address.

**Linux Kernel in Process and File management:** Process, Threads, Process Address Space, Processes Scheduling – System Calls and Libraries: APIs, POSIX, and the C Library, Syscalls, System Call Handler, System call context.

**Linux Kernel Synchronization:** Basics of Kernel Synchronization, Kernel Synchronization Methods – Kernel Locking mechanism, Atomic Operations, Spin Locks, Semaphore.

**Device Management:** Device Types and Device Drivers, Interrupts and Interrupt handlers, Timers and Time management: Jiffies, Hardware Clocks and Timers.

**Linux Kernel in Virtual File System and Kernel Modules:** File Systems Interface and Abstraction, VFS objects: Superblock object, Inode object, Dentry object and File object, Kernel modules – Dynamic Loading and unloading of kernel modules, Case Study Building Kernel module.

## Text Book

1. Kaiwan N Billimoria, “Linux Kernel Programming”, Packt Publisher,2021.
2. Robert Love, “Linux Kernel Development: A thorough guide to the design and implementation of the Linux Kernel”, Third Edition, Addison-Wesley.

**Reference Books & web resources**


1. Daniel P.Bovet, Marco Cesati, “Understanding the Linux Kernel”, , O`Reilly, Third Edition, 2006.
2. Gary Nutt , “Kernel projects for Linux”, Addison Wesley, First edition, 2001.
3. Peter Jay Salzman Michael Burian Ori Pomerantz, “The Linux Kernel Module Programming Guide”, 2001.
4. Linux with Operating System Concepts, Richard Fox, CRC Press, Taylor & Francis, A Chapman & Hall Book, 2015.
5. Linux Kernel Development, Robert Love, Pearson Education, Third Edition, 2010.


**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Basics of Kernel** | |
| 1.1 | Overview of Kernel | 1 |
| 1.2 | Linux kernel design and modes of operation | 1 |
| 1.3 | Boot Process – Boot Loaders and Loading of Kernel | 1 |
| 1.4 | Case study: Initialization of the Linux Kernel | 1 |
| **2** | **Linux Kernel services and networking** | |
| 2.1 | Daemon Services | 1 |
| 2.2 | Service Configuration and tuning | 2 |
| 2.3 | Networking devices | 1 |
| 2.4 | The TCP/IP protocol stack communication | 1 |
| 2.5 | Obtaining System IP address | 1 |
| **3** | **Linux Kernel in Process and File management** | |
| 3.1 | Process, Threads and Process Address Space | 2 |
| 3.2 | Linux Processes Scheduling | 2 |
| 3.3 | System Calls and Libraries: APIs, POSIX, and the C Library | 1 |
| 3.4 | Syscalls and System Call Handler | 2 |
| 3.5 | System call context | 1 |
| **4** | **Linux Kernel Synchronization** | |

| | | |
|---|---|---|
| 4.1 | Basics of Kernel Synchronization | 2 |
| 4.2 | Kernel Synchronization Methods – Kernel Locking mechanism | 1 |
| 4.3 | Atomic Operations | 1 |
| 4.4 | Spin Locks | 1 |
| 4.5 | Semaphore | 2 |
| **5** | **Device Management** | |
| 5.1 | Device Types and Device Drivers | 1 |
| 5.2 | Interrupts and Interrupt handlers | 2 |
| 5.3 | Timers and Time management: Jiffies, Hardware Clocks and Timers | 2 |
| **6** | **Linux Kernel in Virtual File System and Kernel Modules** | |
| 6.1 | File Systems Interface and Abstraction | 1 |
| 6.2 | VFS objects: Superblock object, Inode object, Dentry object and File object | 2 |
| 6.3 | Kernel modules – Dynamic Loading and unloading of kernel modules | 1 |
| 6.4 | Case Study Building Kernel module | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dr. G.Madhupriya, Associate Professor, CSE — gmadhupriya@tce.edu

| | | | | | |
|---|---|---|---|---|---|
| Category | L | T | P | Credit | |
| PSE | 3 | 0 | 0 | 3 | |

| | |
|---|---|
| **22CSPE0** | **WIRELESS NETWORKS** |

## Preamble

This course on Wireless Networks provides an introduction to the basic concepts of wireless networks, architecture and topologies. The objective of this course is to introduce the fundamental concepts and also discuss the main issues in wireless networks such as mobility management, capacity expansion and security. At the end of the course, the students will have a firm understanding of the basic principles of wireless Networks and the issues involved.

## Prerequisite

Data communication and Networks

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the generations of wireless networks, principles of IEEE 802.11 standards for WLAN, GPRS, wireless local loops and operation of Bluetooth. | TPS2 | B | 70 |
| CO2 | Construct a suitable multiplexing/duplexing technique for a given specification. | TPS3 | B | 65 |
| CO3 | Determine the capacity of a CDMA system, along with its output based on a spread spectrum technique. | TPS3 | B | 65 |
| CO4 | Develop a suitable mechanism to increase the capacity of a cellular network. | TPS3 | B | 65 |
| CO5 | Determine the handoff transitions in a cellular network based on different algorithms. | TPS4 | B | 65 |
| CO6 | Examine the security mechanisms in IEEE802.11 wireless LAN and GSM. | TPS3 | B | 65 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | - | - | - | - | - | - | - | - | - | - | L | - | - |
| CO2 | S | M | L | - | - | L | - | L | L | L | - | L | M | - | L |
| CO3 | S | M | L | - | - | L | - | L | L | L | - | L | M | - | L |
| CO4 | S | M | L | - | - | L | - | L | L | L | - | L | M | - | L |
| CO5 | S | M | L | L | - | L | - | L | L | L | - | L | M | - | L |
| CO6 | S | M | L | - | - | L | - | L | L | L | - | L | M | - | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assign ment | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 1 | 2 | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 20 | 20 | | | | | | | | | | | | | 10 | 15 | | | | |
| CO2 | 5 | 10 | 20 | | | | | | | | | | | | | 5 | 10 | | | |
| CO3 | 5 | 10 | 10 | | | | | | | | | | | | | 10 | 5 | | | |
| CO4 | | | | | | | 10 | 10 | 20 | | | | | | | 5 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 10 | 10 | | | | | | 5 | 5 | 5 | | |
| CO6 | | | | | | | | 10 | 10 | | | | | | | 10 | 5 | | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Generations of wireless networks**- 1G wireless systems- FDMA, 2G wireless systems-TDMA, GSM architecture- Mechanism to support Mobile Environment-GPRS – Reference Architecture-Mobility Support in GPRS- Spread spectrum –FHSS, DSSS, CDMA, 3G wireless systems,4G and beyond
**Multiple Access Techniques**-Comparison of TDMA,FDMA and CDMA-Capacity of CDMA - Duplexing techniques FDD and TDD and comparison
**IEEE 802.11 LAN standard**- IEEE 802.11 Protocol architecture and services, OFDM and MAC.- Bluetooth overview, Protocol architecture =, Wireless Local loop
**Infrastructure Network Topology**- Cellular topology ,Cell fundamentals, Signal to interference ratio calculation, Capacity expansion techniques – Cell splitting, sectoring and overlaid methods
**Issues in mobility management**- Location management- location update algorithms- Paging Scheme- Location information Disseminations-Hand off Management – Architecture- algorithms- Handoff management process- Mobile IP -Security mechanisms – Cryptographic protocols in IEEE802.11 WLAN and GSM

## Learning Resources

1. William Stallings, “Wireless Communications and Networks”, Pearson education, 2003
2. Kaveh Pahlavan and Prashant Krishnamurthy, “Principles of Wireless Networks – A unified approach”, Pearson Education, Fourth Edition, 2003
3. Bernard Menezes , “Network Security and Cryptography”, Cengage Learning India, Third impression, 2014.
4. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2003
5. https://www.coursera.org/courses?query=wireless

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Hours | Course Outcome |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | **Generations of wireless networks** | | |
| 1.1 | 1G wireless systems- FDMA | 1 | CO1 |
| 1.2 | 2G wireless TDMA systems | 1 | CO1 |
| 1.3 | GSM Architecture and GPRS | 2 | CO1 |
| 1.4 | Spread spectrum –FHSS,DSSS,CDMA, | 3 | CO3 |
| 1.5 | Capacity of CDMA network | 2 | CO3 |
| 1.6 | 3G wireless systems, 4G and beyond | 1 | CO1 |
| 1.7 | Comparison of TDMA,FDMA and CDMA | 1 | CO2 |
| 1.8 | Comparison of FDD and TDD | 1 | CO2 |
| 1.9 | Wireless Local loop | 1 | CO1 |
| 2 | **IEEE 802.11 LAN standard** | | |
| 2.1 | IEEE 802.11 Protocol architecture and services, | 1 | CO1 |
| 2.2 | OFDM and MAC | 2 | CO1 |
| 2.3 | Bluetooth overview | 1 | CO1 |
| 2.4 | Bluetooth protocol architecture | 1 | CO1 |
| 3 | **Infrastructure Network Topology** | | |
| 3.1 | Cellular topology and cell fundamentals | 2 | CO4 |
| 3.2 | Signal to interference ratio calculation, | 2 | CO4 |
| 3.3 | Capacity expansion techniques- cell splitting | 2 | CO4 |
| 3.4 | Cell sectoring and Overlaid methods | 2 | CO4 |
| 4 | **Issues in mobility management and security** | | |
| 4.1 | Mobility management- location management | 2 | CO5 |
| 4.2 | Hand off management | 3 | CO5 |
| 4.3 | Security mechanisms | 2 | CO6 |
| 4.4 | Cryptographic protocols in IEEE802.11 WLAN and GSM | 3 | CO6 |
| | Total | 36 | |

**Course Designers:**

1. Dr.C.Sridharan,,Associate Professor, CSE,cscse@tce.edu
2. Dr.C.Senthilkumar, Associate Professor, CScskcse@tce.edu

| 22CSPF0 | INTERNET OF THINGS AND ITS APPLICATIONS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PSE | 3 | 0 | 0 | 3 |

## Preamble

This course aims at providing a basic understanding of Internet of Things, exemplifying the application areas where Internet of Things can be applied and enables designing prototypes of Internet-connected products using appropriate tools.

## Prerequisite

- Basic knowledge in Networking and Programming

## Course Outcomes

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

| CO | Course Outcome (CO) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the general IoT architecture and connected domains. (Understand) | TPS3 | B | 85 |
| CO2 | Analyze the requirements to figure out the suitable communication technology and protocols required for an IoT application. (Analyze) | TPS4 | B | 85 |
| CO3 | Develop an IoT management System using network management protocol. (Apply) | TPS3 | B | 85 |
| CO4 | Design a step by step Model Specifications for an IoT System based on IoT – A reference model. (Apply) | TPS3 | B | 85 |
| CO5 | Develop an IoT application using Raspberry Pi for the given specification applying the IoT technologies. (Apply) | TPS3 | B | 85 |
| CO6 | Design a Web API for transaction of data and services in cloud. (Apply) | TPS3 | B | 85 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | - | | | | | | | | M | M | | |
| CO2 | S | S | M | L | - | L | L | L | M | L | | M | M | L | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO4 | S | M | L | - | - | L | L | L | M | L | | M | M | L | L |
| CO5 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO6 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | | | | | | | | | | | | | 30 | | | | | | | | | | 5 | 10 | | | | |
| CO2 | 10 | 10 | | 10 | | | | | | | | | | | | 30 | | | | | | | | | 5 | | | 12 | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 40 | | | | | | | | | | | | 12 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | | | | | | | | 30 | | | | | 10 | 12 | | | |
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 30 | | | | 5 | | 12 | | | |
| CO6 | | | | | | | 10 | 20 | 10 | | | | | | | | | | | | 40 | | | | 5 | | 12 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to IoT:** Introduction, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, Types of Sensors, Types of Actuators, IoT Networking, IoT Levels and Deployment Templates, IoT and M2M, SDN and NFV for IoT. Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth, Wi-Fi, ZigBee, Z-wave, 6LoWPAN, HTTP, AMQP, Features & Functions of CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP, Digital Twins, Federated Computing.

**IoT System Management with NETCONF:** Need for IoT System Management, SNMP, Network Operator Requirements, NETCONF, YANG, NETOPEER, Managing Home Intrusion Detection IoT System with NETCONF-YANG

**IoT Platforms Design Methodology:** IoT Design Methodology – Purpose and Requirement Specification, Process Model Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional and Operational View Specification, Device and Component Integration, Application Development. IoT Systems – Logical Design using Python - Introduction to Python, Python Classes, Packages of Interest for IoT- JSON, XML, HTTLib, URLLib, SMTPLib

**IoT Physical Devices and Endpoint:** Basic Building Block of an IoT Device, Exemplary Device: Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IoT Devices- pcDuino, BeagleBone Black, Cubieboard.

**IoT Physical Server and Cloud:** Cloud Storage Models and Communication API, WAMP, Xively Cloud, Designing RESTful Web API, AWS for IoT, SkyNet IoT Messaging platform.

**Case Studies Illustrating IoT Design and Deployment:** Home Automation, Smart city, Environment, Agriculture, Healthcare, IIoT, Multi-Tier Deployment.

## Text Book


1. Sudip Misra, Anandarup Mukherjee, Arijit Roy,"Introduction to IoT", Cambridge University Press,2022.
2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands on Approach, 2014
3. Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, Architecting the Internet of Things. Springer Science & Business Media, 2011.
4. Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kuffmann, 2010
5. Jonathan L. Zittrain, The Future of the Internet, Yale University Press & Penguin UK 2008.
6. Samuel Greengard, The Internet of Things (The MIT Press Essential Knowledge series), MIT Press, 2015


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to IoT** | |
| 1.1 | Introduction, Physical Design of IoT, Logical Design of IoT, | 1 |
| 1.2 | IoT Enabling Technologies, Types of Sensors, Types of Actuators, IoT Networking, | 1 |
| 1.3 | IoT Levels and Deployment Templates, IoT and M2M, SDN and NFV for IoT. | 1 |
| 1.4 | Wireless Protocol for IoT, Communication Technologies - NFC, Bluetooth, Wi-Fi, ZigBee, Z-wave, | 1 |
| 1.5 | 6LoWPAN, HTTP, AMQP, Features & Functions of CoAP, MQTT, OAuth2, XMPP, CoAP vs HTTP. | 1 |
| 1.6 | Digital Twins, Federated Computing. | 1 |
| **2** | **IoT System Management with NETCONF** | |
| 2.1 | Need for IoT System Management, SNMP | 1 |
| 2.2 | Network Operator Requirements | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.3 | NETCONF, YANG | 1 |
| 2.4 | NETOPEER | 1 |
| 2.5 | Managing Home Intrusion Detection IoT System with NETCONF-YANG | 2 |
| **3** | **IoT Platforms Design Methodology** | |
| 3.1 | IoT Design Methodology | 1 |
| 3.2 | Purpose and Requirement Specification, Process Model Specification, Domain Model Specification, Information Model Specification | 1 |
| 3.3 | Service Specification, IoT Level Specification, Functional and Operational View Specification, | 1 |
| 3.4 | Device and Component Integration, Application Development. | 1 |
| 3.5 | IoT Systems – Logical Design using Python - | 1 |
| 3.6 | Introduction to Python, Python Classes, | 1 |
| 3.7 | Packages of Interest for IoT- JSON, XML, HTTLib, URLLib, SMTPLib | 1 |
| **4** | **IoT Physical Devices and Endpoint** | |
| 4.1 | Basic Building Block of an IoT Device, Exemplary Device: Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi Interfaces. | 1 |
| 4.2 | Programming Raspberry Pi with Python | 4 |
| 4.3 | Other IoT Devices- pcDuino, Beagle Bone Black, Cubieboard | 1 |
| **5** | **IoT Physical Server and Cloud:** | |
| 5.1 | Cloud Storage Models | 1 |
| 5.2 | Communication API | 1 |
| 5.3 | Xively Cloud | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 5.4 | Designing RESTful Web API | 2 |
| 5.5 | AWS for IoT | 1 |
| 5.6 | SkyNet IoT Messaging platform | 1 |
| **6** | **Case Studies Illustrating IoT Design and Deployment:**. | |
| 6.1 | Home Automation, Smart city | 1 |
| 6.2 | Environment | 1 |
| 6.3 | Agriculture, Multi-Tier Deployment | 1 |
| 6.4 | Healthcare, IIoT | 1 |
| | Total | 36 |

**Course Designers:**

1. M.Vijayalakshmi mviji@tce.edu
2. G.S.R.Emil Selvan emil@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPG0** | **RECOMMENDER SYSTEMS** | PE | 3 | 0 | 0 | 3 |

## Preamble

This course provides an in-depth exploration of recommender systems, a critical component of many modern engineering applications. Students will learn the principles, algorithms, and practical implementation of recommendation systems in various domains.

## Prerequisite

- Basic knowledge of machine learning and data analysis
- Programming skills in Python

## Course Outcomes

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

| CO# | Course Outcome 1 (CO1) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Develop user-based and item-based collaborative filtering methods by knowing the differences between memory-based and model-based collaborative filtering, and implement matrix factorization techniques | TPS3 | B | 70 |
| CO2 | Apply content-based filtering techniques by extracting features from items and use TF-IDF and cosine similarity to generate personalized recommendations. | TPS3 | B | 70 |
| CO3 | Integrate collaborative filtering and content-based filtering into hybrid recommender systems by applying weighting strategies or switching mechanisms. | TPS3 | B | 70 |
| CO4 | Use neural networks for recommendations, including embedding layers, matrix factorization with neural networks, neural collaborative filtering, and the application of auto encoders. | TPS3 | B | 70 |
| CO5 | Develop a recommender system for a specific domain or user context by considering the factors such as user preferences, item characteristics, and potential challenges like the attacks, cold start problem and scalability. | TPS3 | B | 70 |
| CO6 | Design, implement, and evaluate a recommender system for a specific use case, considering practical challenges and constraints | TPS4 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO6. | S | S | M | L | L | L | L | | S | S | S | M | M | L | S |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 10 | 20 | | | | | | | | | | | | 40 | | | | | | | | | | 4 | 4 | 12 | | | |
| CO2 | 5 | 10 | 20 | | | | | | | | | | | | 30 | | | | | | | | | | 4 | 4 | 12 | | | |
| CO3 | 5 | 5 | 20 | | | | | | | | | | | | 30 | | | | | | | | | | 4 | 4 | 12 | | | |
| CO4 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 20 | | | | 4 | 4 | 12 | | | |
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 20 | | | | 4 | 4 | 12 | | | |
| CO6 | | | | | | | | | | 20 | | | | | | | | | | | | | | 60 | | | | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Recommender Systems -** Overview of recommendation systems, Types of recommendation systems: collaborative filtering, content-based filtering, hybrid methods, Importance and applications of recommendation systems, Evaluation metrics for recommendation systems

**Collaborative Filtering -** User-based collaborative filtering, Item-based collaborative filtering, Memory-based vs. model-based collaborative filtering, Matrix factorization techniques (Singular Value Decomposition, Alternating Least Squares) - Non-negative matrix factorization

**Content-Based Filtering -** Feature extraction and representation of items, Term Frequency-Inverse Document Frequency (TF-IDF), Cosine similarity and other similarity measures, Building content-based recommendation models

**Hybrid Recommender Systems -** Integration of collaborative and content-based filtering, Weighted and switching hybrid methods, Advantages and challenges of hybrid systems

**Deep Learning for Recommender Systems -** Introduction to neural networks for recommendations, Embedding layers and matrix factorization with neural networks, Neural collaborative filtering, Variational Autoencoders for recommendation

**Advanced Topics -** Context-aware recommendation systems, Session-based recommendation, Attack-resistant recommender systems, Cold start problem and its solutions, Scalability and efficiency in recommendation systems

**Real-world Applications and Case Studies -** Industry use cases of recommender systems, Ethical considerations in recommendation systems, Challenges and future trends in recommendation systems

**Mini Project**

**Text Books**

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press, 1st ed, 2011.
3. Francesco Ricci , Lior Rokach , Bracha Shapira , Recommender Sytems Handbook, 1st ed, Springer, 2011.

**Reference Books & web resources**

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.
2. Kim Falk, Practical Recommender Systems, Manning Publications, 2019
3. Movielens Dataset: A popular dataset for movie recommendations, commonly used in research and academia. It includes various versions with different sizes.
4. Kaggle Datasets: Kaggle is a platform that hosts machine learning competitions. It has a variety of datasets, some of which are related to recommender systems.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Recommender Systems** | |
| 1.1 | Overview of recommendation systems, Types of recommendation systems: collaborative filtering, content-based filtering, hybrid methods, Importance and applications of recommendation systems | 1 |
| 1.2 | Evaluation metrics for recommendation systems | 1 |
| **2** | **Collaborative Filtering** | |
| 2.1 | User-based collaborative filtering | 1 |
| 2.2 | Item-based collaborative filtering | 1 |
| 2.3 | Memory-based vs. model-based collaborative filtering | 1 |
| 2.4 | Matrix factorization techniques (Singular Value Decomposition, Alternating Least Squares) | 2 |
| 2.5 | Non-negative matrix factorization | 2 |
| **3** | **Content-Based Filtering** | |
| 3.1 | Feature extraction and representation of items | 1 |
| 3.2 | Frequency-Inverse Document Frequency (TF-IDF) | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.3 | Cosine similarity and other similarity measures | 1 |
| 3.4 | Building content-based recommendation models | 1 |
| **4** | **Hybrid Recommender Systems** | |
| 4.1 | Integration of collaborative and content-based filtering | 1 |
| 4.2 | Weighted hybrid methods | 1 |
| 4.3 | Switching hybrid methods | 1 |
| 4.4 | Advantages and challenges of hybrid systems | 1 |
| **5** | **Deep Learning for Recommender Systems** | |
| 5.1 | Introduction to neural networks for recommendations | 2 |
| 5.2 | Embedding layers and matrix factorization with neural networks | 2 |
| 5.3 | Neural collaborative filtering | 2 |
| 5.4 | Variational Autoencoders for recommendation | 2 |
| **6** | **Advanced Topics** | |
| 6.1 | Context-aware recommendation systems | 2 |
| 6.2 | Session-based recommendation | 2 |
| 6.3 | Attack-resistant recommender systems | 2 |
| 6.4 | Cold start problem and its solutions | 1 |
| 6.5 | Scalability and efficiency in recommendation systems | 1 |
| **7** | **Real-world Applications and Case Studies** | |
| 7.1 | Industry use cases of recommender systems | 1 |
| 7.2 | Ethical considerations in recommendation systems | 1 |
| 7.3 | Challenges and future trends in recommendation systems | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr M K Kavitha Devi, Professor, Dept. of Computer Science and Engineering mkkdit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPH0** | **CROSS PLATFORM MOBILE APPLICATION DEVELOPMENT** | PE | 3 | 0 | 0 | 3 |

## Preamble

This course provides an exploration of cross-platform mobile application development, equipping students with the skills and knowledge to create mobile apps that can run on multiple platforms using frameworks such as React Native, Flutter, or Xamarin. This course mainly focus the Dart Programming based Mobile Application development in Flutter and this will incorporate the Data connectivity, API Consuming and Application performance.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the fundamentals of Native and Hybrid Mobile application requirements for a chosen application. | TPS3 | 70 | 80 |
| CO2 | Adapt the Dart Programming functionalities such as OOPs and Collections for handling user interface in Flutter Applications. | TPS3 | 70 | 80 |
| CO3 | Apply the Flutter User Interface such as Widgets, Layout and Gestures with each stage of App state Management. | TPS3 | 70 | 80 |
| CO4 | Build an Application that incorporates the RESTAPI Service, Routing and Google Maps. | TPS3 | 70 | 80 |
| CO5 | Adapt the Database connectivity CRUD operation for chosen application and infer the performance metrics. | TPS3 | 70 | 80 |
| CO6 | Analyse the different Mobile application framework for cross platform development and conclude with the best use case. | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO6. | S | M | L | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 2 | - | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 2 | - | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 2 | 5 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 10 | 20 | - | - | 30 | 30 | - | 5 | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Introduction- Mobile app Development-Event Driven Model-Android App Development- Native App, Hybrid App, Cross-platform App-One Code Base-Multiplatform- Flutter Vs React Native-Flutter Architecture-Environmental Setup

**Dart Programming**-Dart Programming Basics-Datatypes, Variables-Operators-Functions-Interfeces-OOPs-Collection-Libraries.

**Flutter User Interface**: IDE-Widgets-Layout-Scaffold-Container-Design and Theme-Interactivity-Gestures-Animation-Calendar-App State Management-GitHub Repos

**Connectivity:** Packages-Accessing REST API-Navigation and Routing-Splash Screen-Google Maps-Silvers-Internalization.

**Data store and Testing** – SQLite-Firebase –Testing-Deployment-Development Tools-

**Non-Functional Requirements:** Performance in App Size-Deferred Components-Rendering-Profiling.Case study: Flutter vs Xamarinn vs Kotlin vs Ionic.

## Text Book

1. Building Cross-Platform Apps with Flutter and Dart: Build scalable apps for Android, iOS, and web from a single codebase (English Edition). India, BPB PUBLICATIONS, 2023.
2. Bailey, Thomas, and Biessek, Alessandro. Flutter for Beginners: An Introductory Guide to Building Cross-platform Mobile Applications with Flutter 2.5 and Dart, 2nd Edition. United Kingdom, Packt Publishing, 2021.

## Reference Books & web resources

1. Payne, Rap. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps. United States, Apress, 2019.
2. Napoli, Marco L.. Beginning Flutter: A Hands On Guide to App Development. United States, Wiley, 2019.

3. Biessek, Alessandro. Flutter for Beginners: An Introductory Guide to Building Cross-platform Mobile Applications with Flutter and Dart 2. United Kingdom, Packt Publishing, 2019.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Mobile app Development-Event Driven Model | 1 |
| 1.2 | Android App Development | 1 |
| 1.3 | Native App, Hybrid App | 1 |
| 1.4 | Cross-platform App | 1 |
| 1.5 | One Code Base | 2 |
| 1.6 | Multiplatform | 1 |
| 1.7 | Flutter Vs React Native | 1 |
| 1.8 | Flutter Architecture- | 1 |
| 1.9 | Environmental Setup | 2 |
| **2** | **Dart Programming** | |
| 2.1 | Basics-Datatypes | 1 |
| 2.2 | Variables-Operators-Functions | 1 |
| 2.3 | Interfaces-OOPs | 1 |
| 2.4 | Collection-Libraries | 1 |
| **3** | **Flutter User Interface** | |
| 3.1 | IDE-Widgets-Layout | 2 |
| 3.2 | Scaffold-Container | 1 |
| 3.3 | Design and Theme | 1 |
| 3.4 | Interactivity- | 1 |
| 3.5 | Gestures-Animation | 1 |
| 3.6 | Calendar- App State Management | 1 |
| 3.7 | GitHub Repos | 1 |
| **4** | **Connectivity** | |
| 4.1 | Packages | 1 |
| 4.2 | Accessing REST API | 2 |
| 4.3 | Navigation and Routing | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.4 | Splash Screen | 1 |
| 4.5 | Google Maps | 1 |
| **5** | **Data store and Testing** | |
| 5.1 | SQLite-Firebase | 2 |
| 5.2 | Testing-Deployment | 1 |
| **6.** | **Non-Functional Requirements** | |
| 6.1 | Performance in App Size | 1 |
| 6.2 | Deferred Components | 1 |
| 6.3 | Rendering-Profiling | 1 |
| 6.4 | Case study: Flutter vs Xamarinn vs Kotlin vs Ionic. | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr.K.Indira, Assistant Professor, Computer Science and Engineering, kiit@tce.edu
2. Dr.RajaLavanya, Assistant Professor, Computer Science and Engineering, rlit@tce.edu

| 22CSPJ0 | SECURITY AND PRIVACY IN CLOUD | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

This course provides an in-depth study of the security and privacy of cloud computing systems. It also addresses the development of an audit to ensure operational integrity and protection of customer data in cloud-based resources.

## Prerequisite

Knowledge on Cloud Computing, Cryptography

## Course Outcomes

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

| CO | Course Outcome Statement | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Determine the Cloud Computing terminology, & concepts | TPS2 | B | 85 |
| CO2 | Construct the security design and architectural considerations for Cloud | TPS3 | B | 85 |
| CO3 | Determine the Data Protection strategies in Cloud | TPS3 | B | 85 |
| CO4 | Explore the Identity, Access control in Cloud | TPS3 | B | 85 |
| CO5 | Illustrate the best practices for Cloud security using various design patterns | TPS3 | B | 85 |
| CO6 | Investigate the monitoring and auditing cloud applications for security | TPS3 | B | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | L | L | L | | L | M | | L |
| CO2. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO3. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO4. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO5. | S | M | L | L | L | | | L | L | L | L | L | M | L | L |
| CO6. | S | S | M | L | L | L | L | M | M | M | L | L | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | | | | | | | | | | | | | | | | | | | | | | | 2 | 5 | | | | |
| CO2 | 10 | 10 | 20 | | | | | | | | | | | | 100 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 10 | 10 | 20 | | | | | | | | | | | | | | | | | | | | | | 2 | 5 | 10 | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4 | | | | | | | 10 | 10 | 10 | | | | | | | | | | | | | | | | 2 | 5 | 15 | | | |
| CO5 | | | | | | | 10 | 10 | 10 | | | | | | | | | | | | 100 | | | | 2 | 5 | 10 | | | |
| CO6 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | | | | | | 5 | 15 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Fundamentals of Cloud Security**- Overview of cloud security- Security Services -Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures

**Security Design and Architecture for Cloud**- Security design principles for Cloud Computing - End-to-End access control - Common attacks and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies

**Data Protection strategies**- Comprehensive data protection, Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key, Business Continuity and Disaster Recovery (BCDR), Principles of General Data Protection Regulation (GDPR)

**Access Control and Identity Management** - Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Storage and network access control options - Intruder Detection and prevention

**Cloud Security Design Patterns**- Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

**Monitoring, Auditing and Management**-Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

## Text Book

1. Roger Mchaney, “Cloud Technologies”, Wiley 2021
2. Dave Shackleford, “Virtualization Security”, Wiley 2013
3. Muhammad Imran Tariq, Shahzadi Tayyaba, Valentina Emilia Balas, “Security and Privacy Trends in Cloud Computing and Big Data”, Taylor & Francis, 2022

## Reference Books & web resources

1. Mark C. Chu-Carroll, “Code in the Cloud”, Pragmatic Bookshelf, 2011.
2. RajkumarBuyya, Christian Vechhiola, “Mastering Cloud Computing Foundations and Applications Programming”, Elsevier Science, 2013.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Fundamentals of Cloud Security** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 1.1 | Overview of Cloud Security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control | 1 |
| 1.2 | Basics of Cryptography - Conventional and public-key cryptography | 2 |
| 1.3 | Hash functions, Authentication, and Digital Signatures | 2 |
| **2** | **Security Design and Architecture for Cloud** | |
| 2.1 | Security design principles for Cloud Computing - End-to-End access control | 2 |
| 2.2 | Common attacks and threats - Network and Storage - Secure Isolation Strategies | 2 |
| 2.3 | Virtualization strategies - Inter-tenant network segmentation strategies | 2 |
| **3** | **Data Protection strategies** | |
| 3.1 | Comprehensive data protection, Data retention, deletion and archiving procedures for tenant data | 2 |
| 3.2 | Data Redaction, Tokenization, Obfuscation, PKI and Key, Business Continuity and Disaster Recovery (BCDR), Principles of General Data Protection Regulation (GDPR) | 3 |
| **4** | **Access Control and Identity Management** | |
| 4.1 | Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization | 2 |
| 4.2 | Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation | 3 |
| 4.3 | Storage and network access control options - Intruder Detection and prevention | 2 |
| **5** | **Cloud Security Design Patterns** | |
| 5.1 | Introduction to Design Patterns, Cloud bursting | 1 |
| 5.2 | Geo-tagging, Secure Cloud Interfaces | 1 |
| 5.3 | Secure Cloud Interfaces, Cloud Resource Access Control | 1 |
| 5.4 | Secure On-Premise Internet Access, Secure External Cloud | 1 |
| **6** | **Monitoring, Auditing and Management** | |
| 6.1 | Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges | 3 |
| 6.2 | Events and alerts - Auditing – Record generation, Reporting and Management | 2 |
| 6.3 | Tamper-proofing audit logs, Quality of Services | 1 |
| 6.4 | Secure Management, User management, Identity management, Security Information and Event Management | 3 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | Total | 36 |

**Course Designer(s):**

1. Dr.M.P.Ramkumar
   Associate Professor
   Computer Science and Engineering ramkumar@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPK0** | **AI BASED RESOURCE MANAGEMENT FOR CLOUD** | PE | 3 | 0 | 0 | 3 |

## Preamble

This course will introduce students to the fundamental concepts of resource management in cloud. Students will learn about various AI based resource management techniques to optimize resource utilization. The course will also cover the ethical and societal implications of resource management in cloud environment.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify the fundamental concepts and techniques of resource management in cloud environment | TPS3 | 70 | 80 |
| CO2 | Acquire proficiency in different AI based techniques for cloud resource management | TPS3 | 70 | 80 |
| CO3 | Analyze AI based techniques to optimize resource prediction, allocation, scheduling, and demand analysis. | TPS4 | 70 | 80 |
| CO4 | Apply predictive modelling to forecasting | TPS3 | 70 | 80 |
| CO5 | choose the ethical and societal implications of resource management in cloud environment. | TPS3 | 70 | 80 |
| CO6 | Apply AI based cloud cost optimization strategy by selecting appropriate tool | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO2 | S | M | L | | L | | | M | L | L | | M | M | M | L |
| CO3 | S | S | M | L | M | L | | M | L | L | | M | S | M | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO 5 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO 6 | S | M | L | L | L | | | M | L | L | | M | M | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 10 | 20 | - | - | - | 35 | - | - | - | - | - | - | - | - | 1 | 4 | 12 | - | - | - |
| CO2 | 5 | 10 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | - | 1 | 4 | 12 | - | - | - |
| CO3 | 5 | 10 | 10 | - | - | - | 10 | 25 | - | - | - | - | - | - | - | 1 | 4 | - | 12 | - | - |
| CO4 | - | - | - | - | - | - | - | - | 5 | - | 25 | - | - | - | 10 | 1 | 4 | 12 | - | - | - |
| CO5 | - | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 30 | 1 | 4 | 12 | - | - | - |
| CO6 | - | - | - | - | - | - | - | - | 5 | 10 | 25 | - | - | - | 60 | 1 | 4 | 10 | | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Motivation - Benefits of AI in cloud resource management - Challenges and opportunities of using AI for cloud resource management.

**Resource Provisioning and Scaling:** Demand prediction and forecasting techniques for cloud resources- AI-driven resource allocation and scaling algorithms- Dynamic provisioning of cloud resources.

**Workload Placement and Optimization:** Workload characterization and classification- AI-based workload placement algorithms- Optimization of workload performance, cost, and energy efficiency.

**Predictive Resource Management:** Predictive modelling – resource optimization -resource allocation.

**Ethical Considerations and Social Impact of AI in Resource Management**: Bias and fairness - Privacy and security concerns - Social impact of AI on resource access.

**AI-driven Cloud Cost Optimization**: Cost analysis and profiling - Optimization of cloud resource allocation for cost efficiency-AI based cloud cost tool

## Learning Resources


1. Janusz Kacprzyk , Pedro Y. Pinero Perez , Rafael E. Bello Perez,"Artificial Intelligence in Project Management and making decisions",Springer,2022.
2. Dr. Wenhong Tian and Yong Dr. Zhao, "Optimized Cloud Resource Management and Scheduling: Theories and Practices",1st Edition ,Morgan,2014.
3. Chebiyyam Siva Murthy , "Resource Management in Real–Time Systems & Networks", MIT Press,2001.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Motivation | 2 |
| 1.2 | Benefits of AI in resource management | 2 |
| 1.3 | Challenges and opportunities of using AI for resource management | 2 |
| **2** | **Resource Provisioning and Scaling** | |
| 2.1 | Demand prediction and forecasting | 2 |
| 2.2 | AI-driven resource allocation and scaling algorithms | 2 |
| 2.3 | Dynamic provisioning of cloud resources | 2 |
| **3** | **Workload Placement and Optimization** | |
| 3.1 | Workload characterization and classification | 2 |
| 3.2 | AI-based workload placement algorithms | 2 |
| 3.3 | Optimization of workload performance, cost, and energy efficiency | 2 |
| **4** | **Predictive Resource Management** | |
| 4.1 | Predictive modelling | 2 |
| 4.2 | Resource optimization | 2 |
| 4.3 | Resource allocation | 3 |
| **5** | **Ethical Considerations and Social Impact** | |
| 5.1 | Bias and fairness | 2 |
| 5.2 | Privacy and security concerns | 1 |
| 5.3 | Social impact of AI on resource access and distribution | 2 |
| **6** | **AI-driven Cloud Cost Optimization** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.1 | Cost analysis and profiling | 2 |
| 6.2 | Optimization of cloud resource allocation for cost efficiency | 2 |
| 6.3 | Cloud Cost tool | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Ms. C. Santhiya, Assistant Professor, CSE csit@tce.edu

| 22CSPL0 | GENERATIVE ADVERSARIAL NETWORKS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

Generative Adversarial Networks (GANs) are considered as one of the most modern fascinating technologies within the field of Deep Learning and Computer Vision. GANs are gaining a lot of attention because they can create fake content and are revolutionizing the field of Artificial Intelligence in producing high-quality results. In this course, we will focus on GAN components, and modern architectures of GANs, and ultimately explore applications from photorealistic imagery of faces, products, and 3D scenes to applications for data augmentation and training of other neural networks.

## Prerequisite

Fundamentals of Machine Learning

Vanilla Recurrent Neural Networks

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Demonstrate Generative Adversarial Networks for generative modeling in images and videos | TPS3 | B | 80 |
| CO2 | Use GANs for Adversarial training, Image Enhancement, and Intrusion Detection | TPS3 | B | 80 |
| CO3 | Illustrate the progress in GANs by the inclusion of gaming effects using deep learning methods | TPS3 | B | 80 |
| CO4 | Employ different GANs like Semi-Supervised GANs, Conditional GANs for optimal solutions | TPS3 | B | 80 |
| CO5 | Develop Image to Image translations with Cycle GANs along with developing GANs with Object-oriented design. | TPS3 | B | 80 |
| CO6 | Compare the significant technological advancements in GAN and analyze their real-world applications | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO2 | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO3 | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO4 | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO5 | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO6 | S | S | M | L | M | | | M | M | L | | | S | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 5 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | - | 1 | 4 | 12 | - | - | - |
| CO2 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | - | 1 | 4 | 12 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | - | 1 | 4 | 12 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 35 | - | 1 | 4 | 12 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 35 | - | 1 | 4 | 12 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 20 | 10 | - | - | - | 30 | 1 | 4 | - | 10 | - | - |

## Syllabus

**INTRODUCTION -**Motivation – Generative Adversarial Networks (GANs)- GANs in action- GAN training -Reaching equilibrium- use of GANs-Introduction to generative modeling – autoencoders function on a high level- autoencoders to GAN-autoencoder components-Usage of autoencoders -Unsupervised learning

**GENERATING HANDWRITTEN DIGITS** - GAN frameworks: Adversarial training -The Generator and the Discriminator -GAN training algorithm -Generating handwritten digits- Deep Convolutional GAN (DCGAN) **-**Convolutional neural networks - Batch normalization- Generating handwritten digits with DCGAN

**TRAINING AND COMMON CHALLENGES:** GANing for success - Evaluation -Training challenges - Game setups -Training hacks - Progressing with GANs -Latent space interpolation – Key innovations –Tensor Flow Hub and hands-on

**SEMI-SUPERVISED GAN -** Implementing a Semi-Supervised GAN - Comparison to a fully supervised classifier - Conditional GAN –Motivation

**CYCLEGAN -** Image-to-image translation **-**Cycle-consistency loss -Adversarial loss - Identity loss -Architecture -Object-oriented design of GANs -Building CycleGAN

**ADVERSARIAL EXAMPLES** -Context of adversarial examples - Lies, damned lies, and distributions - Adversaries to GANs-Practical Applications -GANs in medicine-GANs in fashion

## Text Books

1. Jakub Langr, Vladimir Bok, “GANs in action- Deep learning with Generative Adversarial Networks”, Manning Publishers, 2019

## Reference Books

1. Roshani Raut, Pranav Deepank Pathak, Sachin R Sakhare, Sonali Patil, “Generative Adversarial Networks and Deep Learning, Theory and Applications”, CRC Press, 2023
2. Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021.
3. Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach'', O'Reilly Media, 2017.
4. https://cs236g.stanford.edu/ Generative Adversarial Networks(GANs) Lecture Videos
5. Goodfellow, I., Pouget-Abadie, J., Mirza, M., Xu, B., Warde-Farley, D., Ozair, S., Courville, A., Bengio, Y., 2014a. Generative adversarial nets. Adv. Neural Inf.Process. Syst. 27.
6. https://www.coursera.org/learn/build-basic-generative-adversarial-networks-gans/
   Course era - Course on building basic Generative adversarial networks

   NPTEL –NOC IITM Generative adversarial networks http://www.nitttrc.edu.in/nptel/courses/video/106105215/lec60.pdf
7. Generative Models- University of Washington, Lecture Notes

   https://courses.cs.washington.edu/courses/cse599i/20au/

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures |
|---|---|---|
| 1 | **INTRODUCTION** – (6) | |

| | | |
|---|---|---|
| 1.2 | Generative Adversarial Networks (GANs) | 1 |
| 1.4 | GANs in action - GAN training | 1 |
| 1.5 | Reaching equilibrium - Use of GANs | |
| 1.6 | Introduction to generative modeling | 1 |
| 1.7 | Autoencoders function on a high level | 1 |
| 1.8 | Autoencoders to GAN | 2 |
| 2 | **GENERATING HANDWRITTEN DIGITS** – ( 6) | |
| 2.1 | Foundations of GANs - Adversarial training | 1 |
| 2.2 | The Generator and the Discriminator | 1 |
| 2.3 | GAN training algorithm | 1 |
| 2.4 | Generating handwritten digits | 1 |
| 2.5 | Deep convolutional GAN - Batch normalization | 1 |
| 2.6 | Generating handwritten digits with DCGAN | 1 |
| 3 | **TRAINING AND COMMON CHALLENGES** - (6) | |
| 3.1 | GANing for success - Evaluation | 1 |
| 3.2 | Training challenges - Progressing with GANs | 1 |
| 3.3 | Latent space interpolation | 1 |
| 3.4 | Key innovations | 1 |
| 3.5 | TensorFlow Hub | 1 |
| 3.6 | Hands on | 1 |
| 4 | **SEMI-SUPERVISED GAN - (6)** | |
| 4.1 | Introducing the Semi-Supervised GAN | 1 |
| 4.2 | Implementation | 2 |
| 4.3 | Comparison to a fully supervised classifier | 1 |
| 4.4 | Conditional GAN | 2 |
| 5 | **CYCLEGAN - (6)** | |
| 5.1 | Image-to-image translation | 1 |
| 5.2 | Cycle-consistency loss | 1 |
| 5.3 | Adversarial loss - Identity loss | 1 |
| 5.4 | Object-oriented design of GANs | 1 |
| 5.5 | CycleGAN | 2 |
| 6 | **ADVERSARIAL EXAMPLES - (6)** | |
| 6.1 | Context of adversarial examples | 1 |
| 6.2 | Lies, damned lies, and distributions | 1 |
| 6.3 | Adversaries to GANs - Practical Applications of GANs | 1 |
| 6.4 | GANs in medicine, fashion | 2 |
| 6.5 | GAN innovations | 1 |
| | Total | 36 Hours |

**Course Designer(s):**


1. Dr. K.Sundarakantham, Professor, CSE kskcse@tce.edu

2. Dr. S.Mercy Shalinie, Professor and Head, CSE shalinie@tce.edu

| | | | | | | |
|---|---|---|---|---|---|---|
| **22CSPM0** | **MOBILE AR DESIGN AND DEVELOPMENT** | Category | L | T | P | Credit |
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

This course objective is to underrated the fundamental of Augmented Reality in the modern application and provide the hands-on practice on immersive and interactive AR experiences for mobile devices which involves a combination of creative design, programming, unique capabilities and business domain in AR Application.

## Prerequisite

22CS261 – Engineering Graphics and Extended Reality

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the fundamental of Mobile AR concept such as Marker and Marker less in chosen application. | TPS3 | 70 | 80 |
| CO2 | Adapt the AR functionalities such as Pose Tracking, Detection and Ray casting in Mobile Application. | TPS3 | 70 | 80 |
| CO3 | Apply the AR Interface such as Placing an Object-Prefabs and adapt the C# scripting language for using AR kit. | TPS3 | 70 | 80 |
| CO4 | Build an Application that incorporates the UI Controller and UX assets. | TPS3 | 70 | 80 |
| CO5 | Adapt the AR user Framework to Place Object and Hiding tracked objects for chosen application. | TPS3 | 70 | 80 |
| CO6 | Apply the AR Concept and Algorithms for an Art Gallery Project or similar | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO7. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO8. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO9. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO10. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO11. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO12. | S | M | L | L | M | M | L | M | M | M | L | M | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | |
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 3 | - | - | - | - |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 15 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 15 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 30 | - | - | - | 60 | 2 | 3 | 10 | | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Mobile AR-Historical Development-Types of Mobile AR- Marker Based AR- Marker Less AR- Virtual Reality- Mixed Reality.AR Foundation – Detection of surfaces-identifying feature points-track virtual objects-face and object tracking-AR Algorithms.
**AR concepts**: Pose Tracking-Environmental Detection-Ray casting and physics for AR-Light Estimation-Occlusion.
**Interface**-Simple AR Scene-Placing an Object-Prefabs-C# Scripting: Variables and Data Types-Operators-Conditionals-Arrays-Functions-Classes and Objects- AR Core and AR Kit-set up.
**Reusable AR Framework**: AR User Framework-UI canvas and panels-UI controller- Interaction Controller mode- interaction modes behaviour-UX assets.
AR User Framework: AR Framework Scene Template-Adding Place Object-mode with instructional UI-Building and Run-Hiding tracked objects.
**Building an AR App**: Art Gallery project UX-Collecting Image Data-Framed photo prefab-Hanging a virtual photo-Editing Virtual Objects- Edit mode - Edit menu - Object from Edit mode - Avoiding intersecting objects - Deleting a picture – Replacing image-Replacing the frame-Interacting to edit a picture - finger to move the picture - Pinching to resize the picture-Tracking Images.

## Text Books

1. Linowes, Jonathan. Augmented Reality with Unity AR Foundation: A Practical Guide to Cross-platform AR Development with Unity 2020 and Later Versions. N.p., Packt Publishing, 2021.
2. Glover, Jesse, and Linowes, Jonathan. Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the Power of Unity and Become a Pro at Creating Mixed Reality Applications. United Kingdom, Packt Publishing, 2019.

## Reference Books & web resources

1. Peddie, Jon. Augmented Reality: Where We Will All Live. Germany, Springer International Publishing, 2017.
2. Grubert, Jens, and Grasset, Raphael. Augmented Reality for Android Application Development. United Kingdom, Packt Publishing, 2013.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Mobile AR | 1 |
| 1.2 | Historical Development | |
| 1.3 | Types of Mobile AR- Marker Based AR- Marker Less AR | 1 |
| 1.4 | Virtual Reality- Mixed Reality | 1 |
| 1.5 | AR Foundation | 1 |
| 1.6 | Detection of surfaces | 1 |
| 1.7 | identifying feature points-track virtual objects | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 1.8 | AR Algorithms | 1 |
| **2** | **AR concepts** | |
| 2.1 | Pose Tracking | 1 |
| 2.2 | Environmental Detection | 1 |
| 2.3 | Ray casting and physics for AR | 1 |
| 2.4 | Light Estimation-Occlusion. | 1 |
| **3** | **Interface** | |
| 3.1 | Simple AR Scene | 2 |
| 3.2 | Placing an Object | 1 |
| 3.3 | Prefabs | 1 |
| 3.4 | C# Scripting: Variables and Data Types-Operators-Conditionals | 1 |
| 3.5 | Arrays-Functions- | 1 |
| 3.6 | Classes and Objects | 1 |
| 3.7 | AR Core and AR Kit-set up | 1 |
| **4** | **Reusable AR Framework**: | |
| 4.1 | AR User Framework | 1 |
| 4.2 | UI canvas and panels-UI controller | 2 |
| 4.3 | Interaction Controller mode | 2 |
| 4.4 | interaction modes behaviour- UX assets. | 1 |
| 4.5 | AR User Framework: AR Framework Scene Template | 1 |
| 4.6 | Adding Place Object | 1 |
| 4.7 | Mode with instructional UI | 1 |
| 4.8 | Building and Run-Hiding tracked objects. | 1 |
| **5** | **Building an AR App**: | |
| 5.1 | Art Gallery project UX-Collecting Image Data | 2 |
| 5.2 | Framed photo prefab- Hanging a virtual photo-Editing Virtual Objects | 1 |
| 5.3 | Edit mode - Edit menu - Object from Edit mode | 1 |
| 5.4 | Avoiding intersecting objects - Deleting a picture | 1 |
| 5.5 | Replacing image - Replacing the frame | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 5.6 | Interacting to edit a picture | 1 |
| 5.7 | Finger to move the picture - Pinching to resize the picture- | |
| 5.8 | Tracking Images | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr.N.Shivakumar, Assistant Professor, Computer Science and Engineering, shiva@tce.edu
2. Dr.K.Indira, Assistant Professor, Computer Science and Engineering, kiit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPN0** | **HIGH PERFORMANCE COMPUTING** | PE | 3 | 0 | 0 | 3 |

## Preamble

This course teaches students with strong foundation in parallel computing and high performance computing systems. Students will explore shared and distributed-memory parallel programming model along with parallel programming using OpenMP and MPI. It also describes the principles and structures of high performance computing. This course also gives the practical hands on experience to students in GPU programming using CUDA.

## Prerequisite

- Basics of Computer Architecture and Organization

## Course Outcomes

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

| Cos | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Show the features of High Performance Computing Systems from traditional computing. | TPS3 | B | 75 |
| CO2 | Construct parallel programs using shared memory OpenMP. | TPS3 | B | 75 |
| CO3 | Construct parallel programs using distributed memory MPI. | TPS3 | B | 75 |
| CO4 | Identify the HPC components suitable for the given specification. | TPS3 | B | 75 |
| CO5 | Solve the complex data applications by choosing the suitable HPC model. | TPS3 | B | 75 |
| CO6 | Perform basic GPU programming using CUDA. | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | | | L | M | | | M | M | | L |
| CO2 | S | M | L | L | M | | | L | M | L | | M | M | L | L |
| CO3 | S | M | L | L | M | | | L | M | L | | M | M | L | L |
| CO4 | S | M | L | | M | | | L | M | | | M | M | L | L |
| CO5 | S | M | L | M | M | L | | L | M | M | | M | M | L | L |
| CO6 | S | M | L | | M | | | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | 10 | - | - | - | - | - | - | - | - | - | 5 | 5 | 10 | - | - | - | - | - | - | - | - | - | 2 | 3 | 10 | - | - | - |
| CO2 | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | 5 | 10 | 25 | - | - | - | - | - | - | - | - | - | 2 | 3 | 10 | - | - | - |
| CO3 | 10 | 10 | 15 | - | - | - | - | - | - | - | - | - | 5 | 10 | 25 | - | - | - | - | - | - | - | - | - | 2 | 3 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 10 | - | - | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 2 | 3 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | 10 | 10 | 10 | - | - | - | - | - | - | - | - | - | 5 | 10 | 10 | - | - | - | 2 | 3 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | 5 | 15 | 25 | - | - | - | 2 | 3 | 10 | - | - | - |

## Syllabus

**Basics of High Performance Computing (HPC):** Key Properties of HPC Architecture - Speed, Parallelism, Efficiency, Power, Reliability and Programmability. Structure of HPC systems, Applications of HPC.

**Parallel systems:** Flynn's taxonomy, Von Neumann Sequential Processors, Vector and Pipelining - Pipeline Parallelism and Vector Processing, Multiprocessors - Shared-Memory Multiprocessors - Massively Parallel Processors and Commodity Clusters.

**Parallel computing:** shared memory computers, distributed memory computers and hybrid systems, parallel programming using OpenMP and MPI.

**HPC Architecture components:** HPC Clusters, Computing Capabilities – multi-core CPU, GPU, FPGA and ASICs, Storage - File Storage, Object Storage, Block Storage and Memory-Centric Storage. Network Interconnects and Protocols.

**HPC Models and Frameworks:** Basics of complex data applications – volume, velocity, variety and veracity, Examples - Batch Processing-Apache Spark, Stream Processing, Query Processing-MySQL, Graph Processing and AI processing applications-PyTorch.

**Accelerator Architecture:** Basics of Graphics Processing Units (GPU), GPU Architecture, Heterogeneous systems, CUDA programming – basics of parallel programming and threads in GPUs.

## Text Books

1. High-Performance Big Data Computing, Dhabaleswar K. Panda, Xiaoyi Lu, and Dipti Shankar, The MIT Press, Massachusetts Institute of Technology, Cambridge, 2022.
2. Introduction to High Performance Computing for Scientists and Engineers, Georg Hager Gerhard Wellein, Chapman & Hall/CRC Computational Science Series, CRC Press,2011.
3. High Performance Computing Modern Systems and Practices, Thomas Sterling, Matthew Anderson, Maciej Brodowicz, Morgan Kaufmann Publisher, 2018.

4. Programming in Parallel with CUDA - A Practical Guide, Richard Ansorge, Cambridge University Press,2022.

## Reference Books & web resources

1. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Second Edition, Addison-Wesley, Pearson Education Limited 2003.
2. CUDA by Example: An Introduction to General-Purpose GPU Programming, Jason Sanders, Edward Kandrot, Addison-Wesley Professional, 1st Edition, 2010.
3. The OpenMP Common Core - Making OpenMP Simple Again, Timothy G. Mattson, Yun (Helen) He, and Alice E. Koniges, The MIT Press, 2019.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Basics of High Performance Computing (HPC)** | |
| 1.1 | Key Properties of HPC Architecture - Speed, Parallelism, Efficiency, Power, Reliability and Programmability. | 1 |
| 1.2 | Structure of HPC systems | 2 |
| 1.3 | Applications of HPC | 2 |
| **2** | **Parallel systems** | |
| 2.1 | Flynn's taxonomy | 1 |
| 2.2 | Von Neumann Sequential Processors | 1 |
| 2.3 | Vector and Pipelining - Pipeline Parallelism and Vector Processing | 2 |
| 2.4 | Multiprocessors - Shared-Memory Multiprocessors - Massively Parallel Processors and Commodity Clusters | 2 |
| **3** | **Parallel computing** | |
| 3.1 | shared memory computers, distributed memory computers and hybrid systems | 1 |
| 3.2 | Parallel programming using OpenMP | 3 |
| 3.3 | Parallel programming using MPI | 3 |
| **4** | **HPC Architecture Components** | |
| 4.1 | HPC Clusters | 1 |
| 4.2 | Computing Capabilities – multi-core CPU, GPU, FPGA and ASICs | 2 |
| 4.3 | Storage - File Storage, Object Storage, Block Storage and Memory-Centric Storage | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.4 | Network Interconnects and Protocols | 2 |
| **5** | **HPC Models and Frameworks** | |
| 5.1 | Basics of complex data applications – volume, velocity, variety and veracity | 1 |
| 5.2 | Examples - Batch Processing, Stream Processing, Query Processing, Graph Processing and AI processing applications | 2 |
| 5.3 | Apache Spark, MySQL and PyTorch | 2 |
| **6** | **Accelerator Architecture** | |
| 6.1 | Basics of Graphics Processing Units (GPU) and GPU Architecture | 2 |
| 6.2 | Heterogeneous systems | 1 |
| 6.3 | CUDA programming – basics of parallel programming and threads in GPUs | 3 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.G.Madhupriya, Associate Professor,CSE gmadhupriya@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPP0** | **APPLIED LINEAR ALGEBRA IN AI AND ML** | PE | 3 | 0 | 0 | 3 |

## Preamble

Linear algebra, optimization techniques and statistical methods together form essential tools for most of the algorithms in Artificial Intelligence and Machine Learning. The main objective of this course is to provide students a solid foundation in mathematics and prepare students to pursue advanced study or research in the field of AI and ML. The outcome of this course is to train students with the important concepts and computational techniques in linear algebra which are useful for AI and ML applications.

## Prerequisite

- NIL

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Implement matrix operations to compute QR factorization and pseudo inverse | TPS3 | B | 70 |
| CO2 | Develop System of linear equations and functions using Taylor approximation and Regression model. | TPS3 | B | 70 |
| CO3 | Demonstrate multi-class least squares classifiers, Polynomial classifiers using Linear least squares | TPS3 | B | 70 |
| CO4 | Build Multi-objective, Constrained and Multi-collinearity least squares for AI and ML problems | TPS3 | B | 70 |
| CO5 | Illustrate Nonlinear least squares using Penalty and approximation algorithms | TPS3 | B | 70 |
| CO6 | Use LRA and SLRA to model order selection in time series analysis and collaborative filtering. | TPS3 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO2 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO3 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO5 | S | M | L | | M | L | | M | M | M | | M | M | L | M |
| CO6 | S | M | L | | M | L | | M | M | M | | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment I | | | | | | Assignment II | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 4 | 10 | 20 | | | | | | | | | | | | 50 | | | | | | | | | | | 5 | 15 | | | |
| CO2 | 4 | 10 | 20 | | | | | | | | | | | | 30 | | | | | | | | | | | 5 | 15 | | | |
| CO3 | 2 | 10 | 20 | | | | 2 | 10 | 15 | | | | | | 20 | | | | | | 20 | | | | | 5 | 15 | | | |
| CO4 | | | | | | | 4 | 10 | 15 | | | | | | | | | | | | 30 | | | | | 5 | 15 | | | |
| CO5 | | | | | | | 2 | 5 | 10 | | | | | | | | | | | | 25 | | | | | | 10 | | | |
| CO6 | | | | | | | 2 | 5 | 10 | | | | | | | | | | | | 25 | | | | | | 10 | | | |
| | 10 | 30 | 60 | | | | 10 | 30 | 60 | | | | | | 100 | | | | | | 100 | | | | | 20 | 80 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Matrices:** Zero and Identity matrices, Transpose, Addition, Norm, Matrix-Vector multiplication, Geometric transformations, Selectors, Incidence matrix, Convolution, Matrix-Matrix multiplication, QR factorization, left and right inverses, pseudo inverse, Lagrangian Matrices and Graph.

**Linear functions and Equations**: Taylor approximation, Regression model, Linear and affine functions, System of linear equations, Composition of linear functions, Understanding Linear dynamical systems.

**Linear least squares:** Geometrical interpretation, data fitting, feature engineering, fitting with continuous and discontinuous piecewise linear functions, least squares to classification, multi-class least squares classifiers, Polynomial classifiers. **Case Study:** Application to MNIST data set.

**Multi-objective least squares:** Estimation and regularized inversion and data fitting, Multi-objective least squares application to image de-blurring, constrained least squares application to portfolio optimization, multi-collinearity least squares applications to Principal Component Analysis (PCA) and application to Google page ranking algorithm.

**Nonlinear Model and least squares:** Nonlinear model fitting, Nonlinear least squares classification, Constrained nonlinear least squares: Penalty algorithm, Augmented Lagrangian algorithm, Low rank approximation (LRA) and structured low rank approximation problem (SLRA) and solution. **Case study:** LRA and SLRA application to model order selection in time series, Tensors decomposition based sparse learning in deep networks and application to collaborative filtering.

## Text Books


1. Gilbert Strang , "Linear Algebra and Learning from Data", Wellesley-Cambridge Press, First Edition,2019
2. Stephen Boyd and Lieven Vandenberghe, "Introduction to Applied Linear Algebra-Vectors, Matrices, and Least Squares" Cambridge University Press, 1st edition, 2018


## Reference Books & web resources


1. Crista Arangala, "Linear Algebra with Machine Learning and Data", Chapman and Hall/CRC; First Edition, 2023.
2. Charu C. Aggarwal, "Linear Algebra and Optimization for Machine Learning",Springer .First Edition, 2020


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lecture Hours |
|---|---|---|

| | | |
|---|---|---|
| **1** | **Matrices(8)** | |
| 1.1 | Zero and identity matrices, Transpose, addition, norm, Matrix-vector multiplication | 2 |
| 1.2 | Geometric transformations, Selectors, Incidence matrix | 2 |
| 1.3 | Convolution, Matrix-matrix multiplication, QR factorization | 2 |
| 1.4 | Left and right inverses, pseudo inverse, Lagrangian Matrices and Graph | 2 |
| **2** | **Linear functions and Equations(6)** | |
| 2.1 | Taylor approximation, Regression model, Linear and affine functions | 2 |
| 2.2 | System of linear equations, Composition of linear functions | 2 |
| 2.3 | Understanding Linear dynamical systems | 2 |
| **3** | **Linear least squares(7)** | |
| 3.1 | Geometrical interpretation, data fitting, feature engineering | 2 |
| 3.2 | Fitting with continuous and discontinuous piecewise linear functions, least squares to classification | 2 |
| 3.3 | Multi-class least squares classifiers, Polynomial classifiers. | 2 |
| 3.4 | **Case Study:** Application to MNIST data set. | 1 |
| **4** | **Multi-objective least squares (7)** | |
| 4.1 | Estimation and regularized inversion and data fitting | 2 |
| 4.2 | Multi-objective least squares application to image de-blurring | 1 |
| 4.3 | Constrained least squares application to portfolio optimization | 2 |
| 4.4 | Multi-collinearity least squares applications to Principal Component Analysis (PCA) and application to Google page ranking algorithm. | 2 |
| **5** | **Nonlinear Model and least squares (8)** | |
| 5.1 | Nonlinear model fitting, Nonlinear least squares classification | 2 |
| 5.2 | Constrained nonlinear least squares: Penalty algorithm, Augmented Lagrangian algorithm | 2 |
| 5.3 | Low rank approximation (LRA) and structured low rank approximation problem (SLRA) and solution. | 2 |
| 5.4 | **Case study:** LRA and SLRA application to model order selection in time series, Tensors decomposition based sparse learning in deep networks and application to collaborative filtering. | 2 |
| | **Total Hours** | **36** |

**Course Designer(s):**


1. Dr C S Senthilkumar, AP,Maths kumarstays@tce.edu
2. Dr. M.Nirmala Devi, AP,CSE mnit@tce.edu
3. Dr.B.Subbulakshmi, AP,CSE bscse@tce.edu

| 22CSPQ0 | IOT SECURITY | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

This course will introduce students to the need for IoT security. It provides an overview of the architecture of IoT and emphasizes the value of security protection and privacy measures to the IoT components and applications.

## Prerequisite

Knowledge on Wireless networks, IoT and Security.

## Course Outcomes

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

| CO | Course Outcome (CO) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Establish the needs and requirements for security in an IoT system. (Understand) | TPS2 | 70 | 80 |
| CO2 | Interpret the security architectures for IoT. (Apply) | TPS3 | 70 | 75 |
| CO3 | Deduce the significance of cryptographic algorithms for IoT. (Apply) | TPS3 | 70 | 75 |
| CO4 | Design a layered mechanism for IoT security. (Apply) | TPS3 | 70 | 75 |
| CO5 | Develop an mechanism to ensure privacy of IoT applications. (Apply) | TPS3 | 70 | 75 |
| CO6 | Design a mechanism to guarantee security measures for IoT. (Apply) | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | | | | | | | | | | L | | |
| CO2 | S | M | L | - | - | L | L | L | M | L | | M | M | L | L |
| CO3 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO4 | S | M | L | - | - | L | L | L | M | L | | M | M | L | L |
| CO5 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO6 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | | | | | | | | | | | | | | | | | | | | | | | 4 | 10 | | | | |
| CO2 | 10 | 10 | 10 | | | | | | | | | | | | 50 | | | | | | | | | | 4 | 4 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 40 | | | | | | | | | | 4 | 4 | 10 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | | | | | | | | 30 | | | | 4 | 4 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 30 | | | | 4 | 4 | 10 | | | |
| CO6 | | | | | | | 10 | 20 | 10 | | | | | | | | | | | | 40 | | | | 4 | | 10 | | | |

## Syllabus

**Introduction**: Physical Design of IoT, Logical Design of IoT - Components of an IoT System - Architectures of the Internet of Things - IoT Industries and Their Characteristics - Enabling Technologies - Trends in IoT - M2M, IIoT, Digital Twin, Internet of Robotic Things (IoRT)

**Security Architectures for IoT:** Layered IoT Security Architecture - Security Threats and Methods of Protection for IoT Devices - Security Threats and Methods of Security Protection for Up-Stream Data - Security Threats and Methods of Security Protection for Down-Stream Data - IoT Perception Layer Security - IoT Network Layer Security Mechanisms - Typical Security Techniques for IoT Network Layer - IoT Processing Layer Security Mechanisms - IoT Application Layer Security Mechanisms

**Cryptographic Fundamentals for IoT:** Cryptographic Algorithms and their Security Services – Deterministic and Probabilistic Encryptions - Cryptographic Hash Functions and Message Authentication Codes - Trust Mechanism and Key Management in IoT - Types of Identities in IoT Systems - Identity Authentication Protocols - Key Management - Lightweight PKI for IoT Applications Identity & Access Management Solutions For IoT

**IoT Security** - IoT Perception Layer Security - Security Threats in IoT Perception Layer - IoT Network Layer Security - Security Threats in IoT Network Layer - Security Techniques in Mobile Communication Networks - Security Techniques in LPWAN - IoT Processing Layer Security - Security Threats in IoT Processing Layer - Database for IoT Processing Layer - Access Control Policies Applicable to IoT Processing Layer - Security Mechanisms in Cloud Computing

**Privacy Protection in IoT Applications** - Privacy challenges introduced by the IoT - Privacy Protection by Identity Anonymity - Privacy Protection Based on Data Linkage - Location Privacy Protection - Graded Privacy Protection - RFID System Security - Security and Privacy Issues in RFID Systems - IT Security Versus OT Security - Characteristics of Network Attacks Targeting at OT Security - Characteristics of OT Security - The Limitations of IoT Attackers - Intrusion Tolerance Mechanisms in IoT Systems - Architectural Construction of Intrusion Tolerance Scheme for IoT

**Security Measures for IoT** - IoT Security Versus Traditional IT System Security - The Secure Development Life Cycle (SDLC) - The challenge of secure IoT development - Secure design goals - Setting Up an IoT Compliance Monitoring - IoT Incident Response and Forensic Analysis - Defining, planning, and executing an IoT incident response - IoT forensics

## Text Books

1. Chuan-Kun Wu, Internet of Things Security Architectures and Security Measures, Springer, 2021.

2. Brian Russell, Drew Van Duren, Practical Internet of Things Security, Second Edition, Packt Publishing, 2018.

**Reference Books & web resources**

1. Anupama C. Raman and Pethuru Raj, The Internet of Things: Enabling technologies, platforms, and Use Cases, CRC Press, 2017.
2. Fei Hu, Security and Privacy in Internet of Things (IoTs) - Models, Algorithms, and Implementations, CRC Press, 2016.

**Course Contents and Lecture Schedule**

| Module No | Topic | No of Lectures | Course Outcome |
|---|---|---|---|
| 1 | **Introduction** | | |
| 1.1 | Physical Design of IoT, Logical Design of IoT | 1 | CO1 |
| 1.2 | Components of an IoT System | 1 | CO1 |
| 1.3 | Architectures of the Internet of Things | 1 | CO1 |
| 1.4 | IoT Industries and Their Characteristics | 1 | CO1 |
| 1.5 | Enabling Technologies - Trends in IoT | 1 | CO1 |
| 2 | **Security Architectures for IoT** | | |
| 2.1 | Layered IoT Security Architecture | 1 | CO2 |
| 2.2 | Threats and Methods of Protection for IoT Devices | 1 | CO2 |
| 2.3 | Security Threats and Methods of Security Protection for Up-Stream, Down-Stream Data | 1 | CO2 |
| 2.4 | IoT Perception Layer & Network Layer Security Mechanisms | 1 | CO2 |
| 2.5 | IoT Processing Layer & Application Layer Security Mechanisms | 1 | CO2 |
| 3 | **Cryptographic Fundamentals for IoT** | | |
| 3.1 | Cryptographic Algorithms and their Security Services | 1 | CO3 |
| 3.2 | Deterministic and Probabilistic Encryptions | 1 | CO3 |
| 3.3 | Cryptographic Hash Functions and Message Authentication Codes | 1 | CO3 |
| 3.4 | Trust Mechanism and Key Management in IoT | 1 | CO3 |
| 3.5 | Types of Identities in IoT Systems - Identity Authentication Protocols | 1 | CO3 |
| 3.6 | Key Management, Identity & Access Management Solutions For IoT | 1 | CO3 |
| 4 | **IoT Security** | | |
| 4.1 | IoT Perception Layer Security, Security Threats in IoT Perception Layer | 2 | CO4 |
| 4.2 | IoT Network Layer Security, Security Threats in IoT Network Layer | 2 | CO4 |
| 4.3 | Security Techniques in Mobile Communication Networks, LPWAN | 1 | CO4 |
| 4.4 | IoT Processing Layer Security - Security Threats in IoT Processing Layer | 1 | CO4 |
| 4.5 | Access Control Policies Applicable to IoT Processing Layer | 1 | CO4 |
| 4.6 | Security Mechanisms in Cloud Computing | 1 | CO4 |
| 5 | **Privacy Protection in IoT Applications** | | |
| 5.1 | Privacy challenges introduced by the IoT | 1 | CO5 |
| 5.2 | Privacy Protection by Identity Anonymity, Data Linkage, Location, Graded Privacy Protection | 1 | CO5 |
| 5.3 | RFID System Security - Security and Privacy Issues in RFID Systems | 1 | CO5 |
| 5.4 | IT Security Versus OT Security | 1 | CO5 |
| 5.5 | The Limitations of IoT Attackers | 1 | CO5 |

| | | | |
|---|---|---|---|
| 5.6 | Intrusion Tolerance Mechanisms in IoT Systems - Architectural Construction of Intrusion Tolerance Scheme for IoT | 1 | CO5 |
| **6** | **Security Measures for IoT** | | |
| 6.1 | IoT Security Versus Traditional IT System Security | 1 | CO6 |
| 6.2 | The Secure Development Life Cycle (SDLC) | 1 | CO6 |
| 6.3 | The challenge of secure IoT development, design goals | 1 | CO6 |
| 6.4 | Setting Up an IoT Compliance Monitoring | 1 | CO6 |
| 6.5 | Defining, planning, and executing an IoT incident response | 1 | CO6 |
| 6.6 | IoT forensics | 1 | CO6 |
| | Total | 36 | |

**Course Designer(s):**

1. Dr.G.S.R.Emil Selvan, Associate Professor, CSE emil@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPR0** | **REAL TIME OPERATING SYSTEMS** | PE | 3 | 0 | 0 | 3 |

## Preamble

This course provides the basic core technologies used in developing real time systems. The evolution of System on Chip and its ported real time operating systems are discussed with practical hands on with free RTOS.

## Prerequisite

- Operating Systems

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify Core, Platform, Real Time Operating Systems supported in System on Chip | TPS3 | B | 80 |
| CO2 | Experiment with Time Management basic Service in Real Time Systems | TPS3 | B | 80 |
| CO3 | Implement Task Scheduling Algorithm in Real Time Systems based on problem | TPS3 | B | 80 |
| CO4 | Choose Inter Task Communication and appropriate Synchronization Mechanism | TPS3 | B | 80 |
| CO5 | Apply appropriate Deadlock algorithm for the given real time scenario | TPS3 | B | 80 |
| CO6 | Examine Real time System basic functions in the embedded support Emulator, QEMU | TPS4 | B | 80 |

## Mapping with Programme Outcomes

| **COs** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PS O1** | **PS O2** | **PS O3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO6. | S | S | M | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO2 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 1 | 4 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 1 | 4 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 20 | 10 | - | - | 40 | 20 | 1 | 4 | 10 | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**System on a Chip:** Embedded Systems-Basics of Chips and SoC ICs – Intellectual Property Cores - System on Programmable Chips (SoPC) – Network on Chip – Bus based Interconnection – CPU/IP Cores - Arm – DSP Case Study: Board Specific Packages

**RTOS:** Real-Time Systems and OS –Types - Requirement – Basic Functions – Micro-Kernel Architecture- Kernel mode decomposing and Programming- Performance Metrics-Time Management- Clock Synchronization (SCL)

**Task Management:** RTOS Task Model- Task Control Block –Scheduling Problems – Aperiodic Task Scheduling: Jackson Algorithm, Horn's Algorithm, Non –Pre-emptive Scheduling –Periodic Task Scheduling: Timeline Scheduling, Rate Monotonic Scheduling, Earliest Deadline First – Interrupt handling – Interrupt Service Routines

**Concurrency and Synchronization:** Message Queue – Mail boxes – Resource Sharing –-Inter Task Access Synchronization: Semaphore, Mutex- Inter Task Event Synchronization-Event Flags-Dead Lock - Priority Inheritance Protocol-Highest Locker Protocol – Priority Ceiling Protocol- Memory management

**Real Time Kernel:** QEMU Emulator – Free RTOS – Task Management – Queue Management – Software Timer management – Case Study: Azure RTOS, GreenHills RTOS

## Text Books

1. C.Krishna and K.Shin, Real Time Systems, McGraw Hill, 2000
2. Philip A. Laplante, Seppo J. Ovaska, Real-Time Systems Design and Analysis, Wiley, 2012.
3. Giorgio C. Buttazzo. Hard Real Time Computing Systems: Predictable Scheduling Algorithms and Applications, 3rd Edition. Springer 2011

## Reference Books & web resources


1. Jane W.s.Liu, Real Time Systems,Pearson, 2000
2. Michael J. Flynn, Wayne Luk, Computer System Design: System on Chip, John Wiley and Sons Inc. 2011
3. https://archive.nptel.ac.in/courses/106/105/106105172/, Prof.Rajib Mall, IIT Kharagpur


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **System on a Chip** | |
| 1.1 | Embedded Systems-Basics of Chips and SoC ICs | 1 |
| 1.2 | Intellectual Property Cores- System on Programmable Chips (SoPC) | 1 |
| 1.3 | Network on Chip – Bus based Interconnection | 1 |
| 1.4 | CPU/IP Cores - Arm – DSP | 1 |
| 1.5 | Case Study : Board Specific Packages | 2 |
| **2** | **Real Time Operating Systems** | |
| 2.1 | Real-Time Systems and OS | 1 |
| 2.2 | Types - Requirement | 1 |
| 2.3 | Basic Functions – Micro-Kernel Architecture- Kernel mode decomposing and Programming | 2 |
| 2.4 | Performance Metrics -Time Management - Clock Synchronization (SCL) | 2 |
| **3** | **Task Management** | |
| 3.1 | RTOS Task Model- Task Control Block | 1 |
| 3.2 | Scheduling Problems – Aperiodic Task Scheduling: Jackson Algorithm, Horn's Algorithm, Non –Pre-emptive Scheduling | 3 |
| 3.3 | Periodic Task Scheduling: Timeline Scheduling, Rate Monotonic Scheduling, Earliest Deadline First | 3 |
| 3.4 | Interrupt handling – Interrupt Service Routines | 2 |
| **4** | **Concurrency and Synchronization** | |
| 4.1 | Message Queue – Mail boxes – Resource Sharing | 1 |
| 4.2 | Inter Task Access Synchronization: Semaphore, Mutex | 2 |
| 4.3 | Inter Task Event Synchronization-Event Flags | 2 |
| 4.4 | Dead Lock - Priority Inheritance Protocol-Highest Locker Protocol – Priority Ceiling Protocol | 3 |
| 4.5 | Memory management | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **5** | **Real Time Kernel** | |
| 5.1 | QEMU Emulator | 1 |
| 5.2 | Free RTOS | 1 |
| 5.3 | Task Management | 1 |
| 5.4 | Queue Management | 1 |
| 5.5 | Software Timer management1 | 1 |
| 5.6 | Case Study: Azure RTOS, GreenHills RTOS | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.R.Leena Sri, Associate Professor, Computer Science and Engineering, rlsit@tce.edu

| 22CSPS0 | AGENT BASED SYSTEMS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

This Agent-Based Systems course is a primer for aspiring engineers, offering hands-on training in distributed computing and intelligent automation. Designed to equip participantswith essential skills, the program anticipates and aligns with the evolving landscape of agent-based systems, especially in industrial applications.

## Prerequisite

- Distributed Systems
- Artificial Intelligence
- Deep Learning
- Probability and Statistics

## Course Outcomes

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

| CO | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the core principles and characteristics of multi-agent systems, including agent architectures, communication, and coordination mechanisms. | TPS 3 | 70 | 80 |
| CO2 | Utilize programming languages to design and implement agent architectures, communication protocols, and coordination mechanisms. | TPS 3 | 70 | 80 |
| CO3 | Employ formal methods to verify and validate agent-based systems, including the use of model checking and specification languages. | TPS 3 | 70 | 80 |
| CO4 | Apply linear programming techniques to optimize resource allocation and decision-making processes within agent-based systems | TPS 3 | 70 | 80 |
| CO5 | Analyze and evaluate the emergence of self-organizing behaviors within multi-agent systems and their impact onoverall system performance. | TPS 4 | 70 | 80 |
| CO6 | Analyze real-world case studies, such as smart traffic management, supply chain optimization, and collaborative robotics in manufacturing, to evaluate the effectiveness and adaptability of multi-agent systems. | TPS 4 | 70 | 80 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | L | | M | M | M | L | M | M | L | M |
| CO5. | S | M | L | | L | L | | M | M | M | L | M | M | L | M |
| CO6. | S | M | L | L | M | M | L | M | M | M | M | S | M | M | M |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | | 10 | - | - | - | 20 | - | - | - | - | - | - | - | | 2 | 3 | 15 | - | - | - |
| CO2 | 10 | 10 | 10 | - | - | - | 40 | - | - | - | - | - | - | - | | 2 | 3 | 15 | - | - | - |
| CO3 | 10 | 20 | 20 | - | - | - | 40 | - | - | - | - | - | - | - | | 2 | 3 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 10 | - | 10 | - | - | - | 20 | | 2 | 3 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 10 | 10 | - | 15 | - | - | 20 | 20 | 2 | 3 | - | 10 | - | - |
| CO6 | - | - | - | - | - | - | - | 10 | 20 | - | 15 | - | - | 20 | 20 | 2 | 3 | - | 10 | - | - |

**Syllabus**

**Foundations of Multi-Agent Systems -** Introduction to Artificial Intelligence Programming - Fundamentals of Artificial Intelligence, Machine Learning and Deep Learning - Basics of Distributed Systems - Overview of Multi-Agent Systems - **Agent Architectures and Communication -** Agent Architectures - Agent Communication - Agent Coordination Mechanisms - **Learning and Decision-Making in Multi-Agent Systems -** Agent Learning - Formal Methods for Agent-Based Systems - Game Theory in Multi-Agent Decision-Making - Linear Programming in Agent Decision-Making - **Advanced Topics in Multi-Agent Systems**

**-** Swarm Intelligence in Multi-Agent Systems - Behaviour Trees in Agent Architectures - Ontologies in Multi-Agent Systems - Temporal Logic and Model Checking - **Applications andSpecialized Areas -** Self-Organization in Multi-Agent Systems - Security and Trust in Multi- Agent Systems - Human-Agent Interaction - Bio-Inspired Computing in Multi-Agent Systems

- Multi-Robot Systems and Physical Deployments - Emergent Properties in Multi-Agent Systems - **Case Studies -** Smart Traffic Management - Supply Chain Optimization - Collaborative Robotics in Manufacturing – Drones

**Text Books**

1. Multiagent Systems – A Modern Approach to Distributed Artificial Intelligence (Intelligent Robotics & Autonomous Agents Series),Gerhard Weiss , 2000.
2. Swarm Intelligence From Natural to Artificial Systems, Eric Bonabeau, Marco Dorigo, and Guy Theraulaz, 1999 by Oxford University Press.

3. Behavior Trees in Robotics and AI: An Introduction, Michele Colledanchise (Author), Petter Ögren (Author), Chapman & Hall/CRC Artificial Intelligence and RoboticsSeries) 1st Edition, 2017
4. Reinforcement Learning: An Introduction second edition, Richard S. Sutton and Andrew G. Barto The MIT Press Cambridge, Massachusetts London, England, 2020.

## Reference Books & web resources

1. Ontology-Based Multi-Agent Systems - https://link.springer.com/book/10.1007/978-3-642-01904-3
2. Temporal Logic and State Systems (Texts in Theoretical Computer Science. AnEATCS Series) - https://www.amazon.com/Temporal-Systems-Theoretical-Computer-Science/dp/3540674012
3. https://library.iitmandi.ac.in/os/onlineresources/E-Books/springer-CSE.html

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Foundations of Multi-Agent Systems** | **(6)** |
| 1.1 | Introduction to Artificial Intelligence Programming | 1 |
| 1.2 | Fundamentals of Artificial Intelligence, Machine Learning and Deep Learning | 2 |
| 1.3 | Basics of Distributed Systems | 1 |
| 1.4 | Overview of Multi-Agent Systems | 2 |
| **2** | **Agent Architectures and Communication** | **(6)** |
| 2.1 | Agent Architectures | 2 |
| 2.2 | Agent Communication | 2 |
| 2.3 | Agent Coordination Mechanisms | 2 |
| **3** | **Learning and Decision-Making in Multi-Agent Systems** | **(6)** |
| 3.1 | Agent Learning | 1 |
| 3.2 | Formal Methods for Agent-Based Systems | 1 |
| 3.3 | Game Theory in Multi-Agent Decision-Making | 2 |
| 3.4 | Linear Programming in Agent Decision-Making | 2 |
| **4** | **Advanced Topics in Multi-Agent Systems** | **(6)** |
| 4.1 | Swarm Intelligence in Multi-Agent Systems | 1 |
| 4.2 | Behaviour Trees in Agent Architectures | 1 |
| 4.3 | Ontologies in Multi-Agent Systems | 2 |
| 4.4 | Temporal Logic and Model Checking | 2 |
| **5** | **Applications and Specialized Areas** | **(9)** |
| 5.1 | Self-Organization in Multi-Agent Systems | 1 |
| 5.2 | Security and Trust in Multi-Agent Systems | 2 |
| 5.3 | Human-Agent Interaction | 1 |
| 5.4 | Bio-Inspired Computing in Multi-Agent Systems | 2 |
| 5.5 | Multi-Robot Systems and Physical Deployments | 2 |
| 5.6 | Emergent Properties in Multi-Agent Systems | 1 |
| **6** | **Case Studies** | **(3)** |
| 6.1 | Smart Traffic Management | 1 |
| 6.2 | Supply Chain Optimization | 1 |
| 6.3 | Collaborative Robotics in Manufacturing - Drones | 1 |
| | **Total** | 36 |

## Course Designer(s):

1. Dr. M.Sivakumar, AP/CSE mskcse@tce.edu
2. Mr.S.Santhana Hari, AP/CSE sshcse@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPT0** | **BLOCKCHAIN SECURITY AND PRIVACY** | PE | 3 | 0 | 0 | 3 |

## Preamble

The security and privacy of blockchain can be viewed in two ways. In one, blockchain is used as a security solution to several applications such as finance, supply chain, and healthcare to name a few. The other fantabulous way of looking at it is the security and privacy techniques that is there in the blockchain and that can be tailored in it in the future. This course familiarizes the students about blockchain security and privacy in the second way.

## Prerequisite

A basic course on Blockchain Technology and its Applications

## Course Outcomes

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

| CO | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the fundamental concepts of blockchain technology | TPS3 | 70 | 80 |
| CO2 | Illustrate the security risks existing in blockchian platform | TPS3 | 70 | 80 |
| CO3 | Illustrate the vulnerabilities existing in smart contracts and methods to address the security issues. | TPS3 | 70 | 80 |
| CO4 | Illustrate the advanced cryptographic protocols for blockchain technology. | TPS3 | 70 | 80 |
| CO5 | Apply the various privacy-preserving primitives to blockchain. | TPS3 | 70 | 80 |
| CO6 | Analyze the use of security techniques for the various blockchain platforms. | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | M | M | L | M | M | | M | M | L | L |
| CO2. | S | M | L | | M | M | M | L | M | M | | M | M | M | L |
| CO3 | S | M | L | | L | M | M | L | M | M | | M | M | L | L |
| CO4 | S | M | L | | M | M | M | L | M | M | | M | M | M | L |
| CO5 | S | M | L | | L | M | M | L | M | M | | M | M | L | L |
| CO6 | S | S | M | L | M | S | M | L | M | M | | M | M | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass 1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO 1 | 5 | 10 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | | - | 5 | 10 | - | - | - |
| CO 2 | 5 | 10 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO 3 | - | 10 | 20 | - | - | - | 40 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO 4 | - | - | - | - | - | - | - | 5 | 10 | 15 | - | - | - | 20 | | 2 | 5 | 10 | - | - | - |
| CO 5 | - | - | - | - | - | - | - | 5 | 10 | 15 | - | - | - | 20 | | 2 | 5 | 10 | - | - | - |
| CO 6 | - | - | - | - | - | - | - | - | 10 | 10 | 20 | - | - | 30 | 30 | 2 | - | - | 15 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Blockchain Revisited:** Basics, Architecture, Distributed Consensus, Smart Contracts, Cryptographic Hash, Merkle Tree, Digital Signature - ECDSA.

**Security Challenges in Blockchain:** Common vulnerabilities and attacks, Front End Risks, Back End Risks, Hypeledger Fabric Risks.

**Smart Contract Security:** Ethereum**,** Deploying smart contracts in Solidity, Case study: The DAO Attack, The Party MultiSig Hack, and Smart Contract Security Practices.

**Advanced Cryptographic Primitives in Blockchain:** Commitment Schemes – Hash-based, Encryption-based, Discrete-log based, Accumulators – Basics, Types, Dynamic Universal Accumulator Scheme, Proof systems for Blockchain – ZKP, NIZK, ZK-SNARK.

**Privacy-Preserving Authentication Techniques:** Anonymous Credentials, Blind Signature in Blockchain, Ring signature schemes.

**Blockchain Security in Action:** Bulletproofs, Identity Mixer in Hyperledger Fabric, Monero.

## Text Books

1. Imran Bashir , ‘Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained’, Packt Publishers, 2nd Edition, 2018.

2. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, ‘Blockchain Technology: Cryptocurrency and Applications’, Oxford University Press, 2019.

## Reference Books & web resources

1. Boneh, D, Bu¨nz, B & Fisch, B, ‘Batching techniques for accumulators with applications to iops and stateless blockchains’, Annual International Cryptology Conference, Springer LNCS, vol. 11692, pp. 561-586, 2019.
2. Androulaki, E, Barger, A, Bortnikov, V, Cachin, C, Christidis, K, De Caro, A, Enyeart, D, Ferris, C, Laventman, G & Manevich, Y, ‘Hyperledger Fabric: A distributed operating system for permissioned blockchains’, Proceedings of the Thirteenth EuroSys Conference, DOI. 10.1145/3190508.3190538, Article No. 30, pp. 1-15, 2018.
3. Bünz, Benedikt, Jonathan Bootle, Dan Boneh, Andrew Poelstra, Pieter Wuille, and Greg Maxwell. "Bulletproofs: Short proofs for confidential transactions and more." In 2018 IEEE symposium on security and privacy (SP), pp. 315-334. IEEE, 2018.
4. Sun, Shi-Feng, Man Ho Au, Joseph K. Liu, and Tsz Hon Yuen. "Ringct 2.0: A compact accumulator-based (linkable ring signature) protocol for blockchain cryptocurrency monero." In Computer Security–ESORICS 2017: 22nd European Symposium on Research in Computer Security, Oslo, Norway, September 11-15, 2017, Proceedings, Part II 22, pp. 456-474. Springer International Publishing, 2017.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Blockchain Fundamentals** | |
| 1.1 | Basics, Architecture | 1 |
| 1.2 | Distributed Consensus | 1 |
| 1.3 | Smart Contracts | 1 |
| 1.4 | Cryptographic Hash, Merkle Tree | 1 |
| 1.5 | Digital Signature - ECDSA | 2 |
| **2** | **Security Challenges in Blockchain**, ,. | |
| 2.1 | Common vulnerabilities and attacks, | 1 |
| 2.2 | Front End Risks | 2 |
| 2.3 | Back End Risks | 1 |
| 2.4 | Hypeledger Fabric Risks | 2 |
| **3** | **Smart Contract Security** | |
| 3.1 | Ethereum | 1 |
| 3.2 | Deploying smart contracts in Solidity | 2 |
| 3.3 | The DAO Attack | 1 |
| 3.4 | The Party MultiSig Hack | 1 |
| 3.5 | Smart Contract Security Practices | 1 |
| **4** | **Advanced Cryptographic Primitives in Blockchain** | |
| 4.1 | Commitment Schemes | 2 |
| 4.2 | Accumulators – Basics and Types | 1 |
| 4.3 | Dynamic Universal Accumulator | 1 |
| 4.4 | Proof systems for blockchain | 2 |
| **5** | **Privacy-Preserving Authentication Techniques** | |
| 5.1 | Anonymous Credentials | 2 |
| 5.2 | Blind Signature in Blockchain | 2 |
| 5.3 | Ring signature schemes | 2 |
| **6** | **Blockchain Security in Action** | |
| 6.1 | Bulletproofs | 2 |
| 6.2 | Identity Mixer in Hyperledger Fabric | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.3 | Monero | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dharani J, Assistant Professor, CSE jdicse@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSPU0** | **TRUSTWORTHY AI** | PE | 3 | 0 | 0 | 3 |

## Preamble

This syllabus emphasizes on the basics of Trust, including Fairness. Robustness, Safety, security and Privacy in the context of Artificial Intelligence. This also covers the steps required to implement Trustworthy AI in practice.

## Prerequisite

- Artificial Intelligence

## Course Outcomes

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

| CO | Course Outcome 1 | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Develop Fairness and Robustness in AI | TPS3 | B | 75 |
| CO2 | Develop Transparent and explainable AI | TPS3 | B | 75 |
| CO3 | Build Safe and secure AI | TPS3 | B | 75 |
| CO4 | Apply the concept of privacy and  laws in AI | TPS3 | B | 75 |
| CO5 | Impart accountability and Responsibility in AI | TPS3 | B | 75 |
| CO6 | Experiment Trustworthy AI in practice | TPS4 | B | 75 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | | | L | L | L | | L | M | | L |
| CO2. | S | M | L | | L | | | L | L | L | | L | M | | L |
| CO3 | S | M | L | | L | | | L | L | L | | L | M | | L |
| C04 | S | M | L | | L | | | L | L | L | | L | M | | L |
| CO5 | S | M | L | | L | | | L | L | L | | L | M | | L |
| CO6 | S | S | M | L | L | | | L | L | L | | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 10 | | | | | | | | | | | | 20 | | | | | | | | | | | 5 | 10 | | | |
| CO2 | 10 | 10 | 20 | | | | | | | | | | | | 40 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 10 | 10 | 20 | | | | | | | | | | | | 40 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO4 | | | | | | | 10 | 10 | | | | | | | | | | | | | 20 | | | | 2 | 5 | 10 | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 40 | | | | 2 | 5 | 10 | | | |
| CO6 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | | 40 | | | 2 | 5 | | 10 | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

### Fair and Robust

Bias in AI-Selection Bias-Confirmation Bias-Explicit and Implicit Bias-Institutional Bias-Tradeoffs in Fairness- Leading Practices in Promoting Fairness-Fairness Toolkits Robust vs Brittle AI- Developing Reliable AI-The Challenge of Generalizable Deep Learning-Factors Influencing AI Reliability -Robustness and Bad Actors-Leading Practices in Building Robust and Reliable AI-Driving Toward Robust and Reliable Tools

### Transparent and Explainable

Defining the Nature of Transparency in AI-The Limits of Transparency-Weighing the Impact on the Stakeholders-Taking Steps into Transparency The Components of Understanding AI Function -The Value in Explainable AI -Driving Innovation and Application- Improving Model Performance- Encouraging Use Through Trust-Satisfying Regulatory Inquiries-Factors in Explainability- AI models for Explainabilty-Technical Approaches to Fostering Explainability-Leading Practices in Process- The Explainable Imperative-

### Secure and Safe

AI Compromise-Unsecure AI -The Consequences from Compromised AI-Leading Practices for Shoring-Up AI Security-Securing the Future with AI Understanding Safety and Harm in AI-Aligning Human Values and AI Objectives-Technical Safety Leading Practices-Seeking a Safer Future with AI

### Privacy

Consent, Control, Access, and Privacy-The Friction Between AI Power and Privacy-Beyond Anonymization or Pseudonymization-Privacy Laws and Regulations-Methods for preserving privacy-Leading Practices in Data and AI Privacy

### Accountable and Responsible

Accountability-Balancing Innovation and Accountability-Laws, Lawsuits, and Liability-Leading Practices in Accountable AI-Accounting for Trust in AI Corporate Responsibility in the AI Era-Motivating Responsible AI Use-Balancing Good, Better, and Best-Leading Practices in the Responsible Use of AI-Trust Emerging from Responsibility

### Trustworthy AI in practice

Steps – Identify the Relevant Dimensions of Trust-– Cultivating Trust Through People, Processes, and Technologies -Guidelines for Action on Trustworthy AI

## Text Book

1. Beena Ammanath “Trustworthy AI_ A Business Guide for Navigating Trust and Ethics in AI” First Edition-Wiley -2022

## Reference Books & web resources


1. Yada Pruksachatkun, Matthew Mcateer, Subho Majumdar “Practicing Trustworthy Machine Learning: Consistent, Transparent, and Fair AI Pipelines”O’REILLY -2023
2. https://www.coursera.org/learn/trustworthy-generative-a
3. https://www.coursera.org/learn/trustworthy-ai-for-healthcare-management


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Fair and Robust** | |
| 1.1 | Bias in AI-Selection Bias-Confirmation Bias-Explicit and Implicit Bias | 1 |
| 1.2 | Institutional Bias-Tradeoffs in Fairness- Leading Practices in Promoting FairnesS | 1 |
| 1.3 | Robust vs Brittle AI- Developing Reliable AI | 1 |
| 1.4 | The Challenge of Generalizable Deep Learning-Factors Influencing AI Reliability | 1 |
| 1.5 | Robustness and Bad Actors-Leading Practices in Building Robust and Reliable AI- | 1 |
| 1.6 | Driving Toward Robust and Reliable Tools | 1 |
| **2** | **Transparent and Explainable** | |
| 2.1 | Defining the Nature of Transparency in AI-The Limits of Transparency-Weighing the Impact on the Stakeholders- | 1 |
| 2.2 | Taking Steps into Transparency -The Components of Understanding AI Function | 1 |
| 2.3 | The Value in Explainable AI -Driving Innovation and Application- Improving Model Performance- Encouraging Use Through Trust- | 1 |
| 2.4 | Satisfying Regulatory Inquiries-Factors in Explainability | 1 |
| 2.5 | Technical Approaches to Fostering Explainability-Leading Practices in Process- The Explainable Imperative | 2 |
| **3** | **Secure and Safe** | |
| 3.1 | AI Compromise-Unsecure AI -The Consequences from Compromised AI | 1 |
| 3.2 | Leading Practices for Shoring-Up AI Security-Securing the Future with AI | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.3 | Understanding Safety and Harm in AI-Aligning Human Values and AI Objectives- | 1 |
| 3.4 | Technical Safety Leading Practices-Seeking a Safer Future with AI | 2 |
| **4** | **Privacy** | |
| 4.1 | Consent, Control, Access, and Privacy | 1 |
| 4.2 | The Friction Between AI Power and Privacy-Beyond Anonymization or Pseudonymization- | 2 |
| 4.3 | Privacy Laws and Regulations | 1 |
| 4.4 | Leading Practices in Data and AI Privacy | 2 |
| **5** | **Accountable and Responsible** | |
| 5.1 | Accountability-Balancing Innovation and Accountability | 1 |
| 5.2 | Laws, Lawsuits, and Liability | 1 |
| 5.3 | Leading Practices in Accountable AI-Accounting for Trust in AI | 1 |
| 5.4 | Corporate Responsibility in the AI Era | 1 |
| 5.5 | Motivating Responsible AI Use--Balancing Good, Better, and Best | 1 |
| 5.6 | Leading Practices in the Responsible Use of AI-Trust Emerging from Responsibility | 1 |
| **6** | **Trustworthy AI in practice** | |
| 6.1 | Steps – Identify the Relevant Dimensions of Trust | 2 |
| 6.2 | Cultivating Trust Through People, Processes, and Technologies - | 2 |
| 6.3 | Guidelines for Action on Trustworthy AI | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.C.Senthilkumar, Associate Professor, CSE,cskcse@tce.edu

| 22CSPV0 | AUTONOMOUS SYSTEMS | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PE | 3 | 0 | 0 | 3 |

## Preamble

This course will cover every aspect of autonomous systems, from basic ideas and workings to their wide range of uses and latest developments. Learn the concepts that underpin these robots' autonomous operation and decision-making abilities as you explore their complexities. Become an expert in the human-machine interface, control systems, and computational methods that will influence autonomous systems in the future.

## Prerequisite

- Python Programming
- Linear Algebra and Calculus
- Basic Electronics
- Artificial Intelligence

## Course Outcomes

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

| CO No. | Course Outcome | TCE Proficienc yScale | Expected Proficienc yin % | Expected Attainme nt Level % |
|---|---|---|---|---|
| CO1 | Demonstrate a deep and comprehensive understanding of autonomous systems and its applications. | TPS2 | 70 | 80 |
| CO2 | Acquire proficiency in the kinematics and dynamics of robotic systems, sensor and actuator integration, and control architectures for locomotion and manipulation | TPS3 | 70 | 75 |
| CO3 | Apply computational techniques, and demonstrating competence for implementing autonomous systems. | TPS3 | 70 | 75 |
| CO4 | Analyze historical aspects of UAVs and gain comprehensive knowledge of their components. | TPS4 | 70 | 75 |
| CO5 | Design and Analyze feedback control systems to ensure the stability and performance in autonomous systems. | TPS4 | 70 | 75 |
| CO6 | Design safe, reliable, and verifiable user interfaces for autonomous systems, with an importance of ethical practices in technology and explore advanced and emerging trends in autonomous systems. | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | | | | | | | L | L | | |
| CO2. | S | M | L | | L | | | | | L | | M | M | | M |
| CO3 | S | M | L | | L | | | | | L | | M | M | | M |
| CO4 | S | S | M | L | M | | M | M | M | | | M | M | | M |
| CO5 | S | S | M | L | | | M | M | M | L | | M | M | | M |
| CO6 | S | M | L | | M | | | M | M | L | L | M | S | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | - | 30 | - | - | - | - | 20 | | - | - | - | - | - | - | - | | - | 15 | - | - | - | - |
| CO2 | - | 10 | 25 | - | - | - | - | 40 | - | - | - | - | - | - | - | | - | 5 | 12 | - | - | - |
| CO3 | - | 10 | 25 | - | - | - | - | 40 | - | - | - | - | - | - | - | | - | 5 | 12 | - | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | 15 | - | 20 | - | - | | 40 | - | 5 | - | 12 | - | - |
| CO5 | - | - | - | - | - | - | - | - | - | 15 | - | 20 | - | - | | 40 | - | 5 | - | 12 | - | - |
| CO6 | - | - | - | - | - | - | - | - | - | 20 | 10 | - | - | - | 20 | | - | 5 | 12 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Autonomous Systems -** Definition and significance of autonomous systems - Historical context and evolution of autonomous technologies – Functional Architecture – Software and Hardware Architecture - Major Functions - Applications across Industries

**Mechanisms –** Locomotion and Manipulation - Kinematics and dynamics of robotic systems - Sensors and actuators in robotics - Robot programming languages and control architectures

**Computation for Autonomous Systems -** Vision - Feature extraction and object recognition - Localization techniques - Visual Simultaneous Localization and Mapping (SLAM) - Path planning algorithms - Collision avoidance strategies

**Unmanned Autonomous Vehicles -** Historical aspects - Electro-Optical Sensors – Radio Frequency, and Electronic Components – Electrical Sources - Navigation System
**Control Systems in Autonomous Systems -** Feedback control systems - PID controllers and their applications - State-space representation for control

**Human-Machine Interaction in Autonomous Systems -** User interfaces for autonomous systems - Ethical considerations in autonomous technology - Safe, Reliable, and Verifiable Autonomous Systems.

**Advanced/Emerging Trends in Autonomous Systems** - Swarm robotics – Nano Robots - Bio-inspired autonomous systems - Edge computing in autonomous systems

**Text Book**

1. Nikolaus Correll, Bradley Hayes, Christoffer Heckman, Alessandro Roncone, "Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms" MIT Press, 2022.
2. R.Jha "Theory, Design, and Applications of Unmanned Aerial Vehicles" CRC Press, Taylor & Francis 2017
3. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, Fifth Edition, 2010

**Reference Books & web resources**

1. Mhamed Itmi & Alain Cardon, "New Autonomous Systems", John Wiley & SonsWiley-ISTE, 2016.
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
4. De Gyurky, S.M., & Tarbell, M.A., "The Autonomous System: A FoundationalSynthesis of the Sciences of the Mind", John Wiley & Sons, 2013.
5. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-HillEducation., 2009.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Autonomous Systems** | |
| 1.1 | Definition and significance of autonomous systems | 1 |
| 1.2 | Historical context and evolution of autonomous technologies | 1 |
| 1.3 | Functional Architecture, Software and Hardware Architecture | 1 |
| 1.4 | Major Functions, Applications across industries | 1 |
| **2** | **Mechanisms** | |
| 2.1 | Locomotion and Manipulation | 2 |
| 2.2 | Kinematics and dynamics of robotic systems | 2 |
| 2.3 | Sensors and actuators in robotics | 2 |
| 2.4 | Robot programming languages and control architectures | 2 |
| **3** | **Computation for Autonomous Systems** | |

| | | |
|---|---|---|
| 3.1 | Vision - Feature extraction and object recognition | 1 |
| 3.2 | Localization techniques | 1 |
| 3.3 | Visual Simultaneous Localization and Mapping (SLAM) | 2 |
| 3.4 | Path planning algorithms, Collision avoidance strategies | 2 |
| **4** | **Unmanned Autonomous Vehicles** | |
| 4.1 | Historical aspects - Electro-Optical Sensors | 2 |
| 4.2 | Radio Frequency, and Electronic Components | 2 |
| 4.3 | Propulsion Systems, Electrical Sources | 2 |
| 4.4 | Navigation System | 1 |
| **5** | **Control Systems in Autonomous Systems** | |
| 5.1 | Feedback control systems | 1 |
| 5.2 | PID controllers and their applications | 2 |
| 5.3 | State-space representation for control | 2 |
| **6** | **Human-Machine Interaction in Autonomous Systems** | |
| 6.1 | User interfaces for autonomous systems | 1 |
| 6.2 | Ethical considerations in autonomous technology | 1 |
| 6.3 | Safe, Reliable, and Verifiable Autonomous Systems. | 1 |
| **7** | **Advanced/Emerging Trends in Autonomous Systems** | |
| 7.1 | Swarm robotics, Nano Robots | 1 |
| 7.2 | Bio-inspired autonomous systems, Edge computing in autonomous systems | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

| 22CSRA0 | DEEP LEARNING | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

This syllabus on "Deep Learning" is intended for students with a background in computer science and provides an in-depth exploration of Artificial Neural Networks, Convolutional Neural Networks (ConvNets), and Recurrent Neural Networks (RNNs). The syllabus emphasizes on the practical aspects of Deep Learning, including applications of ConvNets in image recognition, object detection, and segmentation, as well as the use of RNNs in natural language processing (NLP) tasks.

## Prerequisite

- Python Programming

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Construct training algorithms for Neural Networks using the Perceptron learning algorithm and Feed-Forward Networks | TPS 3 | B | 70 |
| CO2 | Illustrate optimization methods for Deep Learning Algorithms | TPS 3 | B | 70 |
| CO3 | Illustrate Convolutional Neural Networks algorithms and solve real-world problems | TPS 3 | B | 70 |
| CO4 | Analyse the Deep Learning algorithms to solve complex problems with an understanding of the trade-offs involved | TPS 4 | B | 70 |
| CO5 | Construct learning algorithms for Recurrent Neural Networks | TPS 3 | B | 70 |
| CO6 | Analyse the Deep Learning algorithms which are more appropriate for various types of learning tasks in domains like Vision and NLP | TPS 4 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO2 | S | M | L | | M | L | | M | L | L | | M | M | M | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO4 | S | S | M | L | M | L | | M | L | L | | M | S | M | L |
| CO5 | S | M | L | | M | L | | M | L | L | | M | M | M | L |
| CO6 | S | S | M | L | M | L | | M | L | L | | M | S | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| **CO** | **CAT 1** | | | | | | **Assignment 1** | | | **CAT 2** | | | | | | **Assignment 2** | | | **Terminal** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | - | 10 | 20 | - | - | - | - | - | 20 | - | - | - | - | - | - | - | - | - | 2 | 5 | - | - | - | - |
| **CO2** | - | 10 | 20 | - | - | - | - | - | 20 | - | - | - | - | - | - | - | - | - | 2 | 5 | 12 | - | - | - |
| **CO3** | - | 20 | 20 | - | - | - | - | - | 60 | - | - | - | - | - | - | - | - | - | 2 | 5 | 12 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | - | 10 | 20 | - | - | - | - | - | 10 | 2 | 5 | - | 12 | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | - | 10 | 20 | - | - | - | - | - | 30 | 2 | 5 | 12 | - | - | - |
| **CO6** | - | - | - | - | - | - | - | - | - | - | 20 | 20 | - | - | - | - | - | 60 | - | 5 | - | 12 | - | - |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Artificial Neural Networks:** Basic concepts of Artificial Neurons, single and multi-layer perceptron, perceptron learning algorithm, its convergence proof, different Activation Functions, softmax cross entropy loss function.

**Optimization:** Types of errors, bias-variance trade-off, overfitting-underfitting, brief review of concepts from optimization, variants of gradient descent, momentum-based methods

**ConvNets, ConvNet Architectures and Dropout/Regularization/BatchnormConvNets:** Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetics of these. ConvNet Architectures: Discussions on famous ConvNet architectures - AlexNet, GoogLeNet, ResNet, MobileNet-v2 Discussion on regularization, Dropout, Batch normalization – Introduction to GCNN (Graph Convolutional Neural Network) - Multiclass Classification Model for Computer Vision (CV)

**CNN Detection and Segmentation Applications:** Basics on detection, segmentation problem definition, challenges, Evaluation, Datasets and Localization by regression. Discussion on detection as classification, region proposals, RCNN and YOLO architectures, fully convolutional segmentations, Mask-RCNNs

**Recurrent Architectures and NLP Applications:** Discussion on Recurrent Neural Networks (RNNs) – Gated Neural Network (GRU), Long-Short Term Memory (LSTM) architectures – Auto Encoders - Generative Adversarial Network (GAN)
**Transformers:** Vision Transformers, Attention Model types, Transformer (BERT)

**CO6 will be evaluated by Mini project - Guidelines for the Mini-project:**

**Group formation**: Students are split into project groups with around 3 members in each group. A team can execute the project using DL algorithms and improve the efficiency of the algorithm by pre-processing methods using any of the DL frameworks like Keras, TensorFlow. At the end of the semester, the team members have to present their project, submit their report and share their lessons learnt/best practices with other teams.

Some of the activities may include: (but not limited to)

- ✓ Image Classification with different DL namely, Multilayer perceptron, Convolutional Neural Networks, Recurrent Neural Networks and Transformers
- ✓ Language Translation with Sequence-to-Sequence Models, Auto encoders and GPT2 model

Some of the Mini-project titles may include: (but not limited to)

- ✓ Image recognition for autonomous vehicles
- ✓ Speech recognition for virtual assistants
- ✓ Real-time emotion detection in videos for marketing analysis

**Text Books**

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep learning, In preparation for MIT Press, Available online: http://www.deeplearningbook.org, 2016

**Reference Books**

1. S. Haykin, Neural Networks and Learning Machines, Prentice Hall of India, 2010
2. Satish Kumar, Neural Networks - A Class Room Approach, Second Edition, Tata McGraw-Hill, 2013
3. B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999
4. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Artificial Neural Networks** | **(6)** |
| 1.1 | Basic concepts of Artificial Neurons | 1 |
| 1.2 | Single and multi-layer perceptron’s | 2 |
| 1.3 | Perceptron learning algorithm, its convergence proof | 1 |
| 1.4 | Activation Function - different Activation Functions | 1 |
| 1.5 | Softmax cross entropy loss function. | 1 |
| **2** | **Optimization** | **(6)** |
| 2.1 | Types of errors | 1 |
| 2.2 | Bias-variance trade-off | 1 |
| 2.3 | Overfitting–Underfitting | 1 |
| 2.4 | Brief review of concepts from optimization | 1 |
| 2.5 | Variants of gradient descent | 1 |
| 2.6 | Momentum based methods | 1 |

| | | |
|---|---|---|
| **3** | **ConvNets, ConvNet Architectures and Dropout/Regularization/Batchnorm.** | **(6)** |
| 3.1 | ConvNets: Basic concepts of Convolutional Neural Networks starting from filtering | 1 |
| 3.2 | Convolution and pooling operation and arithmetic's of these | 1 |
| 3.3 | ConvNet Architectures: Discussions on famous ConvNet architectures - AlexNet, GoogLeNet, ResNet, MobileNet-v2 | 1 |
| 3.4 | Discussion on regularization, Dropout, Batch normalization etc. | 1 |
| 3.5 | Introduction to Graph Convolutional Neural Network (GCNN) | 1 |
| 3.6 | Multiclass Classification Model for Computer Vision (CV) | 1 |
| **4** | **Applications: Detection and Segmentation** | **(6)** |
| 4.1 | Discussion on detection, Segmentation problem definition, challenges | 1 |
| 4.2 | Evaluation, Datasets and Localization by regression | 1 |
| 4.3 | Discussion on detection as classification, region proposals | 1 |
| 4.4 | RCNN and YOLO architectures | 2 |
| 4.5 | Fully convolutional segmentations, Mask-RCNNs | 1 |
| **5** | **Recurrent Architectures and NLP Applications** | **(6)** |
| 5.1 | Introduction to NLP | 1 |
| 5.2 | Discussion on Recurrent Neural Networks (RNNs) | 1 |
| 5.3 | Gated Neural Network (GRU) Architecture | 1 |
| 5.4 | Long-Short Term Memory (LSTM) architectures | 1 |
| 5.5 | Auto Encoders - Generative Adversarial Networks (GAN) | 2 |
| **6** | **Transformers** | **(6)** |
| 6.1 | Introduction to Vision Transformers | 1 |
| 6.2 | Discussion on Attention Model types | 2 |
| 6.3 | Discussion on Transformers (BERT) | 2 |
| | **Mini Project on various Deep Learning Algorithms/ Applications** | 1 |
| **Total Hours** | | **36** |

**Course Designer(s):**

1. Dr.K. Sundarakantham, Professor, CSE, kskcse@tce.edu
2. Mr. S.Santhana Hari, AP,CSE sshcse@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRB0** | **WEB 3.0 AND METAVERSE** | PEES | 3 | 0 | 0 | 3 |

## Preamble

The cutting-edge technologies that are reshaping the internet are examined in this course. The word "Metaverse" is causing a stir in the constantly changing computer industry and grabbing the interest of tech enthusiasts The purpose of this course is to familiarise students with the idea of the Metaverse and its relevance in the modern world. It will discover about the functions of blockchain technology and non-fungible tokens (NFTs) in these domains.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the fundamentals of blockchain technology and its role in Web3 | TPS3 | 70 | 80 |
| CO2 | Identify and explain the key technologies that enable the metaverse, such as virtual reality, augmented reality, blockchain, and decentralized systems. | TPS3 | 70 | 80 |
| CO3 | Explain the key components and technologies that contribute to the creation of the metaverse. | TPS3 | 70 | 80 |
| CO4 | Adapt various NFT standards and their use cases for decentralised organisations. | TPS3 | 70 | 80 |
| CO5 | Design and build decentralized applications using appropriate development frameworks. | TPS3 | 70 | 80 |
| CO6 | Analyze industry-specific applications of the metaverse like gaming, education, healthcare. | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO3 | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | M | M | L | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO6 | S | M | L | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | | | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | | 2 | 5 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 2 | - | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 2 | 5 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 2 | 5 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 10 | 20 | - | - | 30 | 30 | - | - | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

### Introduction to Web 3.0

Building a Web 3.0 Community-Web 3.0: The Road Ahead- Design elements for Web 3.0 Websites – Structure- Human Computer Interaction perspective- Key Blockchain Components: DLT and Smart Contracts -Blockchain-Based Digital Assets-Stablecoins-Valuation Metrics for Digital Assets-dApps

### Fundamentals of Metaverse

The history of the Metaverse- Evolution of metaverse-Overview to metaverse functional blocks-Cases on metaverse applications in different industries-Understanding Extended Reality-Overview to AR/VR for metaverse-Technical architecture of XR applications-Understanding VR ecosystems

### Building the metaverse technology:

Networking -Computing -Virtual World Engines - Interoperability - Hardware - Payment Rails -Artificial Intelligence, Cloud, Data Analytics-Digital Twins, Mirror World and Manufacturing-Importance of Avatars to the Metaverse and Digital Identity-Challenges and trends

**Non-Fungible Tokens (NFTs)**

Four Types of NFTs-Three Types of NFT Platforms-DAOs- Decentralised Finance (DeFi): types of market makers, designs and applications-Decentralised Autonomous Organisations (DAO): Communities, governance and use cases

**DeFi,GameFi and SocialFi:**

Introduction to DeFI, Smart contracts and how it works-DeFi Vs Traditional Finance-Five layers of DeFI-Both sides of DeFI-Use Cases of DeFI in Metaverse-More use cases of DeFI, - Metaverse and GameFI, GameFI Ecosystem in Metaverse- Changing gaming landscape GameFI and Metaverse- Metaverse and SocialFI

**Case study:** Social Media in Meta, Education in Metaverse, Gaming in Meta, Facebook's Meta

**Text Book**

1. Evan Karnoupakis ,"NFTs, the Metaverse, and Everything Web 3.0" O'Reilly Media, Inc., January 2023,
2. Matthew Ball ,The Metaverse: And How It Will Revolutionize Everything
3. Cathy Hackl, Dirk Lueth, Tommaso Di Bartolo, John Arkontaky (Editor), Yat Siu "Navigating the Metaverse: A Guide to Limitless Possibilities in a Web 3.0 World",Wiley,2022

**Reference Books & web resources**

1. Metaverse Web 3.0 and DeFi: A Fintech Masterclass | Udemy
2. Web3 and Strategy: Blockchain, Metaverse, and NFT Essentials (15.562) | MIT Orbit
3. IIT Delhi Advanced Certification in Web 3.0, Social Media, and Metaverse (timespro.com)
4. Metaverse and Web3 Online Course with Certificate | 3.0 University (3university.io)

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Web 3.0** | |
| 1.1 | Building a Web 3.0 Community-Web 3.0: The Road Ahead | 1 |
| 1.2 | Design elements for Web 3.0 Websites – Structure-Human Computer Interaction perspective | 1 |
| 1.3 | Key Blockchain Components: DLT and Smart Contracts | 1 |
| 1.4 | Blockchain-Based Digital Assets | 1 |
| 1.5 | Stablecoins-Valuation Metrics for Digital Assets- | 1 |
| 1.6 | dApps | 1 |
| **2** | **Fundamentals of Metaverse** | |
| 2.1 | The history of the Metaverse- Evolution of metaverse | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.2 | Overview to metaverse functional blocks | 1 |
| 2.3 | Cases on metaverse applications in different industries | 1 |
| 2.4 | Understanding Extended Reality-Overview to AR/VR for metaverse | 1 |
| 2.5 | Technical architecture of XR applications | 1 |
| 2.6 | Understanding VR ecosystems | 1 |
| **3** | **Building the metaverse technology** | |
| 3.1 | Networking | 1 |
| 3.2 | Computing -Virtual World Engines | 1 |
| 3.3 | Interoperability - Hardware - Payment Rails | 1 |
| 3.4 | Artificial Intelligence, Cloud, Data Analytics | 2 |
| 3.5 | Digital Twins, Mirror World and Manufacturing | 1 |
| 3.6 | Importance of Avatars to the Metaverse and Digital Identity - Challenges and trends | 2 |
| **4** | **Non-Fungible Tokens (NFTs)** | |
| 4.1 | Four Types of NFTs-Three Types of NFT Platforms | 1 |
| 4.2 | DAOs- Decentralised Finance (DeFi | 2 |
| 4.3 | Types of market makers, designs and applications | 1 |
| 4.4 | Decentralised Autonomous Organisations (DAO): Communities, governance and use cases | 2 |
| **5** | **DeFi,GameFi and SocialFi** | |
| 5.1 | Introduction to DeFI, Smart contracts and how it works | 1 |
| 5.2 | DeFi Vs Traditional Finance-Five layers of DeFI-Both sides of DeFI | 1 |
| 5.3 | Use Cases of DeFI in Metaverse | 1 |
| 5.4 | Metaverse and GameFI, GameFI Ecosystem in Metaverse | 2 |
| 5.5 | Changing gaming landscape GameFI and Metaverse | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 5.6 | Metaverse and Socialfi | 2 |
| 6 | **Case study** | |
| 6.1 | Social Media in Meta, Education in Metaverse | 1 |
| 6.2 | Gaming in Meta | 1 |
| 6.3 | Facebook's Meta | 1 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.S.Prasanna,Associate Professor,CSE sprcse@tce.edu
2. Dr.Raja Lavanya,Assistant Professor,CSE rlit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRC0** | **5G NETWORK SECURITY** | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course will introduce students to security for 5G networks. It provides an overview of the standard 5G networks, as well as emphasizes the importance of monitoring, privacy and security in the 5G architecture.

## Prerequisite

Knowledge on Computer networks, Mobile Communication and Security.

## Course Outcomes

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

| CO | Course Outcome (CO) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Determine the requirements for security in 5G (Understand) | TPS2 | 70 | 75 |
| CO2 | Interpret the recommendations and challenges for 5G security. (Apply) | TPS3 | 70 | 75 |
| CO3 | Deduce the importance of 5G Security landscape. (Apply) | TPS3 | 70 | 75 |
| CO4 | Design a step by step model for 5G device and user security. (Apply) | TPS3 | 70 | 75 |
| CO5 | Develop a mechanism to ensure privacy and security of operators and 5G positioning. (Apply) | TPS3 | 70 | 75 |
| CO6 | Design a mechanism to ensure 5G Cloud and Virtual Network Security. (Apply) | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | L | | | | | | | | | | L | | |
| CO2 | S | M | L | - | - | L | L | L | M | L | | M | M | L | L |
| CO3 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO4 | S | M | L | - | - | L | L | L | M | L | | M | M | L | L |
| CO5 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |
| CO6 | S | M | L | - | M | L | L | L | M | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 10 | 10 | | | | | | | | | | | | | | | | | | | | | | | 4 | 10 | | | | |
| CO2 | 10 | 10 | 10 | | | | | | | | | | | | 50 | | | | | | | | | | 4 | 4 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 50 | | | | | | | | | | 4 | 4 | 10 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | | | | | | | | 30 | | | | 4 | 4 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 30 | | | | 4 | 4 | 10 | | | |
| CO6 | | | | | | | 10 | 20 | 10 | | | | | | | | | | | | 40 | | | | 4 | | 10 | | | |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**5G Mobile Networks** - 5G Requirements - 5G Enabling Technologies - Drivers for 5G - New Use Cases - 5G Architecture overview - Security requirements and security services of the 5G system - Security services - Security domains - Network access security - Network domain security - User domain security - Application domain security - SBA domain security - Visibility and configurability of security

**Mobile Networks Security Landscape** - Mobile Security Lifecycle Functions - Design Principles for 5G Security - Security Recommendations and Challenges - Novel Technologies for 5G Security - Security in SDN based Mobile Networks - Cyber Security Business Models in 5G - The Business Case of Cyber Security in the Era of 5G - Business Model Options in 5G Cyber Security

**5G Network Security** - Physical Layer Security - WBPLSec Applied to 5G networks - 5G-WLAN Security - Network Architecture for WiFi-5G Networks interoperability - Security Consideration for Architectural Design of WiFi-5G Networks - Safety of 5G Network Physical Infrastructures - Customer Edge Switching - CES Security Framework - Software Defined Security Monitoring in 5G Networks - Software-Defined Monitoring Architecture

**5G Device and User Security** - IoT Security - Distributed Security Platform - Mobile Cloud Robot Security Scenarios - User Privacy, Identity and Trust in 5G - 5G Positioning - Outdoor versus Indoor Positioning Technologies - Passive versus Active Positioning - Security Threats and Privacy Issues in 5G Positioning - Physical-Layer Based Security Enhancements Mechanisms for Positioning in 5G - Cryptographic Techniques for Security and Privacy of Positioning

**5G Cloud and Virtual Network Security** - Mobile Virtual Network Operators (MVNO) Security - Cloudification of the Network Operators - TaaS Deployment Security - 5G, NFV, SDN and a Telco Cloud Security -- NFV-based Security Services - Cloud and MEC Security - Cloud Computing in 5G Networks - MEC in 5G Networks - Security Challenges in 5G Cloud and 5G MEC - Security Architectures for 5G Cloud and MEC - Security and Privacy Issues in New 5G Technologies

## Text Books

1. Pramod Nair, Securing 5G and Evolving Architectures, Addison-Wesley Professional, 2021.

2. Madhusanka Liyanage, Ijaz Ahmad, Ahmed Bux Abro, A Comprehensive Guide to 5G Security, Wiley, 2018.

**Reference Books& web resources**

1. Ahmed A. Abd El-Latif · Bassem Abd-El-Atty, Security and Privacy Preserving for IoT and 5G Networks: Techniques, Challenges, and New Directions, Springer, 2022.
2. Jyrki T. J. Penttinen, 5G Explained - Security and Deployment of Advanced Mobile Communications, Wiley, 2019.

**Course Contents and Lecture Schedule**

| Module No | Topic | No of Lectures | Course Outcome |
|---|---|---|---|
| 1 | **5G Mobile Networks** | | |
| 1.1 | 5G Requirements - 5G Enabling Technologies | 1 | CO1 |
| 1.2 | Drivers for 5G - New Use Cases | 1 | CO1 |
| 1.3 | 5G Architecture overview | 1 | CO1 |
| 1.4 | Security requirements and security services of the 5G system | 1 | CO1 |
| 1.5 | Security domains | 1 | CO1 |
| 2 | **Mobile Networks Security Landscape** | | |
| 2.1 | Mobile Security Lifecycle Functions | 1 | CO2 |
| 2.2 | Design Principles for 5G Security | 1 | CO2 |
| 2.3 | Security Recommendations and Challenges | 1 | CO2 |
| 2.4 | Novel Technologies for 5G Security | 1 | CO2 |
| 2.5 | Security in SDN based Mobile Networks | 1 | CO3 |
| 2.6 | Cyber Security Business Models in 5G | 1 | CO3 |
| 2.7 | The Business Case of Cyber Security in the Era of 5G | 1 | CO3 |
| 2.8 | Business Model Options in 5G Cyber Security | 1 | CO3 |
| 3 | **5G Network Security** | | |
| 3.1 | WBPLSec Applied to 5G networks | 1 | CO3 |
| 3.2 | 5G-WLAN Security - Network Architecture for WiFi-5G Networks interoperability | 1 | CO3 |
| 3.3 | Security Consideration for Architectural Design of WiFi-5G Networks | 1 | CO3 |
| 3.4 | Safety of 5G Network Physical Infrastructures | 1 | CO3 |
| 3.5 | Customer Edge Switching, CES Security Framework | 1 | CO4 |
| 3.6 | Software Defined Security Monitoring in 5G Networks | 1 | CO4 |
| 3.7 | Software-Defined Monitoring Architecture | 1 | CO4 |
| 4 | **5G Device and User Security** | | |
| 4.1 | IoT Security - Distributed Security Platform | 1 | CO4 |
| 4.2 | Mobile Cloud Robot Security Scenarios | 1 | CO4 |
| 4.3 | User Privacy, Identity and Trust in 5G | 1 | CO5 |
| 4.4 | 5G Positioning - Outdoor versus Indoor Positioning Technologies | 1 | CO5 |
| 4.5 | Passive versus Active Positioning - Security Threats and Privacy Issues in 5G Positioning | 1 | CO5 |

| | | | |
|---|---|---|---|
| 4.6 | Physical-Layer Based Security Enhancements Mechanisms for Positioning in 5G - Cryptographic Techniques for Security and Privacy of Positioning | 1 | CO5 |
| 5 | **5G Cloud and Virtual Network Security** | | |
| 5.1 | Mobile Virtual Network Operators (MVNO) Security | 1 | CO6 |
| 5.2 | Cloudification of the Network Operators - TaaS Deployment Security | 1 | CO6 |
| 5.3 | 5G, NFV, SDN and a Telco Cloud Security | 1 | CO6 |
| 5.4 | NFV-based Security Services | 1 | CO6 |
| 5.5 | Cloud and MEC Security | 1 | CO6 |
| 5.6 | Security Architectures for 5G Cloud and MEC | 1 | CO6 |
| 5.7 | Security and Privacy Issues in New 5G Technologies | 1 | CO6 |
| | Total | 36 | |

**Course Designer(s):**

1. Dr.G.S.R.Emil Selvan, Associate Professor, CSE emil@tce.edu

| 22CSRD0 | EDGE AI | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course on Edge AI is a first level course for aspiring engineers of Edge Computing/IoT/AI developers to acquire practice-based AI/Machine Learning skills and Edge Computing fundamentals. The course has been designed with a clear vision on future developments of Edge Computing in industrial application

## Prerequisite

- Distributed Computing
- Artificial Intelligence
- Machine Learning
- Deep Learning

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Choose relational model of edge computing along with AI, Machine Learning and IoT | TPS3 | 70 | 80 |
| CO2 | Identify architecture and communication protocols for edge application constraints | TPS3 | 70 | 80 |
| CO3 | Develop Edge AI application with its core technological components | TPS3 | 70 | 80 |
| CO4 | Practice on tools supporting for ML,DL and Edge Computing solutions | TPS3 | 70 | 80 |
| CO5 | Use model-architecture co-design where real-time, hardware, energy, and privacy constraints of edge devices play | TPS3 | 70 | 80 |
| CO6 | Analyse Technical constraints required for designing edge application with proper societal requirements | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | L | | M | M | M | L | M | M | L | M |
| CO5. | S | M | L | | L | L | | M | M | M | L | M | M | L | M |
| CO6. | S | S | M | L | S | S | M | M | M | M | M | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 20 | - | - | - | 30 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO2 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | | 1 | 4 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 1 | 4 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | | 1 | 4 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 20 | 10 | - | - | 40 | 20 | 1 | 4 | 10 | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Overview**-Edge computing; Internet-of-Things (IoT); cyber-physical systems- Tiny ML and Neural Networks-Lightweight DL models

**Architectures and Communication**: hardware and application constraints-mobile Processors-Accelerators –Networking Protocols: Wi-Fi –Bluetooth Low Energy protocol- MQTT protocol-Binary data packing and unpacking – Real-Time database

**Edge AI Development:** Embedded Systems-MicroPython firmware and environments - Energy-aware machine learning (ML); Deep learning; model compression; Knowledge distillation;

**Edge AI Applications:** Federated learning; ML security; System optimization; Model-architecture co-design; object detection; social sensing;

**Edge AI Deployment:** On Device: Peripherals: ADC, UART, SPI, I2C, PWM, Timer: Temperature Sensor, Reading and decoding GPS Signals-Servomotor-Edge Server: Video Surveillance -Cloud Based: Autonomous Agents

## Text Books

1. Perry lea, IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security, Packet Publishing, 2020, 2nd Edition
2. Fadi Al-Turjman,Edge Computing From Hype to Reality, EAI/Springer Innovations in Communication and Computing,2019
3. Pete Warden and Daniel Situnayake, TinyML , O'Reilly, 2019

## Reference Books & web resources

1. AWS IoT: Developing and Deploying an Internet of Things: https://courses.edx.org/courses/course-v1:AWS+OTP AWSD5+1T2019/course/
1. https://www.nvidia.com/en-us/on-demand/session/gtcfall21-a31535/, Edge AI and Robotics, DLI

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | Overview | |
| 1.1 | Edge computing; | 1 |
| 1.2 | Internet-of-Things (IoT); | 1 |
| 1.3 | Cyber-physical systems | 1 |
| 1.4 | Tiny ML and Neural Networks-Lightweight DL models | 3 |
| **2** | Architectures and Communication: | |
| 2.1 | Hardware and application constraints | 1 |
| 2.2 | Mobile processors-Accelerators | 1 |
| 2.3 | Networking Protocols: WiFI –Bluetooth Low Energy protocol- MQTT protocol | 2 |
| 2.4 | Binary data packing and unpacking | 1 |
| 2.5 | Real-Time database | 1 |
| **3** | Edge AI Development | |
| 3.1 | Embedded Systems | 1 |
| 3.2 | MicroPython firmware and environments | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.3 | Energy-aware machine learning (ML) | 1 |
| 3.4 | Deep learning; model compression | 2 |
| 3.5 | Knowledge distillation | 2 |
| **4** | Edge AI Applications | |
| 4.1 | Federated learning | 1 |
| 4.2 | ML security | 1 |
| 4.3 | System optimization | 1 |
| 4.4 | Model-architecture co-design | 2 |
| 4.5 | object detection | 1 |
| 4.6 | social sensing | 1 |
| **5** | Edge AI Deployment | |
| 5.1 | On Device: Peripherals: ADC, UART, SPI, I2C, PWM, Timer: Temperature Sensor, Reading and decoding GPS Signals-Servomotor | 3 |
| 5.2 | Edge Server: Video Surveillance | 3 |
| 5.3 | Cloud Based: Autonomous Agents | 3 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.R.Leena Sri, Associate Professor, rlsit@tce.edu
   Computer Science and Engineering,

| 22CSRE0 | DECENTRALIZED APPLICATIONS DEVELOPMENT | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course explores the fundamentals and practical aspects of decentralized applications (DApps) development, covering blockchain networks, smart contracts, and the tools and techniques necessary for building secure and efficient DApps. Students will gain hands-on experience in designing DApp interfaces, managing decentralized storage, and implementing business logic within decentralized frameworks. Students will develop a comprehensive understanding of DApp ecosystems through case studies and projects.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the key concepts of blockchain, decentralized networks, and different consensus methods that power decentralized applications. | TPS3 | 70 | 80 |
| CO2 | Demonstrate proficiency in writing and deploying smart contracts using Solidity, enabling secure, automated transactions and interactions on the blockchain. | TPS3 | 70 | 80 |
| CO3 | Apply skills in front-end and back-end development, including the use of Web3.js and Ether.js libraries, to create functional and user-friendly decentralized applications. | TPS3 | 70 | 80 |
| CO4 | Identify various types of DApps, such as those for finance, identity, and marketplaces, and understand their real-world applications. | TPS3 | 70 | 80 |
| CO5 | Implement decentralized storage and databases, like IPFS and OrbitDB, to efficiently manage data in DApps. | TPS3 | 70 | 80 |
| CO6 | Develop end-to-end DApps that handle data, manage user interactions, and process transactions securely on a decentralized network. | TPS4 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | M | M | L | M | M | M | | M | M | L | M |
| CO6. | S | M | L | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 5 | - | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 5 | 15 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | - | 15 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 5 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 5 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 10 | 20 | - | - | 60 | - | - | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction :** Introduction to Blockchain and Decentralized Network - Types of Blockchain- Consensus mechanisms- Blockchain and Decentralization - The History of Decentralized Applications-Working of Decentralized Apps -DApps Protocols

**Smart contracts and Solidity Language :** Solidity Data Types- Contract Structure -State Variables Functions- Decentralized Apps Using Ethereum DApps - Ether.js library -Front-end- User Interface (UI) design and development for Decentralized Applications -Web3.js- Smart Contracts (Backend of the App) –Storage-IPFS

**Flourishing Dapp Ecosystem** : Decentralized Wealth-Decentralized Identity-Decentralized Computing-Decentralized Bandwidth-Decentralized Markets for Decentralized Assets-Practical Decentralization

**Decentralized Databases:** OrbitDB - Peer to Peer Distributed Database- BigchainD**B-** Ties DB- Bluzelle- Amazon QLDB

**Decentralized Apps and Frameworks**: OpenBazaar- DTube- Ocean Protocol

**Implementing Business Logic in DApps** : Managing user data and state in DApps, Handling transactions and payments-Smart contract development techniques- End-to-end development of a DApp-Case study

## Text Books

1. Shahid Shaikh ,"Building Decentralized Blockchain Applications: Learn How to Use Blockchain as the Foundation for Next-Gen Apps", BPB Publications,2021
2. Siraj Raval,"Decentralized Applications", O'Reilly Media,2016

## Reference Books & web resources


1. Andreas M. Antonopoulos and Dr. GavinWood," Mastering Ethereum Building Smart Contracts and DApps ",O'Reilly ,2019
2. https://www.udemy.com/course/decentralized-app-development-with-blockchain-novice-to-pro
3. Decentralized Application (DApp) Development from coursera
4. https://Solidity by Example.org


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Introduction to Blockchain and Decentralized Network | 1 |
| 1.2 | Types of Blockchain | 1 |
| 1.3 | Consensus mechanisms | 1 |
| 1.4 | Blockchain and Decentralization | 1 |
| 1.5 | The History of Decentralized Applications | |
| 1.6 | Working of Decentralized Apps | 1 |
| 1.7 | DApps Protocols | 1 |
| **2** | **Smart contracts and Solidity Language** | |
| 2.1 | Solidity Data Types | 1 |
| 2.2 | Contract Structure- State Variables | 1 |
| 2.3 | Functions | 1 |
| 2.4 | Decentralized Apps Using Ethereum DApps | 1 |
| 2.5 | Ether.js library | 1 |
| 2.6 | Front-end- User Interface (UI) design and development for Decentralized Applications | 1 |
| 2.7 | Web3.js | 1 |
| 2.8 | Smart Contracts (Backend of the App) | 1 |
| 2.9 | Storage | 1 |
| 2.10 | IPFS | 1 |
| **3** | **Flourishing Dapp Ecosystem** | |
| 3.1 | Decentralized Wealth | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.2 | Decentralized Identity | 1 |
| 3.3 | Decentralized Computing | 1 |
| 3.4 | Decentralized Bandwidth | 1 |
| 3.5 | Decentralized Markets for Decentralized Assets | 1 |
| 3.6 | Practical Decentralization | 1 |
| **4** | **Decentralized Databases** | |
| 4.1 | OrbitDB - Peer to Peer Distributed Database- | 1 |
| 4.2 | BigchainDB | 2 |
| 4.3 | Ties DB | 2 |
| 4.4 | Bluzelle | 1 |
| 4.5 | Amazon QLDB | 1 |
| **5** | **Decentralized Apps and Frameworks** | |
| 5.1 | OpenBazaar | 1 |
| 5.2 | DTube | 1 |
| 5.3 | Ocean Protocol | 1 |
| **6.** | **Implementing Business Logic in DApps** | |
| 6.1 | Managing user data and state in DApps | 1 |
| 6.2 | Handling transactions and payments | 1 |
| 6.3 | Smart contract development techniques- End-to-end development of a DApp | 1 |
| 6.4 | Case study | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr.N.Shivakumar, Assistant Professor shiva@tce.edu
2. Dr.Raja Lavanya, Assistant Professor rlit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRF0** | **SCALABLE MICROSERVICES** | PEES | 3 | 0 | 0 | 3 |

## Preamble

The objective of this course is to enhance students with principles of scalable microservice design using the event driven architecture. The students also gain knowledge about the practical implementation details of the design principles using the Spring Boot framework.

## Prerequisite

Basic Knowledge of Cloud Computing and Software Engineering

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Illustrate the strategies and best practices of designing scalable microservices | TPS3 | 70 | 80 |
| CO2 | Apply the event driven messaging patterns and protocols for efficient exchange of service messages across microservices. | TPS3 | 70 | 80 |
| CO3 | Develop microservice applications using the event driven and domain driven bounded context principles. | TPS3 | 70 | 80 |
| CO4 | Apply the event driven microservice data patterns and distributed database concepts to represent the data of the given application. | TPS3 | 70 | 80 |
| CO5 | Illustrate the microservice design framework for the given scenario using Spring Boot. | TPS3 | 70 | 80 |
| CO6 | Design and Deploy the given application as a microservice with the illustration of the multi-tier architecture. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | L | M | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | L | M | L | | M | M | M | | M | M | L | M |
| CO5. | S | M | L | L | M | L | | M | M | M | | M | M | L | M |
| CO6. | S | M | L | L | M | M | L | M | M | M | | M | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** | | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 3 | 5 | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 15 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 30 | - | - | - | 60 | 2 | 3 | 10 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Scalable Microservices:** Microservice, Event Driven Microservice: Architecture, Deployment, Technology, Autonomy, Resilience, Availability and Scalability. Basics of Containerization and Clustering.

**Event-Driven Microservices:** The Message Broker, Events and Messages, Asynchronous Messaging, Reactive Systems, Messaging Patterns-Publish-Subscribe, Work Queues, Filtering and Data Durability, Message Broker Protocols, Standards, and Tools, AMQP and RabbitMQ.

**Building Event-Driven Microservices:** N-Tier Architectures, Durable vs. Ephemeral Message Brokers and GDPR, Event-Driven Message Types, Common Event-Driven Messaging Patterns, Event-Driven Service Topologies, Organizing Event-Driven Microservice Boundaries: Organizational Composition, Domain-Driven Design and Bounded Contexts, Request-Driven vs. Event-Driven Services

**Structural Patterns and Chaining process:** Transactional consistency in Distributed Systems, Event-driven Orchestration Pattern, Event-driven Choreography pattern, Data Retrieval in Event-driven Architectures and Associated Patterns – Event Sourcing, Command sourcing, CQS and CQRS.

**Microservice design using Spring Boot Framework:** Setting Up the Development Environment with the Spring Boot Skeleton Web App, Three-Tier, Three-Layer Architecture, Modeling Domain-Driven Design, Business Logic, Presentation Layer, REST APIs with Spring Boot, Automatic Serialization and Testing.

**Development and Deployment of Applications:** Setting Up the Development Environment with the React Skeleton, A JavaScript Client, Rendering, Integration with the App, Adding Configuration to the Spring Boot App and Deploying the React, The Data Model - Choosing a Database, Spring Boot Data JPA, Entities and Repositories design, Service Layer, Controller Layer and User Interface deployment.

## Learning Resources

1. Hugo Filipe Oliveira Rocha, “Practical Event-Driven Microservices Architecture Building Sustainable and Highly Scalable Event-Driven Microservices,”, Apress,2022, ISBN-13 (pbk): 978-1-4842-7467-5, ISBN-13 (electronic): 978-1-4842-7468-2, https://doi.org/10.1007/978-1-4842-7468-2.
2. Sandeep Jagtap “Domain-Driven Design and Microservices Explained with Examples”, Leanpub,2023.

3. Rajiv Srivastava, "Cloud Native Microservices with Spring and Kubernetes: Design and Build Modern Cloud Native Applications using Spring and Kubernetes" , BPB Publications, 2021, ISBN: 9390684315,9789390684311.
4. Moises Macero Garcia, "Learn Microservices with Spring Boot a Practical Approach to RESTful Services Using an Event-Driven Architecture, Cloud-Native Patterns, and Containerization", Apress, Second Edition, 2020, ISBN-13 (pbk): 978-1-4842-6130-9, ISBN-13 (electronic): 978-1-4842-6131-6, https://doi.org/10.1007/978-1-4842-6131-6.
5. Harry Percival and Bob Gregory, "Architecture Patterns with Python Enabling Test-Driven Development, Domain-Driven Design, and Event-Driven Microservices" O'Reilly Media, First Edition, 2020, ISBN:978-1-492-05220-3.
6. Thomas A. Limoncelli, Strata R. Chalup and Christina J. Hogan, "The Practice of Cloud System Administration DevOps and SRE Practices for Web Services", Volume 2, , Addison Wesley, Second Edition, 2015, ISBN-13: 978-0-321-94318-7, ISBN-10: 0-321-94318-X.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Scalable Microservices** | |
| 1.1 | Microservice, Event Driven Microservice: Architecture, Deployment, Technology | 1 |
| 1.2 | Autonomy, Resilience, Availability and Scalability | 1 |
| 1.3 | Basics of Containerization | 1 |
| 1.4 | Basics of Clustering | 1 |
| 2 | **Event-Driven Microservices** | |
| 2.1 | The Message Broker, Events and Messages, Asynchronous Messaging, Reactive Systems. | 2 |
| 2.2 | Messaging Patterns-Publish-Subscribe, Work Queues, Filtering and Data Durability, Message Broker Protocols, Standards, and Tools. | 2 |
| 2.3 | AMQP and RabbitMQ. | 2 |
| **3** | **Building Event-Driven Microservices** | |
| 3.1 | N-Tier Architectures, Durable vs. Ephemeral Message Brokers and GDPR, Event-Driven Message Types, Common Event-Driven Messaging Patterns. | 2 |
| 3.2 | Event-Driven Service Topologies, Organizing Event-Driven Microservice Boundaries: Organizational Composition. | 1 |
| 3.3 | Domain-Driven Design and Bounded Contexts | 2 |
| 3.4 | Request-Driven vs. Event-Driven Services | 1 |
| **4** | **Structural Patterns and Chaining process** | |
| 4.1 | Transactional consistency in Distributed Systems | 2 |
| 4.2 | Event-driven Orchestration Pattern, Event-driven Choreography pattern. | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.3 | Data Retrieval in Event-driven Architectures and Associated Patterns – Event Sourcing, Command sourcing | 2 |
| 4.4 | CQS and CQRS | 2 |
| **5** | **Microservice design using Spring Boot Framework** | |
| 5.1 | Setting Up the Development Environment with the Spring Boot Skeleton Web App. | 1 |
| 5.2 | Three-Tier and Three-Layer Architecture, Modeling Domain-Driven Design | 2 |
| 5.3 | Business Logic, Presentation Layer | 1 |
| 5.4 | REST APIs with Spring Boot, Automatic Serialization and Testing | 2 |
| **6** | **Development and Deployment of Applications** | |
| 6.1 | Setting Up the Development Environment with the React Skeleton, A JavaScript Client, Rendering, Integration with the App. | 2 |
| 6.2 | Adding Configuration to the Spring Boot App and Deploying the React. | 1 |
| 6.3 | The Data Model - Choosing a Database, Spring Boot Data JPA, Entities and Repositories design | 2 |
| 6.4 | Service Layer, Controller Layer and User Interface deployment | 1 |
| | **Total** | **36** |

**Course Designer(s):**


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   Associate Professor
2. Dr.K.Indira kiit@tce.edu
   Assistant Professor

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRG0** | **DEVOPS FOR CLOUD** | PEES | 3 | 0 | 0 | 3 |

## Preamble

The objective of this course is to enhance students with a deep understanding of efficient service delivery practices during the build and deployment phases of Cloud services. Students will be able to design and deploy highly automated, reliable, and scalable service delivery pipelines that align with modern DevOps and SRE principles. It also covers the principles of DevOps culture and bridge the gap between development and operations for faster, more reliable software releases incorporated with CI/CD pipelines.

## Prerequisite

Basic Knowledge of Cloud Computing

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the different service models in cloud computing, the types of machines used in cloud environments and the level of resource sharing in the cloud. | TPS3 | 70 | 80 |
| CO2 | Adapt the strategic shift from traditional software development approaches into key DevOps methodologies, values, and principles by exploring the practices of agile and Continuous Delivery. | TPS3 | 70 | 80 |
| CO3 | Illustrate the core values and principles of DevOps focusing on how they foster collaboration, integration, automation, and continuous improvement in software delivery. | TPS3 | 70 | 80 |
| CO4 | Experiment the modern DevOps practices in the build phase of service delivery and ensure fast and reliable deployment. | TPS3 | 70 | 80 |
| CO5 | Illustrate the deployment phase of service delivery in DevOps, focusing on efficient and automated strategies for promoting, installing, testing, and managing applications in production. | TPS3 | 70 | 80 |
| CO6 | Compute the Site Reliability Engineering (SRE) principles in a DevOps framework, using Google Cloud Platform (GCP) for cloud-native development | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO2. | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO3. | S | M | L | | L | | | M | M | M | | M | M | | M |
| CO4. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO5. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |
| CO6. | S | M | L | L | M | L | L | M | M | M | L | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 5 | 15 | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 3 | 5 | - | - | - |
| CO2 | 5 | 5 | 30 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 10 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 3 | 15 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | 20 | 2 | 3 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 30 | - | - | - | 60 | 2 | 3 | 10 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Cloud Service Platform** - Level of Service Abstraction: Infrastructure as a Service, Platform as a Service, Software as a Service; Type of Machine: Physical Machines, Virtual Machines, Containers; Level of Resource Sharing: Compliance, Privacy, Cost and Control.

**DevOps Strategy** - The Traditional Approach vs The DevOps Approach, The Three Ways of DevOps: Workflow, Improve Feedback and Continual Experimentation and Learning; DevOps Evolution and Site Reliability Engineering.

**DevOps Values and Principles:** Relationships, Integration, Automation, Continuous Improvement, Common Nontechnical DevOps Practices, Common Technical DevOps Practices and Release Engineering DevOps Practices; Agile and Continuous Delivery.

**Service Delivery: The Build Phase** - Service Delivery Strategies: Pattern: Modern DevOps Methodology and Anti-pattern: Waterfall Methodology, Build-Phase Steps: Develop, Commit, Build, Package and Register, Build Console and Continuous Integration.

**Service Delivery: The Deployment Phase** - Deployment-Phase Steps: Promotion, Installation and Configuration; Testing and Approval; Operations Console; Infrastructure Automation Strategies: Preparing Physical Machines, Preparing Virtual Machines and Installing OS and Services; Continuous Delivery and Infrastructure as Code.

**Site Reliability Engineering (SRE) Practices DevOps using Google Cloud**: Basics of SRE, SRE's approach toward DevOps, SRE's: Technical and Cultural practices, Implementing DevOps using Google Cloud: Cloud native development, CI in GCP, CD in GCP, Continuous monitoring on GCP, CI/CD pipeline in GCP.

## Text Book


1. Thomas A. Limoncelli, Strata R. Chalup and Christina J. Hogan,"The Practice of Cloud System Administration DevOps and SRE Practices for WebServices", Volume 2, Addison Wesley, 2015.
2. Mohammed Ilyas Ahmed, "Cloud-Native DevOps: Building Scalable and Reliable Applications", Apress, 2024. ISBN: 9798868804069.
3. Justin Domingus, John Arundel, "Cloud Native DevOps with Kubernetes" O'Reilly Media, Second Edition,2022, ISBN-13 : 978-1098116828
4. Craig Walls, "Spring Boot in Action", Manning Publications, 2016, ISBN: 1617292540,9781617292545.


## Reference Books & web resources


1. Pro PowerShell for Amazon Web Services: DevOps for the AWS Cloud, Brian Beach, Apress.
2. Hands-On Guide to AgileOps A Guide to Implementing Agile, DevOps, and SRE for Cloud Operations, Navin Sabharwal, Raminder Rathore, Udita Agrawal, Apress, 2022.
3. Google Cloud for DevOps Engineers: A practical guide to SRE and achieving Google's Professional Cloud DevOps Engineer certification, Sandeep Madamanchi, Packt Publishing, 2021.


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Cloud Service Platform** | |
| 1.1 | Level of Service Abstraction:<br>Infrastructure as a Service, Platform as a Service, Software as a Service | 2 |
| 1.2 | Type of Machine: Physical Machines, Virtual Machines | |
| 1.3 | Containers-Level of Resource Sharing | 2 |
| 1.4 | Compliance-Privacy, Cost and Control. | 1 |
| 2 | **DevOps Strategy** | |
| 2.1 | The Traditional Approach vs The DevOps Approach | 2 |
| 2.2 | The Three Ways of DevOps | 1 |
| 2.3 | Workflow, Improve Feedback and Continual Experimentation and Learning | 1 |
| 2.4 | DevOps Evolution and Site Reliability Engineering. | 1 |
| **3** | **DevOps Values and Principles** | |
| 3.1 | Relationships, Integration, Automation, Continuous Improvement | 1 |
| 3.2 | Common Nontechnical DevOps Practices, Common Technical DevOps Practices | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.3 | Release Engineering DevOps Practices | 1 |
| 3.4 | Continuous Delivery. | 1 |
| **4** | **Service Delivery: The Build Phase** | |
| 4.1 | Service Delivery Strategies: Pattern: Modern DevOps Methodology and Anti-pattern | 2 |
| 4.2 | Waterfall Methodology, | 1 |
| 4.3 | Build-Phase Steps: Develop, Commit, Build, Package | 1 |
| 4.4 | Register, Build Console and Continuous Integration. | 1 |
| **5** | **Service Delivery: The Deployment Phase** | |
| 5.1 | The Deployment Phase - Deployment-Phase Steps: Promotion, Installation and Configuration; | 2 |
| 5.2 | Testing and Approval; Operations Console | 2 |
| 5.3 | Infrastructure Automation Strategies: Preparing Physical Machines | 2 |
| 5.4 | Preparing Virtual Machines and Installing OS and Services | 1 |
| 5.5 | Continuous Delivery and Infrastructure as Code. | 1 |
| **6** | **Site Reliability Engineering (SRE) Practices for DevOps using Google Cloud** | |
| 6.1 | Basics of SRE, SRE's approach toward DevOps | 2 |
| 6.2 | SRE's : Technical and Cultural practices | 1 |
| 6.3 | Implementing DevOps using Google Cloud: | 1 |
| 6.4 | Cloud native development, CI in GCP, CD in GCP, | 2 |
| 6.5 | Continuous monitoring on GCP, | |
| 6.6 | CI/CD pipeline in GCP. | 2 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr.G.Madhupriya, Associate Professor — gmadhupriya@tce.edu
2. Dr.K.Indira Assistant Professor — kiit@tce.edu

| **22CSRH0** | **BIG DATA ENGINEERING** | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

The course aims at facilitating the students to understand the concepts of big data and the need for big data analytics. It focuses on different technologies that are used to store, process and analyse large volume of data. Students will also learn about various analytical methods that can be applied on different types of data to produce meaningful conclusions. The course also introduces the concepts of streaming for building real time data analysis applications.

## Prerequisite

Basics of Database Management Systems

## Course Outcomes

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

| CO# | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Recognize the need of a framework to process big data and identify the suitable analytical methods to analyse big data | TPS2 | B | 75 |
| CO2 | Use the Hadoop technologies for storing, processing and analysing huge amount of data. | TPS3 | B | 70 |
| CO3 | Exhibit the use of NoSQL databases for organizing and handling large scale data. | TPS3 | B | 70 |
| CO4 | Perform exploratory data analysis and evaluate Machine Learning models for big data | TPS3 | B | 70 |
| CO5 | Demonstrate the data analysis using spark and develop spark applications. | TPS3 | B | 70 |
| CO6 | Practice appropriate methods and techniques for mining data streams. | TPS3 | B | 70 |
| CO7 | Develop a complete data analytics solution for the given problem scenario. | TPS4 | B | 70 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | M | L | | | | | | | | L | | L | L | | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO3 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO4 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO5 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO6 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO7 | S | S | M | L | M | M | L | L | M | M | L | M | S | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 15 | - | | | | | | | | | | | | | | | | | | | | | | - | 5 | - | | | |
| CO2 | 5 | 20 | 20 | | | | | | | | | | | | 20 | | | | | | | | | | 2 | 5 | 12 | | | |
| CO3 | 5 | 15 | 15 | | | | | | | | | | | | 20 | | | | | | | | | | 2 | 5 | 12 | | | |
| CO4 | | | | | | | 5 | 10 | 15 | | | | | | | | | | | | 20 | | | | 2 | 5 | 12 | | | |
| CO5 | | | | | | | 5 | 10 | 15 | | | | | | | | | | | | 20 | | | | 2 | 5 | 12 | | | |
| CO6 | | | | | | | 5 | 20 | 15 | | | | | | | | | | | | 20 | | | | 2 | 5 | 12 | | | |
| CO7 | | | | | | | | | | | | | | | 30 | 30 | | | | | 20 | 20 | | | | | | | | |
| Total | **15** | **50** | **35** | | | | **15** | **40** | **45** | | | | | | **70** | **30** | | | | | **80** | **20** | | | **10** | **30** | **60** | | | |

## Syllabus

**Understanding Big Data:** Evolution and Definition, Big Data Characteristics, Different types of Data, Challenges with Big Data - Big Data Architecture - big data applications, Traditional Business Intelligence versus Big Data – Data Lake, Architecture, Data lake vs Data Warehouse. **Analytics on Big Data:** Defining big data analytics, Classification of Analytics – Challenges in Big data analytics.

**Hadoop & Hadoop EcoSystem:** Hadoop Architecture, HDFS - NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers, Algorithms Using MapReduce: Matrix-vector multiplication, Matrix multiplication, Relational Algebra operations - Join operations: optimization for join operations, theta join, skew aware join, YARN & Zookeeper, Hadoop Cluster Setup & Hadoop Configuration.

**Hadoop Technologies:** Pig – Introduction, Parallel processing using Pig, Pig Architecture, Pig data model, Pig Latin- Input and output, Relational operators, User defined functions Hive –

Introduction, Hive Architecture, Hive QL-Data Definition and Data Manipulation, Hive QL queries-Map Reduce Scripts

**NoSQL Data Management** - Introduction to NoSQL – Sharding and Replication, ACID and BASE Properties, CAP Theorem, Data models – Column Family, Key-Value and Document data models, graph databases, Case studies: HBase – data model and implementations, Redis – Environment and Configuration, Commands, Neo4j – data model, Cassendra - Features, CQL, Key spaces.

**Exploratory Data Analysis:** Visualizations - Visual data analysis techniques- interaction techniques. **Machine Learning for Big Data:** Feature Engineering, Supervised and Unsupervised model selection and tuning

**In memory Processing:** Overview of Spark, Hadoop vs. Spark, Resilient Distributed Datasets(RDDs) in Spark, Creating RDD, RDD Operations, and Saving RDD, Data Frames & Spark SQL, Spark Streaming, Spark ML, Writing Spark Application - Spark Programming in Python, Application Execution.

**Mining Data Streams:** Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions

**Text Book**

1. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge Universities Press, 3rd edition, 2020.
2. David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph”, Elsevier, August 23, 2013.

**Reference Books**

1. Tom White, “Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale”, Orielly, 4th Edition, 2015.
2. Jeffrey Aven, “Data Analytics with Spark Using Python”, Addison-Wesley; 1st edition, 2018.
3. Brij B Gupta, Mamta, “Big Data Management and Analytics”, World Scientific Publishing Company, 2023.
4. Dan Sullivan, “NoSQL for Mere Mortals”, Addison-Wesley, 2015
5. https://spark.apache.org/docs/latest/api/python/pyspark.html
6. https://github.com/adamjshook/mapreducepatterns
7. https://spark.apache.org/mllib/

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Understanding Big Data (4)** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 1.1 | Evolution and Definition, Big Data Characteristics, Different types of Data | 1 |
| 1.2 | Challenges with Big Data, Big Data Architecture - Big Data applications | 1 |
| 1.3 | Traditional Business Intelligence versus Big Data, Data Lake, Architecture, Data lake vs Data Warehouse | 1 |
| 1.4 | **Analytics on Big Data:** Defining big data analytics, Classification of Analytics – Challenges in Big data analytics. | 1 |
| **2** | **Hadoop & Hadoop Ecosystem (5)** | |
| 2.1 | Hadoop Architecture, HDFS – NameNode, Secondary NameNode, and DataNode | 1 |
| 2.2 | Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers, Algorithms Using MapReduce: Matrix-vector multiplication, Matrix multiplication | 2 |
| 2.3 | Relational Algebra operations - Join operations: optimization for join operations, theta join, skew aware join | 1 |
| 2.4 | YARN & Zookeeper, Hadoop Cluster Setup & Hadoop Configuration | 1 |
| **3** | **Hadoop Technologies(5)** | |
| 3.1 | Pig – Introduction, Parallel processing using Pig, Pig Architecture, Pig data model | 1 |
| 3.2 | Pig Latin- Input and output, Relational operators, User defined function | 2 |
| 3.3 | Hive – Introduction, Hive Architecture, Hive QL-Data Definition and Data Manipulation, Hive QL queries - Map Reduce Scripts | 2 |
| **4** | **NoSQL Data Management (6)** | |
| 4.1 | Introduction to NoSQL – Sharding and Replication, ACID and BASE Properties, CAP Theorem | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.2 | Data models – Column Family, Key-Value and Document data models, graph databases | 1 |
| 4.3 | Case Studies: HBase – data model and implementations | 1 |
| 4.4 | Redis – Environment and Configuration, Commands | 1 |
| 4.5 | Neo4j – data model, Cassendra - Features, CQL, Key spaces | 2 |
| **5** | **Exploratory Data Analysis(4)** | |
| 5.1 | Visualizations - Visual data analysis techniques-interaction techniques | 2 |
| 5.2 | **Machine Learning for Big Data:** Feature Engineering, Supervised and Unsupervised model selection and tuning | 2 |
| **6** | **In memory Processing (6)** | |
| 6.1 | Overview of Spark, Hadoop vs. Spark | 1 |
| 6.2 | Resilient Distributed Datasets(RDDs) in Spark | 1 |
| 6.3 | Creating RDD, RDD Operations, and Saving RDD | 1 |
| 6.4 | Data Frames & Spark SQL, Spark Streaming, Spark ML | 2 |
| 6.5 | Writing Spark Application - Spark Programming in Python, Application Execution. | 1 |
| **7** | **Mining Data Streams (6)** | |
| 7.1 | Introduction to Streams Concepts – Stream Data Model and Architecture | 1 |
| 7.2 | Stream Computing - Sampling Data in a Stream | 1 |
| 7.3 | Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments | 2 |
| 7.4 | Counting Oneness in a Window, Decaying Window | 1 |
| 7.5 | Real time Analytics Platform(RTAP) Applications - Case Studies - Sentiment Analysis, Stock Market Predictions | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | **Total** | **36** |

**Course Designer(s):**

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| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRJ0** | **FEDERATED LEARNING** | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course provides the basic technologies and needs for Federated Learning (FL). The learners will understand different architectures and algorithms in FL and explore privacy preserving techniques in collaborative learning. At the end of the course the learners will be provided practical exposure to real-world federated learning applications.

## Prerequisite

A basic knowledge is required in the following areas;

- Distributed Systems
- Deep Learning
- Python Programming

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Infer the fundamental concepts and types of federated learning | TPS2 | 70 | 80 |
| CO2 | Implement federated learning models using open source tools | TPS3 | 70 | 75 |
| CO3 | Identify the impact of data heterogeneity on model convergence and accuracy | TPS3 | 70 | 75 |
| CO4 | Determine security and privacy challenges in FL and its mitigation methods | TPS3 | 70 | 75 |
| CO5 | Illustrate scalability and resource management challenges of deploying FL on distributed machine learning | TPS3 | 70 | 75 |
| CO6 | Appraise FL to real-world case studies like personalized FL, cross silo vs. cross device FL | TPS4 | 70 | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | L | L | | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO5. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO6. | S | S | M | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 15 | 15 | | - | - | - | | - | - | - | - | - | - | - | | | 8 | | - | - | - |
| CO2 | 5 | 10 | 20 | - | - | - | 50 | - | - | - | - | - | - | - | | | 4 | 15 | - | - | - |
| CO3 | 5 | 10 | 20 | | - | - | 50 | - | - | - | - | - | - | - | | | 4 | 15 | | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | | - | - | 30 | | | 4 | 15 | | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | | - | - | 30 | | | 4 | 15 | | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 10 | 20 | - | - | | 4 0- | | 4 | - | 12 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Federated Learning:** Motivation and Need-Centralized vs. Decentralized Learning Paradigm-Taxonomy of FL: Horizontal, Vertical, and Transfer FL-Federated Learning workflow and Terminology-Cases Study: Google Gboard

**Federated Learning Architectures and Algorithms:** Client-Server Orchestration Model-Aggregation Techniques.-Knowledge Distillation-Handling Non-IID / skewed Data- Case Study: Credit Scoring

**Security and Privacy in FL:** Threat Models-Differential Privacy-Secure- CCPI, Multi-Party Computation-Homomorphic Encryption-Attack Vectors: Data Poisoning, Model Inversion, -Secure aggregation & federated analytics

**System Design and Implementation—**Platforms and Frameworks: TensorFlow Federated, PySyft, Flower-Federated Optimization Techniques--Case Study: Apple Siri, Google Gboard6

**Regulatory & Ethical Dimension-**GDPR, HIPAA, RBI guidelines (India) relevance to FL-Fairness and bias in distributed data-Responsible AI frameworks

**Applications and Case Studies:** Cross silo-Federated Learning in Healthcare, Smart Devices, Finance, IoT-Personalized FL-FL in Edge and Mobile Devices-Open Research Problems

**Reference Books & web resources**

1. Jeyakrusna Sahoo, Mariya Ouaissa, Akarsh K. Nair “Federated Learning- Principles, Paradigms, and Applications”,Taylor & Francis, 2024
2. Kairouz, P., McMahan, H. B., et al. "Advances and Open Problems in Federated Learning", *Foundations and Trends in Machine Learning*, 2021.
3. Li, T., Sahu, A. K., et al. "Federated Learning: Challenges, Methods, and Future Directions", *IEEE Signal Processing Magazine*, 2020.
4. Bonawitz, K. et al. "Towards Federated Learning at Scale: System Design", *SysML 2019*.
5. TensorFlow Federated Documentation – https://www.tensorflow.org/federated
6. PySyft and Flower Documentation (OpenMined.org)

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Federated Learning** | |
| 1.1 | Motivation and Need | 1 |
| 1.2 | Centralized vs. Decentralized Learning paradigm | 1 |
| 1.3 | Taxonomy of FL: Horizontal, Vertical, and Transfer FL | 1 |
| 1.4 | Federated Learning workflow and terminology | 1 |
| 1.5 | Cases Study: Google Gboard | 2 |
| **2** | **Federated Learning Architectures and Algorithms** | |
| 2.1 | .Client Server Orchestration | 1 |
| 2.2 | Aggregation Techniques | 1 |
| 2.3 | Knowledge Distillation | 2 |
| 2.4 | Handling Non-IID / skewed Data | 2 |
| 2.5 | Case Study: Credit Scoring | 1 |
| **3** | **Security and Privacy in FL** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.1 | Threat Models | 1 |
| 3.2 | Differential Privacy-Secure – CCPI, Multi-party Computation-Homomorphic Encryption | 3 |
| 3.3 | Attack Vectors: Data Poisoning, Model Inversion | 3 |
| 3.4 | Secure aggregation & federated analytics | 2 |
| **4** | **System Design and Implementation** | |
| 4.2 | Platforms and Frameworks: TensorFlow Federated, PySyft, Flower | 2 |
| 4.3 | Federated Optimization Techniques | 2 |
| 4.5 | Case Study: Apple Siri, Google Gboard | 1 |
| **5** | **Regulatory & Ethical Dimension** | |
| 5.1 | GDPR, HIPAA, RBI guidelines (India) relevance to FL | 2 |
| 5.2 | Fairness and bias in distributed data | 2 |
| 5.3 | Responsible AI frameworks | 2 |
| **6** | **Applications and Case Studies** | |
| 6.1 | Federated Learning in Healthcare, Smart Devices, Finance, IoT | 1 |
| 6.2 | Personalized FL-Cross Silo | 1 |
| 6.3 | FL in Edge and Mobile Devices- Open Research Problems | 1 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.R.Leena Sri, Associate Professor, rlsit@tce.edu
   Computer Science and Engineering,

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSRK0** | **EDGE COMPUTING** | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course provides knowledge and abilities on how IoT and Edge Computing are used to meet application demands in Industrial intelligence. The objective of this course is to make students to understand computing and communication technologies used for IoT, Edge and Cloud Computing. This course also includes middleware architecture between Edge & Cloud and adding intelligence at the edge. At the end of the course students should be able to implement Edge-Cloud Systems for an application opportunity.

## Prerequisite

- Algorithms
- Data Structure
- Network Programming
- Cloud Computing

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Interpret architectures, entities used in Edge Computing along with its benefits and challenges | TPS2 | 75 | 80 |
| CO2 | Implement the networking and routing protocols for communication and processing occurs in the Edge to cloud scenario | TPS3 | 70 | 75 |
| CO3 | Demonstrate the use of smart gateways and collaboration protocol using appropriate middleware infrastructure and lightweight OS | TPS3 | 70 | 75 |
| CO4 | Apply containerization and orchestration tools to manage edge data system | TPS3 | 70 | 75 |
| CO5 | Implement the tool for analyse the data at the edge to know the real-time insights and provide resolution to the problems in various domains | TPS3 | 70 | 75 |
| CO6 | Distinguish physical and logical workspace for the real time edge computing applications Edge-Fog- Cloud environment | TPS4 | 70 | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | L | | | L | | | | L | L | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2. | S | M | L | | M | M | L | M | L | L | | L | M | L | L |
| CO3. | S | M | L | | M | M | L | M | L | L | | L | M | L | L |
| CO4. | S | M | L | | M | M | L | M | L | L | | L | M | L | L |
| CO5. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO6. | S | S | M | L | M | M | L | M | M | M | L | S | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass1 | CAT2 | | | | | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 4 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 20 | | - | - | - | | - | - | - | - | - | - | - | | | 8 | | - | - | - |
| CO2 | 5 | 10 | 20 | - | - | - | 50 | - | - | - | - | - | - | - | | | 4 | 15 | - | - | - |
| CO3 | 5 | 10 | 20 | | - | - | 50 | - | - | - | - | - | - | - | | | 4 | 15 | | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 5 | 20 | | - | - | 20 | | | 4 | 15 | | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 5 | 20 | | - | - | 20 | | | 4 | 15 | | - | - |
| CO6 | - | - | - | - | - | - | - | 5 | 5 | 15 | 15 | - | - | 20 | 40 | | 4 | - | 12 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Foundation & Architecture of Edge Computing:** Concepts, Characteristics and Attributes-Reference Architecture-Multi View, Concept View, Function View, Deployment View-Multi-access Edge Computing(MEC) reference model-Content Delivery Networks vs. MEC-Benefits-Drawbacks

**Edge Networking and Protocols:** Networking-5G/LTE-Network Protocols-MQTT, CoAP, WebSocket-5G MEC Architecture-Slicing in 5G. software-defined Clouds-Slicing management in Edge and Fog

**Middleware Infrastructures:** Cloud-fog-mist-edge Consortium-Mobile Cloud Computing vs Edge Computing, -Smart Gateway-IoT Hub, Event Hub-Collaboration Protocols-Lightweight OS ad frameworks-Case Study: Cisco Packet Tracer-Smart City, factories, traffic

**Data management & orchestration:** Time Series Database-Streamlining Analytics-Cloud Database-Data Scrapping-Docker container and Cloud native Kubernetes-Digital Twin-Case Study: Node-red-Temperature Monitoring, Prometheus tool

**Edge Analytics:** Edge Analytics Architecture-Challenges in Centralized IoT-OTA-Remote Diagnostics-Security, Privacy and Trust-Case Study: AWS Greengrass, Mender, Kafka

**Edge Computing in Industry Application:** Autonomous Vehicles & V2X (Vehicle –to Everything)-Healthcare-Green Edge Computing- Industry 4.0

**Reference Books & web resources**


1. Rajkumar Buyya, Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, Wiley 2019
2. Perry lea, IoT and Edge Computing for Architects: Implementing Edge and IoT Systems from Sensors to Clouds with Communication Systems, Analytics, and Security, Packet Publishing, 2020, 2nd Edition
3. Fadi Al-Turjman,Edge Computing From Hype to Reality, EAI/Springer Innovations in Communication and Computing,2019
4. Jie Cao,Quan Zhang,Weisong Shi, Edge Computing: A Primer, SpringerBriefs in Computer Science, 2018
5. Edge Computing Consortium : https://ecconsortium.eu/
6. AWS IoT: Developing and Deploying an Internet of Things: https://courses.edx.org/courses/course-v1:AWS+OTP AWSD5+1T2019/course/
7. IoT Networks and Protocols : https://courses.edx.org/courses/course-v1:CurtinX+IOT3x+3T2020/course/
8. Packet Tracer: http://static-pt-assets.s3.amazonaws.com/tutorials71.htm#stub


**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Hours | Course Outcome |
|---|---|---|---|
| 1 | **Foundation & Architecture of Edge Computing** | | |
| 1.1 | Concepts, Characteristics and Attributes | 1 | CO1 |
| 1.2 | Reference Architecture-Multi View, Concept View, Function View, Deployment View | 3 | CO1 |
| 1.3 | Multi-access Edge Computing(MEC) reference model | 1 | CO1 |
| 1.4 | Content Delivery Networks vs. MEC | 1 | CO1 |
| 2 | **Edge Networking and Protocols** | | |
| 2.1 | Networking-5G/LTE- | 1 | CO2 |
| 2.2 | Network Protocols-MQTT, CoAP, WebSocket | 2 | CO2 |
| 2.3 | 5G MEC Architecture | 1 | CO2 |

| | | | |
|---|---|---|---|
| 2.4 | Slicing in 5G. software-defined clouds | 2 | CO2 |
| 2.5 | Slicing management in Edge and Fog | 1 | CO2 |
| 3 | **Middleware Infrastructures** | | |
| 3.1 | Cloud-fog-mist-edge consortium | 1 | CO3 |
| 3.2 | Mobile Cloud Computing vs Edge Computing | 1 | CO3 |
| 3.3 | Smart Gateway-IoT Hub, Event Hub | 1 | CO3 |
| 3.4 | Collaboration Protocols | 1 | CO3 |
| 3.5 | Lightweight OS and frameworks | 1 | CO3 |
| 3.6 | Case Study: Cisco Packet Tracer-Smart City, factories, traffic | 1 | CO3 |
| 4 | **Data management & orchestration** | | |
| 4.1 | Time Series database | 1 | CO4 |
| 4.2 | Streamlining Analytics | 1 | CO4 |
| 4.3 | Cloud Database | 1 | CO4 |
| 4.4 | Data Scrapping | 1 | |
| 4.5 | Docker container and Cloud native Kubernetes | 2 | CO4 |
| 4.6 | Digital Twin | 1 | CO4 |
| | Case Study: Node-red – Temperature Monitoring, Prometheus tool | 1 | CO4 |
| 5 | **Edge Analytics** | | |
| 5.1 | Edge Analytics Architecture | 1 | CO5 |
| 5.2 | Challenges in Centralized IoT | 1 | CO5 |
| 5.3 | OTA-Remote Diagnostics | 1 | CO5 |
| 5.4 | Security, Privacy and Trust | 1 | CO5 |
| 5.5 | Case Study: AWS Greengrass, Mender, Kafka | 1 | CO5 |
| 6 | **Edge Computing in Industry Application** | | |

| | | | |
|---|---|---|---|
| 6.1 | Autonomous Vehicles & V2X (Vehicle –to Everything), Digital Twin | 1 | CO6 |
| 6.2 | Healthcare | 1 | CO6 |
| 6.3 | Green Edge Computing | 1 | CO6 |
| 6.4 | Industry 4.0 | 1 | CO6 |
| | **Total** | **36** | |

**Course Designer(s):**

1. Dr.R.Leena Sri, Associate Professor, rlsit@tce.edu
   Computer Science and Engineering,

| 22CSRL0 | BUSINESS PROCESS AUTOMATION | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 2 | 0 | 2 | 3 |

(Theory cum Practical)

## Preamble

Business process automation design and development course offers comprehensive knowledge and professional level skills focused on developing and deploying software robots to achieve automation. The course introduces RPA platform and enables a student to use RPA software to automate business processes.

## Prerequisite

- Knowledge of Webapp development

## Course Outcomes

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

| CO1 | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Illustrate the operation of basic computing and programming concepts. | TPS2 | 70 | 85 |
| CO2 | Apply the business and management aspect of process automation. | TPS3 | 70 | 80 |
| CO3 | Automate business processes using various functionalities and features of RPA tool. | TPS3 | 70 | 80 |
| CO4 | Identify the process for image,audio, text and data tables automation. | TPS3 | 70 | 80 |
| CO5 | Deploy software bots independently for process automation. | TPS3 | 70 | 80 |
| CO6 | Develop software bots for email automation and exception handling. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | | | | L | | L | | L |
| CO2 | S | M | L | M | S | L | L | L | L | L | M | L | M | M | L |
| CO3 | S | M | L | M | S | L | L | L | L | L | M | L | M | M | L |
| CO4 | S | M | L | M | S | L | L | L | L | L | M | L | M | M | L |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | S | M | L | M | S | L | L | L | L | L | M | L | M | M | L |
| CO6 | S | M | L | M | S | L | L | L | L | L | M | L | M | M | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | OCR | | | | | | Model Lab | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | - | - | - | - | - | - | - | - | - | - | - | 10 | - | - | - | - | - | - | - | - | - | - | 2 | 15 | - | - | - | - |
| CO2 | 10 | 10 | 20 | - | - | - | - | - | - | - | - | - | - | - | 15 | - | - | - | - | - | 20 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO3 | 10 | 10 | 20 | | - | - | - | - | - | - | - | - | - | - | 20 | - | - | - | - | - | 20 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 10 | 10 | 10 | - | - | - | - | - | 20 | - | - | - | - | - | 20 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | - | - | 20 | - | - | - | - | - | 20 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO6 | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | - | - | 15 | - | - | - | - | - | 20 | - | - | - | | 5 | 10 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

### ESSENTIALS OF PROGRAMMING FOR AUTOMATION

Programming Concepts Basics -Python- Basic Web Concepts - Data Structures - Data Tables - Algorithms - Software Processes - .Net Framework - .Net Fundamentals - XML - HTML - CSS - Variable & Arguments.

### RPA FOUNDATIONS AND BUSINESS USE CASES

RPA Basics - History of Automation - Programming Constructs in RPA - Types of Bots - Standardization of processes - RPA Development methodologies - RPA business case- Risks & Challenges with RPA - RPA emerging ecosystem, Agentic AI ,Blue Prism, Descript

### RPA TOOL BASICS

Introduction to RPA Tool -Number Variables - Array Variables - Date and Time Variables - Data Table Variables-Importing New Namespaces - Control Flow Introduction - Loops - Advanced Control Flow - Sequences - Flowcharts - Data Manipulation Introduction - Scalar Variables, Collections and Tables - mapping of BPA to LLM

### ADVANCED AUTOMATION CONCEPT AND TECHNIQUES

Recording and Advanced UI Interaction- Data Scraping –Audio Automation-Video Automation - Scraping Advanced Techniques - Selectors-Advanced Citrix Automation - Introduction Retrieval - Data Tables in BPA-Extracting Data from PDF - Extracting a single piece of data - Anchors - Automation of L1 and L2 jobs

**EMAIL AUTOMATION & EXCEPTIONAL HANDLING** Email Automation - Incoming Email Automation – Sending Email Automation-Debugging and Exception Handling - Debugging Tools – Strategies for Solving issues – Catching errors.

**Text Book**

1) Tripathi, Alok Mani. "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath". Packt Publishing Ltd, 2018.

**Reference Books & web resources**

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livinston, "Introduction to robotic process automation: A primer", Institute of robotic process automation, 2015
2. Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant." Middletown, DE. Omakustanne (2018).
3. https://www.uipath.com/rpa/robotic-process-automation

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| 1. | **Essentials of Programming for Automation (4)** | |
| 1.1 | Programming Concepts Basics, Understanding the application | 1 |
| 1.2 | Basic Web Concepts ,Protocols, Email Clients, Data Structures | 1 |
| 1.3 | Data Tables, Algorithms , Software Processes Software Design, Scripting, Net Framework,.Net Fundamentals | 1 |
| 1.4 | XML - Control Structures and functions HTML - CSS - Variable & Arguments. | 1 |
| 2 | **RPA Foundations and Business Use Cases (4)** | |
| 2.1 | RPA Basics - History of Automation, RPA Vs Automation - Processes & Flowcharts | 1 |
| 2.3 | Programming Constructs in RPA Types of Bots - RPA Advanced Concepts | 1 |
| 2.4 | RPA Development methodologies, RPA business case | 1 |

| | | |
|---|---|---|
| 2.5 | RPA Team - Process Design, RPA and emerging ecosystem. Popular tools ,Blue prism ,Descript | 1 |
| 3. | **RPA TOOL INTRODUCTION & BASICS (5)** | |
| 3.1 | Introduction to RPA Tool - The User Interface - Variables - | 1 |
| 3.2 | Managing Variables - Naming Best Practices - The Variable Panel Managing Arguments - Naming Best Practices | 1 |
| 3.4 | Using Arguments - About Imported Namespaces - Importing New Namespaces - | 1 |
| 3.5 | Control Flow Introduction , Flowcharts - The Assign Activity - The Delay Activity - | 1 |
| 3.7 | Data Manipulation Introduction - Scalar Variables, Collections and Tables - Text Manipulation – Data Manipulation -Gathering and Assembling Data | 1 |
| 4. | **AUTOMATION TECHNIQUES (4)** | |
| 4.1 | Recording and Advanced UI Interaction - Recording | 1 |
| 4.2 | Introduction - Basic and Desktop Recording - Web Recording - Input/ Output Methods | 1 |
| 4.3 | Screen Scraping - Data Scraping - Scraping Advanced Techniques | 1 |
| 4.4 | Customization - Debugging - Dynamic Selectors - Partial Selectors | 1 |
| **5** | **ADVANCED AUTOMATION CONCEPT (4)** | |
| 5.1 | RPA Challenge - Image, Audio, Video, Text & Advanced Citrix Automation | 1 |
| 5.2 | Introduction Retrieval - Advanced Citrix Automation Challenges - | 1 |
| 5.3 | Best Practices - Using tab for Images - Starting Apps - Excel Data Tablets & PDF - Data Tables in RPA - Excel and Data Tables basics | 1 |
| 5.4 | Data Manipulation in excel - Extracting Data from PDF- Extracting a single piece of data | 1 |

| 6. | **EMAIL AUTOMATION & EXCEPTIONAL HANDLING (3)** | |
|---|---|---|
| 6.1 | Email Automation - Email Automation - Incoming Email Automation –. | 1 |
| 6.2 | Sending Email automation - Debugging and Exception Handling - | 1 |
| 6.3 | Debugging Tools – Strategies for Solving issues – Catching errors | 1 |
| | **Total** | **24** |

**List of Experiments** for practical hands on:

| Experiment No. | Experiment Title (24 hours ) | Course Outcomes |
|---|---|---|
| 1 | Automating File Management (Python) | CO2 |
| 2 | Web Scraping and CSV Export (Python) | CO2 |
| 3 | Automated Email Sending (Python) | CO2 |
| 4 | Reading PDF and Extracting Data (Python) | CO3 |
| 5 | Desktop Automation Using pyautogui (Python) | CO3 |
| 6 | Web Form Automation with Selenium (Python) | CO3 |
| 7 | Hello World Bot & Variable Handling | CO4 |
| 8 | Web Data Scraping to Excel | CO4 |
| 9 | Excel-Based Automation | CO5 |
| 10 | PDF Invoice Extraction | CO5 |
| 11 | Email Automation and Attachment Download | CO6 |
| 12 | Exception Handling and Logging | CO6 |

**Course Designer(s):**


| | |
|---|---|
| Dr.K.NarasimhaMallikarjunan, Associate Professor , CSE | arjunkambaraj@tce.edu |

| 22CSRM0 | SOFTWARE TESTING AND QUALITY CONTROL | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

This course encourages students to learn and practice a disciplined approach to software testing and software quality assurance. Students will understand key testing strategies such as black-box and white-box testing, and explore various testing techniques. The course also teaches the basics of Software Quality Assurance, including ethics, quality checks, and standards, to help build reliable and high-quality software.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the key techniques and processes involved in software testing. | TPS2 | 70 | 85 |
| CO2 | Identify suitable tests to be carried out for given specification | TPS3 | 70 | 80 |
| CO3 | Design test cases for given software using appropriate test generation methods. | TPS3 | 70 | 80 |
| CO4 | Construct a test suite to meet the given adequacy criteria involving coverage and mutation score. | TPS3 | 70 | 80 |
| CO5 | Prepare a test plan for given software specification and develop scripts to automate the testing of a given software using appropriate testing tools | TPS3 | 70 | 80 |
| CO6 | Apply software quality assurance methods and measurements to check and improve software processes while following ethical rules and industry standards. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | L | | | | L | L | - | - |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | M | M |
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | M | M |
| CO4. | S | M | L | | L | L | | M | M | M | | M | M | M | M |
| CO5. | S | M | L | | L | L | | M | M | M | | M | M | M | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6. | S | M | L | | M | M | L | M | M | M | L | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 20 | | - | - | - | - | - | - | - | - | - | | 30 | | | | | | | | | | | 2 | 3 | - | - | - | - |
| CO2 | 5 | 10 | 25 | - | - | - | - | - | - | - | - | - | | | 35 | | | | | | | | | | 2 | 3 | 15 | - | - | - |
| CO3 | 5 | 5 | 25 | - | - | - | - | - | - | - | - | - | | | 35 | | | | | | | | | | 2 | 3 | 15 | - | - | - |
| CO4 | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | | | | | | | | | 20 | | | | 2 | 3 | 15 | - | - | - |
| CO5 | - | - | - | - | - | - | 5 | 5 | 25 | - | - | - | | | | | | | | | 20 | | | | 2 | 3 | 15 | - | - | - |
| CO6 | - | - | - | - | - | - | 5 | 5 | 25 | - | - | - | | | | | | | | | 60 | | | | 2 | 3 | 10 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Testing as an Engineering Activity, Principles of Testing, V-model concepts, Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design, Developer/Tester Support of Developing a Defect Repository, Defect Prevention strategies.
**Testing strategies and techniques:** Testing strategies, Unit Testing, integration testing, system and acceptance testing, performance testing, regression testing, internationalization testing, ad hoc testing, object oriented testing, Usability and Accessibility Testing.

**Black Box Approach to Test Case Design:** Random Testing, Requirements based testing, Equivalence partitioning, boundary value analysis, cause effect graphing, state based testing, domain testing

**White Box Approach to Test design:** Test Adequacy Criteria, static testing vs. structural testing, adequacy criteria based on control flow, principles of mutation testing, equivalent mutants, fault detection using mutation, Test assessment using mutation

**Test Management and Automation**: People and organizational issues in testing, Organization structures for testing teams, testing services, Test Planning, Test Plan Components, Test Plan Attachments, Locating Test Items, test management, test process, Reporting Test Results-Test Automation: Software test automation, skill needed for automation, scope of automation, design and architecture for automation, requirements for a test tool, challenges in automation

**Software Quality Assurance**: Ethical Basis for Software Quality — Software Processes and Methodologies- Software Quality Assurance Metrics- Software Configuration Management- CMM (Capability Maturity Model)- Software Engineering Standards.

## Text Book

1. Aditya P. Mathur "Foundations of Software Testing", Second Edition ,Pearson Education, 2014.
2. Claude Y. Laporte, Alain April ,"Software Quality Assurance"Wiley,January 2018.

## Reference Books & web resources


1. Srinivasan Desikan, Gopalaswamy Ramesh, “Software testing – principles and practices”, First Edition ,Pearson Education, 2009
2. Roger S. Pressman, Software Engineering A Practitioner's Approach, Seventh Edition, Mcgraw Hill International Edition.,2010


## Course Contents and Lecture Schedule

| odule No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Testing as an Engineering Activity | 1 |
| 1.2 | Principles of Testing, V-model concepts | 1 |
| 1.3 | Tester’s Role in a Software Development Organization | 1 |
| 1.4 | Origins of Defects, Cost of defects, Defect Classes | 1 |
| 1.5 | The Defect Repository and Test Design, Developer/Tester Support of Developing a Defect Repository, | 1 |
| 1.6 | Defect Prevention strategies | 1 |
| **2** | **Testing strategies and techniques** | |
| 2.1 | Testing strategies, Unit Testing, integration testing | 1 |
| 2.2 | System and acceptance testing | 1 |
| 2.3 | Performance testing, regression testing | 1 |
| 2.4 | Internationalization testing, ad hoc testing | 1 |
| 2.5 | Object oriented testing | 1 |
| 2.6 | Usability and Accessibility Testing | 1 |
| **3** | **Black Box Approach to Test Case Design** | |
| 3.1 | Random Testing, Requirements based testing | 1 |
| 3.2 | Equivalence partitioning | 1 |
| 3.3 | Boundary value analysis, cause effect graphing | 1 |
| 3.4 | State based testing | 1 |
| 3.5 | Domain testing | 1 |
| **4** | **White Box Approach to Test design** | |

| odule No. | Topic | No. of Periods |
|---|---|---|
| 4.1 | Test Adequacy Criteria, static testing vs. structural testing | 1 |
| 4.2 | Adequacy criteria based on control flow, principles of mutation testing | 1 |
| 4.3 | Equivalent mutants, fault detection using mutation | 1 |
| 4.4 | Test assessment using mutation | 1 |
| **5** | **Test Management and Automation** | |
| 5.1 | People and organizational issues in testing | 1 |
| 5.2 | Organization structures for testing teams, testing services | 1 |
| 5.3 | Test Planning, Test Plan Components | 1 |
| 5.4 | Test Plan Attachments, Locating Test Items | 1 |
| 5.5 | Test management, test process | 1 |
| 5.6 | Reporting Test Results-Test | 1 |
| 5.7 | Automation: Software test automation, skill needed for automation | 1 |
| 5.8 | Scope of automation, design and architecture for automation | 1 |
| 5.9 | Requirements for a test tool, challenges in automation | 1 |
| **6** | **Software Quality Assurance** | |
| 6.1 | Ethical Basis for Software Quality | 1 |
| 6.2 | Software Processes and Methodologies | 1 |
| 6.3 | Software Quality Assurance Metrics | 1 |
| 6.4 | Software Configuration Management | 1 |
| 6.5 | CMM (Capability Maturity Model) | 1 |
| 6.6 | Software Engineering Standards | 1 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.Raja Lavanya, Assistant Professor, Computer Science and Engineering, rlit@tce.edu
2. Dr.N.Anita, Assistant Professor, Computer Science and Engineering, naacse@tce.edu

| 22CSRN0 | BEHAVIOURAL AND EMOTIONAL INTELLIGENCE | Category | L | T | P | C |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

## Preamble

Emotional Artificial Intelligence (EAI) is an emerging field where technology meets human emotions, enabling machines to understand and respond to how people feel. It is used in areas like education, mental health, marketing, and human-computer interaction. This course introduces Emotional AI and basic psychological concepts of emotions, along with hands-on techniques for recognizing emotions from text, voice, and facial expressions. Ethical considerations are also discussed, ensuring students gain the knowledge and practical skills to build responsible, emotion-aware technologies.

## Prerequisite

- Basic knowledge of Machine Learning (ML) & Deep Learning (DL), Python programming and Natural Language Processing (NLP) concepts

## Course Outcomes

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

| CO. No | Course Outcomes (COs) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Relate the principles of Emotional AI, affective computing, and emotional theories to real world challenges in everyday environments, including concepts such as personality, perception, and stress. | TPS 3 | 70 | 75 |
| CO2 | Apply Natural Language Processing and machine learning techniques to perform emotion detection from textual data. | TPS 3 | 70 | 75 |
| CO3 | Employ speech processing and facial recognition techniques to determine emotional states from audio and visual inputs. | TPS 3 | 70 | 75 |
| CO4 | Interpret ethical, social, and design principles to produce transparent and responsible emotion-aware AI systems. | TPS 3 | 70 | 75 |

| | | | | |
|---|---|---|---|---|
| CO5 | Analyze the effectiveness of different machine learning and deep learning models for emotion detection across text, speech, and facial modalities. | TPS 4 | 70 | 75 |
| CO6 | Infer design trade-offs and ethical implications in emotion-aware systems by examining real-world Emotional AI applications and case studies. | TPS 4 | 70 | 75 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | L | L | | L | | | | M | L | L | L |
| CO2 | S | M | L | | M | L | | M | L | L | | M | M | L | L |
| CO3 | S | M | L | | M | L | | M | L | L | | M | M | L | L |
| CO4 | S | M | L | | L | | | M | L | L | | M | M | | L |
| CO5 | S | M | L | | M | | | M | L | L | | M | M | L | L |
| CO6 | S | M | L | | M | L | | M | L | L | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 | | | | | | Assignment 1 | | | CAT 2 | | | | | | Assignment 2 | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 1 | 2 | 3 | 4 | 5 | 6 |
| **CO1** | 10 | 10 | 10 | - | - | - | - | - | 20 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| **CO2** | 10 | 10 | 10 | - | - | - | - | - | 20 | - | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| **CO3** | - | 20 | 20 | - | - | - | - | - | 60 | | - | - | - | - | - | - | - | - | 2 | 5 | 10 | - | - | - |
| **CO4** | - | - | - | - | - | - | - | - | - | 10 | 10 | 10 | - | - | - | - | - | 10 | 2 | 5 | 10 | - | - | - |
| **CO5** | - | - | - | - | - | - | - | - | - | 10 | 10 | - | 15 | - | - | - | - | 30 | 2 | 5 | - | 10 | - | - |

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO6** | - | - | - | - | - | - | - | - | - | 10 | 10 | - | 15 | - | - | - | - | 60 | - | 5 | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Emotional AI & Affective Computing** - Definition and scope of Emotional AI – Applications - education, mental health, Human Computer Interaction (HCI), marketing, robotics - Introduction to Affective Computing (Picard's work) - Basic concepts from psychology & neuroscience - Emotions vs Feelings vs Moods - Ekman's 6 basic emotions – James Lange theory – Human - centered AI and emotion – Personality - Meaning and development - Major determinants of Personality theories of Personality - Stress - causes and effect of job Stress

**Emotion Detection from Text** - Natural Language Processing techniques for text preprocessing - Sentiment analysis vs Emotion recognition - Emotion classification using: lexicon-based methods - BERT and GloVe embeddings for emotion detection - Deep Learning models (BiLSTM, Transformers) - Datasets: EmoLex, SemEval, GoEmotions

**Emotion Detection from Speech and Facial Expressions** - Speech features (pitch, energy, MFCCs) - DL models for Speech Emotion Recognition (SER) – Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) - Facial Emotion Recognition (FER2013 dataset) - Multimodal emotion recognition and fusion techniques - Case study - Fusion of speech and visual cues for emotion detection

**Ethical, Social & Design Considerations** - Privacy, bias and surveillance concerns - Emotion manipulation and user consent - Fairness and representation in emotion datasets - Ethical design of affective systems - Introduction to Explainable AI (XAI) - XAI for EEG emotion classification using DL

**Applications & Real-World Systems** - Emotion-aware chatbot and virtual assistant - Case Studies - Emotional AI in education - Replika - An emotionally aware chatbot for mental health support – Human - Robot interaction - Pepper Robot

## Text Books

1. Affective Computing (The MIT Press) - Rosalind W. Picard, 1997
2. Interaction Design: Beyond Human-Computer Interaction (Wiley) - Helen Sharp, Jenny Preece, Yvonne Rogers, 2019

## Reference Books

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd ed.). O'Reilly Media, Géron, A, 2022.
2. Encyclopedia Of Human Computer Interaction, Claude Ghaouil, 2006
3. Applied machine learning and AI for engineers: Solve business problems that can't be solved algorithmically. O'Reilly Media, Jeff Prosise, 2022

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Lectures |
|---|---|---|
| **1** | **Introduction to Emotional AI & Affective Computing** | **(7)** |
| 1.1 | Definition and scope of Emotional AI | 1 |
| 1.2 | Applications - education, mental health, HCI, marketing, robotics | 1 |
| 1.3 | Introduction to Affective Computing (Picard's work) | 1 |
| 1.4 | Basic concepts from psychology & neuroscience<br>Emotions vs Feelings vs Moods, Ekman's 6 basic emotions, James Lange theory | 1 |
| 1.5 | Human - Centered AI and emotion | 1 |
| 1.6 | Personality - Meaning and development - Major determinants of Personality theories of Personality | 1 |
| 1.7 | Stress - causes and effect of job Stress | 1 |
| **2** | **Emotion Detection from Text** | **(6)** |
| 2.1 | Natural Language Processing techniques for text preprocessing | 2 |
| 2.2 | Sentiment analysis vs. Emotion recognition | 2 |
| 2.3 | Emotion classification using - lexicon-based methods (NRC Emotion Lexicon) | 2 |
| **3** | **Machine Learning & Deep Learning methodology** | **(6)** |
| 3.1 | BERT and GloVe embeddings for emotion detection | 2 |
| 3.2 | Deep Learning models (BiLSTM, Transformers) | 2 |
| 3.3 | Datasets: EmoLex, SemEval, GoEmotions | 2 |
| **4** | **Emotion Detection from Speech and Facial Expressions** | **(7)** |
| 4.1 | Speech features: pitch, energy, MFCCs | 1 |
| 4.2 | DL models for speech emotion recognition (SER) – CNNs, RNNs | 2 |
| 4.3 | Facial Emotion Recognition (FER2013 dataset) | 1 |
| 4.4 | Multimodal emotion recognition and fusion techniques | 2 |
| 4.5 | Case study - Fusion of speech and visual cues for emotion detection | 1 |
| **5** | **Ethical, Social & Design Considerations** | **(6)** |
| 5.1 | Privacy, bias, and surveillance concerns | 1 |
| 5.2 | Emotion manipulation and user consent | 1 |
| 5.3 | Fairness and representation in emotion datasets | 1 |
| 5.4 | Ethical design of affective systems | 1 |
| 5.5 | Introduction to Explainable AI (XAI) - XAI for EEG emotion classification using DL | 2 |
| **6** | **Applications & Real-World Systems** | **(4)** |
| 6.1 | Emotion-aware chatbots and virtual assistants | 1 |
| 6.2 | Case Studies: Emotional AI in education | 1 |
| 6.3 | Case Studies: Replika – An emotionally aware chatbot for mental health support | 1 |

| | | |
|---|---|---|
| 6.4 | Case Studies: Human - Robot interaction - Pepper Robot | 1 |
| **Total Hours** | | **36** |

**Course Designer(s):**

1. Mr. S. Santhana Hari, AP, CSE sshcse@tce.edu
2. Mrs. N. Sheerin Sitara, AP,CSE nsscse@tce.edu

| 22CSRP0 | SOFTWARE SECURITY ENGINEERING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 3 | 0 | 0 | 3 |

**Preamble**

This course aims at providing an understanding about the fundamental concepts and properties in software security, security process models and the software security practices. It also focuses on Software Security Knowledge for Architecture and design concepts of Software Security Testing.

**Prerequisite**

NIL

**Course Outcomes**

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

| CO | Course Outcome (CO) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the security concepts | TPS2 | 70 | 80 |
| CO2 | Develop a Security Assurance Case by applying the suitable security properties | TPS3 | 70 | 75 |
| CO3 | Apply the SQUARE process model to develop and document security requirements using systematic tools and methods. | TPS3 | 70 | 75 |
| CO4 | Apply elicitation, prioritization, and risk analysis to secure software design. | TPS3 | 70 | 75 |
| CO5 | Illustrate security principles, guidelines, attack patterns, and testing methods to enhance software architecture and design. | TPS3 | 70 | 75 |
| CO6 | Examine security failures, attacker perspectives, and system complexity challenges in secure software development. | TPS3 | 70 | 75 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | - | | | | | | | | L | L | | |
| CO2 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |
| CO3 | S | M | L | - | M | L | L | L | L | L | | L | M | L | L |
| CO4 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |
| CO5 | S | M | L | - | - | L | L | M | L | L | | L | M | L | L |
| CO6 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | | | | | | | | | | | | | | | | | | | | | | | 4 | 5 | | | | |
| CO2 | 5 | 5 | 20 | | | | | | | | | | | | 50 | | | | | | | | | | 4 | 5 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 50 | | | | | | | | | | | 5 | 10 | | | |
| CO4 | | | | | | | 5 | 10 | 10 | | | | | | | | | | | | 30 | | | | 4 | 5 | 10 | | | |
| CO5 | | | | | | | 5 | 10 | 20 | | | | | | | | | | | | 30 | | | | 4 | 5 | 10 | | | |
| CO6 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 40 | | | | 4 | 5 | 10 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** System Complexity- Software Assurance and Software Security-Processes and Practices in Software Security-Threats to Software Security -Sources of Software Insecurity-Software requirements in SDLC

**Properties of Secure Software:** Core Properties of Secure Software-Influential Properties of Secure Software-Influences on properties- Building Security Assurance.

**Requirements Engineering**: Quality Requirements-Security Requirements Engineering-SQUARE Process Model-Requirements Elicitation-Elicitation Evaluation Criteria-Requirements Prioritization-Identify Candidate Prioritization Methods- Prioritization Technique Comparison-Recommendations for Requirements Prioritization.

**Security Practices:** Architectural Risk Analysis: Characterization, Threat. Assessment, Determination, Risk. Risk Mitigation Planning. Recapping Architectural Risk Analysis.

**Security principles**: Security Principles-Security Guidelines, Attack Patterns-Software Security-DevOps and Micro services security- Testing: Contrasting Software Testing and Software Security Testing, Functional Testing, Risk-Based Testing.

**Security and Complexity**: System Assembly Challenges - Security Failures - Functional and Attacker Perspectives for Security Analysis- System Complexity Drivers and Security Deep Technical Problem Complexity

**Text Book**

1. Software Security Engineering A Guide for Project Managers by Julia H.Allen, ean J. Barnum, Robert J. Ellison and Gary McGraw, May 11, 2008
2. Mead, Nancy R., and Carol Woody. Cyber security engineering: A practical approach for systems and software assurance. Addison-Wesley Professional, 2016.

**Reference Books**

1. John Musa D, “Software Reliability Engineering”, 2nd Edition, Tata McGraw-Hill, 2005
2. Du, Wenliang. Computer & internet security: a hands-on approach. Independently published, 2022.
3. Anderson, Ross J. Security engineering: a guide to building dependable distributed systems. John Wiley & Sons, 2010.
4. Suhel Ahmad Khan, Rajeev Kumar, Raees Ahmad Khan- Software Security Concepts & Practices – CRC Press, 2023

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction**. | |
| 1.1 | System Complexity -Software Assurance and Software Security. | 1 |
| 1.2 | Processes and Practices in Software Security. Threats to Software Security | 1 |
| 1.3 | Sources of Software Insecurity-Software Requirements in SDLC | 2 |
| **2** | **Properties of Secure Software** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.1 | Introduction, Defining Properties of Secure Software: Core Properties of Secure Software Software. | 2 |
| 2.2 | Influences on properties: The Defensive Perspective. The Attacker's Perspective. | 2 |
| 2.3 | Building a Security Assurance Case. | 2 |
| **3** | **Requirements Engineering**: | |
| 3.1 | Quality Requirements, Security Requirements Engineering. | 2 |
| 3.2 | SQUARE Process Model: A Brief Description of SQUARE, Tools, Expected results. | 2 |
| 3.3 | Requirements Elicitation | 2 |
| 3.4 | Requirements Prioritization: Identify Candidate Prioritization Methods, Prioritization Technique Comparison, and Recommendations for Requirements Prioritization. | 2 |
| **4** | **Security Practices** | |
| 4.1 | Architectural Risk Analysis: Characterization, Threat. Assessment, Determination, Risk | 2 |
| 4.2 | Risk Mitigation Planning. Recapping Architectural Risk Analysis. | 2 |
| **5** | **Security principles**: | |
| 5.1 | Software Security Knowledge for Architecture and Design Security Principles | 2 |
| 5.2 | Security Guidelines, and Attack Patterns: Security Principles, Security Guidelines, Attack Patterns.. | 2 |
| 5.3 | Software Security Testing: Contrasting Software Testing and Software Security Testing, Functional Testing, Risk-Based Testing | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **6** | **Security and Complexity** | |
| 6.1 | System Assembly Challenges - Security Failures | 2 |
| 6.2 | Functional and Attacker Perspectives for Security Analysis: Identity Management: Functional Perspective - Identity Management: Attacker's Perspective - Identity Management and Software Development | 2 |
| 6.3 | System Complexity Drivers and Security | 2 |
| 6.4 | Deep Technical Problem Complexity | 2 |
| | Total | 36 |

**Course Designers:**

1. Dr. C. Senthil Kumar cskcse@tce.edu

# CURRICULUM AND SYLLABI

# FOR

# INDUSTRY SUPPORTED COURSES

**FOR THE STUDENTS ADMITTED IN THE**

**ACADEMIC YEAR 2023 - 2024**

**THIAGARAJAR COLLEGE OF ENGINEERING**
(A Government Aided Autonomous Institution affiliated to Anna University)
**MADURAI – 625 015, TAMILNADU**

Phone: 0452 – 2482240, 41
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Web: www.tce.edu

| 22CS1A0 | GENERATIVE AI TOOLS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PEES | 1 | 0 | 0 | 1 |

## Preamble

This course explores Generative Artificial Intelligence tools, focusing on algorithms that create new content such as images and text. It provides a historical overview of generative models, and dives into foundational concepts like neural networks and backpropagation. The course also examines advanced techniques like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), discussing their applications in data generation, image synthesis, and more. The ethical considerations, including bias and privacy, are addressed to provide a comprehensive view of the challenges in Generative AI.

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the key concepts and various types of generative models, including Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and autoregressive models for data generation and vector quantized diffusion models | TPS3 | B | 75 |
| CO2 | Apply generative techniques to create synthetic data, generate images, and perform text-to-image synthesis | TPS3 | B | 75 |
| CO3 | Demonstrate the ability to use Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) to solve real-world problems, such as data augmentation and image restoration | TPS3 | B | 75 |
| CO4 | Apply best practices to fine-tune generative models, including hyperparameter tuning, transfer learning, and regularization to avoid overfitting | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS 01 | PS 02 | PS 03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | L | L | L | | L | M | | | M | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | | | M | M | L | L |
| CO3 | S | M | L | | M | L | | L | M | M | | M | M | L | L |
| CO4 | S | M | L | | L | L | | L | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Terminal | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 5 | 15 | - | - | - |
| CO2 | 5 | 5 | 15 | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO3 | 5 | 5 | 15 | - | - | - |
| CO4 | 5 | 5 | 15 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

**Syllabus**

**Introduction to Generative AI** – Historical overview of generative modeling – Importance of generative models in AI and machine learning –- Types of generative models: GANs, VAEs, autoregressive models and vector quantized diffusion models

**Understanding Generative Models** – Probabilistic modeling and generative processes - Generative Adversarial Networks (GANs) –Generator and discriminator architectures in GANs – Training process: adversarial training, Nash equilibrium – Variants of GANs: DCGANs, WGANs, CGANs - Variational Autoencoders (VAEs) –Encoder and decoder architectures in VAEs – Latent space representation and sampling techniques–Loss functions for training VAEs: reconstruction loss, KL divergence

**Applications of GANs and VAEs** –Image generation and synthesis using GANs –Data generation and augmentation with VAEs - Training and Fine-Tuning Generative Models – Hyper parameter tuning for generative models – Transfer learning and pretraining techniques - Ethics and Challenges in Generative AI – Bias and fairness issues in generative models – Privacy concerns in generating synthetic data

**Hands-on Projects and Demonstrations** - Building a simple GAN, VAE model in TensorFlow or PyTorch - Generating images or text using pre-trained generative models - Demonstrating the impact of hyperparameters on model performance

**Text Book**

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems - Aurelien Geron, Third Edition O'Reilly 2022.

**Reference Books & web resources**

1. https://www.oreilly.com/library/view/generative-deeplearning/9781492041931/ch01.html
2. https://www.mygreatlearning.com/blog/generative-ai-models/
3. https://www.geeksforgeeks.org/what-is-generative-ai/
4. https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/what-is-generative-ai
5. https://www.baeldung.com/cs/vae-vs-gan-image-generation

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Generative AI (2)** | |
| 1.1 | Evolution of Generative AI – Benefits - Historical overview of generative modeling - Importance of generative models in AI and machine learning | 1 |
| 1.2 | Types of generative models: GANs, VAEs, and autoregressive models and vector quantized diffusion models | 1 |
| **2** | **Understanding Generative Models (5)** | |
| 2.1 | Probabilistic modeling and generative processes | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.2 | Generative Adversarial Networks (GANs) - Generator and discriminator architectures in GANs | |
| 2.3 | Training process: adversarial training, Nash equilibrium | 1 |
| 2.4 | Variants of GANs: DCGANs, WGANs, and CGANs | 1 |
| 2.5 | Variational Autoencoders (VAEs) - Encoder and decoder architectures in VAEs | 1 |
| 2.6 | Latent space representation and sampling techniques | 1 |
| 2.7 | Loss functions for training VAEs: reconstruction loss, KL divergence | |
| **3** | **Applications of GANs and VAEs (3)** | |
| 3.1 | Image generation and synthesis using GANs - Data generation and augmentation with VAEs | 1 |
| 3.2 | Training and Fine-Tuning Generative Models - Hyperparameter tuning for generative models - Transfer learning and pretraining techniques | 1 |
| 3.3 | Ethics and Challenges in Generative AI - Bias and fairness issues in generative models - Privacy concerns in generating synthetic data | 1 |
| **4** | **Hands-on Projects and Demonstrations (4)** | |
| 4.1 | Building a simple GAN, VAE model in TensorFlow or PyTorch | 2 |
| 4.2 | Generating images or text using pre-trained generative models - Demonstrating the impact of hyperparameters on model performance | 2 |
| | **Total** | 14 |

**Course Designers**


1. Mr. Vijay Shankar, Software Engineer, Ericsson vvs221199@gmail.com
2. Dr.K.Sundarakantham, Professor, CSE kskcse@tce.edu
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| 22CS1B0 | CONTAINERIZED CI AND CD | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course helps the students to understand the concept and significance of containerization in deploying microservices with CI/CD. It also teaches the students about the benefits of using containerized orchestration and pipelining in the CI and CD process. The course gives practical hands-on with the tools for CI/CD, containerization and orchestration using Jenkins, Docker and Kubernetes.

## Prerequisite

- Nil

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify the significance of CI/CD and design software applications with CI/CD principles | TPS3 | B | 80 |
| CO2 | Use the CI/CD tools to develop software using CI/CD methodology | TPS3 | B | 80 |
| CO3 | Develop and deploy microservice applications using containers | TPS3 | B | 80 |
| CO4 | Apply container orchestration and containerized pipeline | TPS3 | B | 80 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | | | | L | L | | L | M | | |
| CO2. | S | M | L | | M | L | | | M | M | | M | M | L | L |
| CO3. | S | M | L | | M | L | | | M | M | | M | M | L | L |
| CO4. | S | M | L | | M | L | | | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Level | Terminal Examination |
|---|---|
| Remember | 10 |
| Understand | 30 |
| Apply | 60 |
| Analyse | - |
| Evaluate | - |
| Create | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Basics of CI and CD:** Overview of software development process using monolithic and microservices architecture principles and challenges, Need for CI/CD, Basics of DevOps, Example of microservice software development with and without CI/CD, an overview using git and an overview using a simple script.
**Case study for CI/CD:** Jenkins overview and setup, My first Jenkins job, Jenkins pipelines, Declarative vs scripted pipelines, Jenkins plugins and integration with git.
**Containerization:** Introduction to containerization - Need of containers, Docker basics, A sample software project with and without docker.
**Container Orchestration and Pipelining:** Scaling up docker – Kubernetes, Understanding the basics of infrastructure as code using minikube, Basics of containerized pipeline.

## Text Book

1. Marko Anastasov, Jerome Petazzoni,Pablo Tomas Fernandez Zavalia, “CI/CD with Docker and Kubernetes-How to Deliver Cloud Native Applications at High Velocity”, Second Edition, 2022.
2. John Edward Cooper Berg, "DevOps. Building CI/CD Pipelines with Jenkins, Docker Container, AWS ECS, JDK 11, Git and Maven 3", Amazon,2019.

## Reference Books & web resources

1. https://docs.docker.com/get-started/
2. https://kubernetes.io/docs/tutorials/kubernetes-basics/create-cluster/cluster-intro/
3. https://minikube.sigs.k8s.io/docs/start/

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Basics of CI and CD** | |
| 1.1 | Overview of software development process using monolithic and microservices architecture principles and challenges, Need for CI/CD | 1 |
| 1.2 | Basics of DevOps | 1 |
| 1.3 | Example of microservice software development with and without CI/CD | 1 |
| 1.4 | An overview using git and an overview using a simple script. | 1 |
| **2** | **Case study for CI/CD** | |
| 2.1 | Jenkins overview and setup | 1 |
| 2.2 | My first Jenkins job, Jenkins pipelines, Declarative vs scripted pipelines | 2 |
| 2.3 | Jenkins plugins and integration with git | 1 |
| **3** | **Containerization** | |
| 3.1 | Introduction to containerization - Need of containers | 1 |
| 3.2 | Docker basics and A sample software project with and without docker | 2 |
| **4** | **Container Orchestration and Pipelining** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.1 | Scaling up docker using Kubernetes | 1 |
| 4.2 | Understanding the basics of infrastructure as code using minikube | 1 |
| 4.3 | Basics of containerized pipeline | 1 |
| | Total | 14 |

**Course Designer(s):**

1. Mr.S.Raghav, Software Development Engineer II, Amazon sraghavmdu@gmail.com
2. Dr.G.Madhupriya,gmadhupriya@tce.edu
3. Dr.K.Indra, kiit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS1C0** | **AR FOR INDUSTRY 4.0** | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course provides a comprehensive understanding of AR technologies and their applications within the context of Industry 4.0. Throughout this course, students will delve into the theoretical foundations and practical implementations of AR, exploring its role in reshaping manufacturing, maintenance, training, and other critical domains

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Understand the basics of AR for user interaction and advanced interaction used in game development. | TPS2 | B | 80 |
| CO2 | Classify Rendering Optimizations in project and Hand-Gesture-Recognition for wearable devices . | TPS3 | B | 75 |
| CO3 | Apply the knowledge of designing Industrial 4.0 Systems for various applications. | TPS3 | B | 75 |
| CO4 | Experiment the Industrial Metaverse and digital representations of physical industrial assets and spaces that people can control, communicate, and interact . | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | L | L | L | | L | L | | L |
| CO2 | S | M | L | | M | | | L | L | L | | L | M | L | L |
| CO3 | S | M | L | | M | M | | L | L | L | | L | M | L | L |
| CO4 | S | M | L | | M | M | | L | L | L | | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| **Cognitive Level** | **Terminal Examination** |
|---|---|
| Remember | 10 |
| Understand | 30 |
| Apply | 60 |
| Analyse | - |
| Evaluate | - |
| Create | - |

## Syllabus

**Overview of AR concepts-** Understanding of User Experience Design & Development, Key Factors about Game Development.

**Optimization Techniques** for AR **-**Maximizing performance(LOD), HLSL Shader programming Lighting Techniques, Testing Process (Rseponsive test VR) , Gesture Input(AR/MR).

**Applications of AR in Industry operations -** Applications of AR and VR for supply chain: a macro perspective approach, Convergence of AR/VR with IoT in manufacturing and their novel usage in IoT

**Industrial Metaverse -**Proficiency of Metaverse using virtual reality for industry and users perspective, Exploring practical use-cases of augmented reality using photogrammetry - 3D reconstruction tools in the Metaverse

## Reference Books & web resources

1. Richa Goel, Sukanta Kumar Baral, Tapas Mishra, and Vishal Jain, “Augmented and Virtual Reality in Industry 5.0”, De Gruyter 2023

2. Carsten Röcker, Sebastian Büttner, “Human-Technology Interaction Shaping the Future of Industrial User Interfaces”, Springer International Publishing, 2023

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Overview of AR concepts** | |
| 1.1 | Understanding of User Experience Design & Development | 1 |
| 1.2 | Custom inputs and movements to control key factors in game development. | 1 |
| **2** | **Optimization Techniques** for AR | |
| 2.1 | Maximizing performance(LOD) | 1 |
| 2.2 | HLSL Shader programming Lighting Techniques | 1 |
| 2.3 | Testing Process (Rseponsive test VR) | 1 |
| 2.4 | Gesture Input(AR/MR). | 1 |
| **3** | **Applications of AR in Industry operations** | |
| 3.1 | Applications of AR and VR for supply chain: a macro perspective approach | 1 |
| 3.2 | Convergence of AR/VR with IoT in manufacturing and their novel usage in IoT | 2 |
| **4** | **Industrial Metaverse** | |
| 4.1 | Proficiency of Metaverse using virtual reality for industry and users perspective | 1 |
| 4.2 | Exploring practical use-cases of augmented reality using photogrammetry | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.3 | 3D reconstruction tools in the Metaverse | 2 |
| | **Total** | **14** |

**Course Designers:**


1. Mr.S.Gokulakannan seenivasangokulakannan@gmail.com
2. Dr.N.Shivakumar shiva@tce.edu
3. Dr.RajaLavanya rlit@tce.edu

| 22CS1D0 | DATA VISUALIZATION USING POWER BI |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PEES | 1 | 0 | 0 | 1 |

## Preamble

In today's data-driven world, organizations need to quickly and accurately make informed decisions based on vast amounts of data. Power BI is a powerful data visualization tool that allows users to create interactive dashboards and reports that help them analyze and communicate insights from data. Data visualization is an essential skill for anyone who wants to understand and communicate insights from data. This course is designed to inculcate the basics of data visualization with Power BI.

## Prerequisite

Basic understanding of data analysis concepts

## Course Outcomes

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

| CO Number | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the concepts of Business Intelligence and Power BI installation | TPS2 | B | 80 |
| CO2 | Build the data transformation using the query editor and Managing Data Relationships | TPS3 | B | 75 |
| CO3 | Create calculated measures and columns visuals in Power BI | TPS3 | B | 75 |
| CO4 | Make use of dashboards that supports on- premise data gateway and connecting with databases. | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | L | | | L | | L | | L | L | | L |
| CO2 | S | M | L | | M | | | L | L | M | L | L | M | L | M |
| CO3 | S | M | L | | M | | | L | L | M | L | L | M | L | M |
| CO4 | S | M | L | | M | | | L | L | M | L | L | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern:

| Cognitive Levels | Terminal Examination |
|---|---|
| Remember | 20 |
| Understand | 40 |
| Apply | 40 |
| Analyse | 0 |
| Evaluate | 0 |
| Create | 0 |

## Syllabus

**Introduction to Power BI**-Introduction to Business Intelligence: Self-Service Business Intelligence (SSBI)-Introduction to Power BI: Traditional BI vs. Power BI-Uses of Power BI-The Flow of Work in Power BI-Basic Components of Power BI-Introduction to Building Blocks of Power BI-Data model and importance of Data Modelling

**Power BI Desktop and Data Transformation**-Data Sources in Power BI Desktop-Loading Data in Power BI Desktop-Views in Power BI Desktop-Query Editor in Power BI-Transform, Clean, Shape, and Model Data-Manage Data Relationship- Editing a Relationship-Cross Filter Direction-Saving Work file

**Data Analysis Expression (DAX)** -Introduction to DAX-Importance of DAX- Data Types in DAX-DAX Calculation Types-Steps to Create Calculated Columns-Measures in DAX- DAX Syntax, Functions and Operators-DAX Tables and Filtering

**Data Visualization**-Introduction to Visuals in Power BI: Visualization Charts in Power BI-Matrixes and Tables- Slicers and Map Visualizations- Modifying Colors in Charts and Visuals: Shapes, Text Boxes, and Images- Custom Visuals-Page Layout and Formatting- Bookmarks and Selection Pane-KPI Visuals

**Power BI Service-**Introduction to Power BI Service-Creating a Dashboard- Configuring a Dashboard- Power BI Embedded- Bookmarks and buttons **Connectivity Modes-**Data Sources Supported in Power BI- Exploring Live Connections to Data Sources-Connecting Directly to SQL Azure- Connecting Directly to SQL Server Analysis Services/My SQL- Connecting Power BI in Excel

## References

1. Data Visualization with Microsoft Power BI, Alex Kolokolov, Maxim Zelensky, O'Reilly Media Inc, 2024
2. Data Visualization : Using Power BI, Orange and Excel, Dr. Shirshendu Roy, Notion Press, 2021
3. Power BI Data Analysis and Visualization, Suren Machiraju, Suraj Gaurav, De Gruyter, 2018

## Course Contents and Lecture Schedule

| Data Visualization Using Power BI | | |
|---|---|---|
| **Module Number** | **Topic** | **No. of Lectures** |
| 1 | **Introduction to Power BI** | |
| 1.1 | Introduction to Business Intelligence: Self-Service Business Intelligence (SSBI)-Introduction to Power BI: Traditional BI vs. Power BI | 1 |
| 1.2 | Uses of Power BI-The Flow of Work in Power BI-Basic Components of Power BI | 1 |
| 1.3 | Introduction to Building Blocks of Power BI-Data model and importance of Data Modelling | 1 |
| 2 | **Power BI Desktop and Data Transformation** | |

| | | |
|---|---|---|
| 2.1 | Data Sources in Power BI Desktop-Loading Data in Power BI Desktop | 1 |
| 2.2 | Views in Power BI Desktop-Query Editor in Power BI-Transform, Clean, Shape, and Model Data | 1 |
| 2.3 | Manage Data Relationship- Editing a Relationship-Cross Filter Direction-Saving Work file | 1 |
| 3 | **Data Analysis Expression (DAX)** | |
| 3.1 | Introduction to DAX-Importance of DAX- Data Types in DAX-DAX Calculation Types | 1 |
| 3.2 | Steps to Create Calculated Columns-Measures in DAX- DAX Syntax, Functions and Operators-DAX Tables and Filtering | 1 |
| 4 | **Data Visualization** | |
| 4.1 | Introduction to Visuals In Power BI: Visualization Charts in Power BI-Matrixes and Tables | 1 |
| 4.2 | Slicers and Map Visualizations- Modifying Colors in Charts and Visuals: Shapes, Text Boxes, and Images | 1 |
| 4.3 | Custom Visuals-Page Layout and Formatting- Bookmarks and Selection Pane-KPI Visuals | 1 |
| 5 | **Power BI Service** | |
| 5.1 | Introduction to Power BI Service-Creating a Dashboard-Configuring a Dashboard- Power BI Embedded- Bookmarks and buttons | 1 |
| 5.2 | **Connectivity Modes-**Data Sources Supported in Power BI-Exploring Live Connections to Data Sources | 1 |
| 5.3 | Connecting Directly to SQL Azure- Connecting Directly to SQL Server Analysis Services/My SQL- Connecting Power BI in Excel | 1 |
| | **Total Lectures** | **14** |

**Course Designers:**

1. Dr. G.S.R.EmilSelvan - emil@tce.edu
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3. Mr. M. Midunprasath - midunprasath.10697163@ltimindtree.com

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS1E0** | **DESIGN PATTERN** | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course introduces the fundamental principles of software design patterns in software development by providing reusable solutions to common design problems, promoting modular and maintainable code, and facilitating collaboration and communication among team members. Students will learn various design patterns categorized into creational, structural, behavioral, and application pattern. This course provides a comprehensive understanding of software design patterns and their applications in building robust, flexible and maintainable software systems.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify and illustrate the common design problems in software development and justify the use of appropriate design patterns to address the requirements. | TPS3 | B | 75 |
| CO2 | Explore with the features of structural design pattern to promote the modular and reusable design for easier maintenance of software systems. | TPS3 | B | 75 |
| CO3 | Adapt the significance of behavioural design pattern to enable code reusability across different parts of the system. | TPS3 | B | 75 |
| CO4 | Apply Application design pattern in the chosen application to meet the code level requirements of Industry Standardization. | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | L | L | L | | L | M | | | M | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | | | M | M | L | L |
| CO3 | S | M | L | | M | L | | L | M | M | | M | M | L | L |
| CO4 | S | M | L | | L | L | | L | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Level | Terminal Examination |
|---|---|
| Remember | 10 |
| Understand | 30 |
| Apply | 60 |
| Analyse | - |
| Evaluate | - |
| Create | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction**: Design Pattern-History of Patterns-Advantage and Metrics - Classification of Patterns

**Catalog**: Creation Patterns-Structural Patterns-Behavioural Patterns

**Creation Pattern**- Factory Method-Abstract Factory-Builder-Prototype-Singleton

**Structural Pattern**-Adapter-Bridge-Composite-Decorator-Façade-Flyweight-Proxy

**Behavioural Pattern**- Chain if Responsibility-Command-Iterator-Mediator-Memento-Observer-State-Strategy-Template-Methods-Visitor

**Application Pattern**: MVC, MVP, MVI, MVVM and VIPER –Micro service Design Pattern

## Text Book

1. Head First Design Patterns: A Brain-Friendly Guide" by Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra (2021).
2. "Hands-On Design Patterns with Kotlin" by Alexey Soshin (2019)
3. Learning JavaScript Design Patterns: A JavaScript and Node.js Developer's Guide" by Eduardo Diaz (2020).
4. "JavaScript Design Patterns: 10 Coding Patterns You Should Learn to Master Efficient JavaScript Programs" by Christopher Hayes (2021).

## Reference Books & web resources

1. "Learning JavaScript Design Patterns: A JavaScript and Node.js Developer's Guide" by Eduardo Diaz (2020).
2. Microservices Patterns: With examples in Java 1st Edition, Kindle Edition by Chris Richardson (2018)
3. https://microservices.io/patterns/

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | **Introduction** | |
| 1.2 | Design Pattern | 1 |
| 1.3 | History of Patterns | |
| 1.4 | Advantage and Metrics | 1 |
| 1.5 | Classification of Patterns | 1 |
| **2** | **Creation Pattern** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.1 | Factory Method | 1 |
| 2.2 | Abstract Factory-Builder | 1 |
| 2.3 | Prototype-Singleton | 1 |
| 3 | **Structural Pattern** | |
| 3.1 | Bridge-Composite | 1 |
| 3.2 | Adapter- -Decorator-Façade | 1 |
| 3.3 | Flyweight-Proxy | |
| **4** | **Behavioural Pattern** | |
| 4.1 | Chain if Responsibility | 1 |
| 4.2 | Command-Iterator-Mediator | 1 |
| 4.3 | Memento-Observer-State | |
| 4.4 | Strategy-Template | 1 |
| 4.5 | Methods-Visitor | |
| **5** | **Application Pattern** | |
| 5.1 | MVC, MVP | 1 |
| 5.2 | MVI, MVVM | |
| 5.3 | VIPER | 1 |
| 5.4 | Micro service Design Pattern | 1 |
| | **Total** | **14** |

**Course Designers:**


1. Mr.C.Manimaran — c.manimrn12@gmail.com
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| 22CS1F0 | VIRTUALIZATION ESSENTIALS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course empowers the students with the knowledge and skills necessary to build the potential of virtualization concepts and resource provision management with VM Management in open source virtualization environment, KVM. It also provides students with an understanding of cloud computing concepts, technologies and practices with an open source cloud platform.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify and illustrate the virtualization principles and its type that can be used for the given application. | TPS3 | B | 75 |
| CO2 | Explore the features of virtualization management in Enterprise Virtualized Environments. | TPS3 | B | 75 |
| CO3 | Utilize the open source virtualization tools to simulate the virtual environment for the given application. | TPS3 | B | 75 |
| CO4 | Use open source cloud platform to deploy and manage applications. | TPS3 | B | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | L | M | L | | M | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | L | | M | M | L | L |
| CO3 | S | M | L | L | M | L | | L | M | M | | M | M | L | L |
| CO4 | S | M | L | L | M | L | | L | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Level | Continuous Assessment Test | Assignment | Terminal Examination |
|---|---|---|---|
| Remember | - | - | 10 |
| Understand | 20 | 20 | 30 |
| Apply | 80 | 80 | 60 |
| Analyse | - | - | - |

| | | | |
|---|---|---|---|
| Evaluate | - | - | - |
| Create | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

**Syllabus**

**Introduction to Virtualization** - Overview of virtualization, hypervisors, types of hypervisors, types of virtualization, virtualization in cloud, Virtualization Advantages and disadvantages, VM Basics - VM, Resource Provisioning, Virtual CPU, Virtual Memory, Virtual networking and virtual graphics processing.

**Virtual Machine Management**: Working with Virtual Machines-Creating templates and Clones, Modifying Virtual Machines, Migrating Virtual Machines, Creating Virtual Machine Snapshots.

**Enterprise Solutions:** VMWare ESXi, Microsoft Hyper-V, Virtual Box and VMWare Workstation-Image building - Image conversion - Image resizing.

**Open source virtualization KVM** - Introduction, Installation, Configuring, creating guest VMs, managing and monitoring guest VMs.

**Cloud Computing**: Virtualization Vs Cloud Computing - Cloud - Service and Deployment models -. Open Source Cloud platform: Introduction to OpenStack Cloud Component-Installation-Identity Service-Image Service-Networking Service-Compute Service.

**Text Book**

1. M. Portnoy, "Virtualization Essentials", United Kingdom: John Wiley and Sons, 2023.
2. G. Blokdyk, "Virtualization Management: A Complete Guide"StarBooks Publisher, 2020.
3. Kusnetzky, Dan. Virtualization: A Manager's Guide. United States, O'Reilly Media, Incorporated, 2011.

**Reference Books & web resources**

1. P. von Oven, Mastering VMware Horizon 8: An Advanced Guide to Delivering Virtual Desktops and Virtual Apps, 1st ed., Apress, 2021.
2. K. Jackson, C. Bunch, E. Sigler, and J. Denton, OpenStack Cloud Computing Cookbook, 4th ed., Packt Publishing, 2018.
3. G. Blokdyk, Virtualization Management: A Complete Guide. 5StarBooks Publisher, 2020.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Overview of virtualization | 1 |
| 1.2 | Hypervisors | |
| 1.3 | Types of hypervisors | |
| 1.4 | Types of virtualization | 1 |
| 1.5 | Virtualization in cloud | 1 |
| 1.6 | Virtualization Advantages and disadvantages | |
| 1.7 | VM Basics - VM, Resource Provisioning, Virtual CPU,. | 1 |
| 1.8 | Virtual Memory, Virtual networking and virtual graphics processing | 1 |
| **2** | **Virtual Machine Management** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.1 | Working with Virtual Machines | 1 |
| 2.2 | Creating templates and Clones | |
| 2.3 | Modifying Virtual Machines | |
| 2.4 | Migrating Virtual Machines | 1 |
| 2.5 | Migrating Virtual Machines | |
| 2.6 | Creating Virtual Machine Snapshots | 1 |
| **3** | **Enterprise Solutions** | |
| 3.1 | VMWare ESXi | 1 |
| 3.2 | Microsoft Hyper-V | |
| 3.3 | Virtual Box and VMWare Workstation | 1 |
| 3.4 | Image building - Image conversion - Image resizing | |
| 4 | **Open source virtualization KVM** | |
| 4.1 | Installation and Configuring host | 1 |
| 4.2 | Creating guest VMs | |
| 4.3 | Managing and monitoring guest VM | |
| **5** | **Cloud Computing** | |
| 5.1 | Virtualization Vs Cloud Computing | 1 |
| 5.2 | Cloud - Service models | |
| 5.3 | Deployment models | |
| 5.4 | Open Source Cloud platform: Introduction to OpenStack Cloud Component | 2 |
| 5.5 | Installation-Identity Service-Image Service | |
| 5.6 | Networking Service-Compute Service | |
| | Total | 14 |

**Course Designers:**


1. Mr.E.Mahendran, Joint Director — mahendran.e@gmail.com CDAC, Chennai
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| 22CS1G0 | SOFTWARE DEFINED NETWORKS ESSENTIALS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PEES | 1 | 0 | 0 | 1 |

## Preamble

This course helps students understand the significance of SDN, which enables scalable, flexible, and secure network infrastructures. By leveraging these technologies, students will be able to build and manage cloud networks with efficient resource utilization, robust security, and dynamic scalability, aligning with modern demands in cloud computing and network management.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Identify the significance of Software Define Network.(CO1) | TPS3 | 70 | 80 |
| CO2 | Adapt the concepts of service provider network virtualization to optimize the backbone networks to accommodate growing user demands and new services. | TPS3 | 70 | 80 |
| CO3 | Demonstrate the SDN stems from its centralized architecture, which enhances QoS, availability, and consistency while simplifying configuration management. | TPS3 | 70 | 80 |
| CO4 | Adapt the features of Open Daylight, ONOS, and Mininet SDN Controllers to provide a comprehensive ecosystem for developing, testing, and deploying SDN solutions across varied network environments | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | | | | L | L | | L | M | | |
| CO2 | S | M | L | | M | L | | | M | M | | M | M | L | L |
| CO3 | S | M | L | | M | L | | | M | M | | M | M | L | L |
| CO4 | S | M | L | | M | L | | | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Levels | Continuous Assessment Tests | Assignment | Terminal Examination |
|---|---|---|---|
| Remember | - | - | - |
| Understand | 20 | 20 | 20 |
| Apply | 80 | 80 | 80 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** History and evolution of SDN-Architecture of SDN-Components
**Scalability**: Data Centres-Service provider networks-ISP Automation
**Reliability**: QoS-Service Availability-Consistency-Configuration Management-Access Control Violations-Network Operating System (NOS).
**SDN Architecture** - Planes – data and control management - Interfaces – northbound and south bound-SDN Controllers: OpenDaylight - ONOS – Mininet- Open vSwitch.
**Network Virtualization**-Network Function Virtualization and Network Slicing.

## Text Book

1. Kshira Sagar Sahoo,Bibhudatta Sahoo and Brojo Kishore Mishra,"Software-Defined Networking for Future Internet Technology Concepts and Applications" CRC Press ,2021.
2. R. Sadique, S. Rajeev," SDN and NFV Security", Springer, ISBN: 9783031205456,2023.

## Reference Books & web resources

1. Larry Peterson, Carmelo Cascone, Bruce Davie," Software-Defined Networks: A Systems Approach", Systems Approach LLC, 2021
2. Anand Nayyar, Bhawna Singla, Preeti Nagrath," Software Defined Networks: Architecture and Applications", John Wiley & Sons, 2022
3. Mangesh M. Ghonge, Sabyasachi Pramanik, Amol D. Potgantwar," Software Defined Networking for Ad Hoc Networks", Springer Nature, 2022.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | History and evolution of SDN | 1 |
| 1.2 | Architecture of SDN | 1 |
| 1.3 | Components | 1 |
| **2** | **Scalability** | |
| 2.1 | Data Centres | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.2 | Service provider networks | 2 |
| 2.3 | ISP Automation | 1 |
| **3** | **Reliability** | |
| 3.1 | QoS | 1 |
| 3.2 | Service Availability | |
| 3.3 | Consistency | 1 |
| 3.4 | Configuration Management | |
| 3.5 | Access Control Violations | 1 |
| 3.6 | Network Operating System | 1 |
| **4** | **SDN Architecture** | |
| 4.1 | Planes – data and control management | 1 |
| 4.2 | - Interfaces – northbound and south bound | |
| 4.3 | SDN Controllers: OpenDaylight | 1 |
| 4.4 | ONOS – Mininet- Open vSwitch. | |
| 5 | **Network Virtualization** | |
| 5.1 | Network Function Virtualization | 1 |
| 5.2 | Network Slicing | |
| | Total | 14 |

**Course Designer(s):**

| | |
|---|---|
| Mahendran E<br>Industry<br>Area of expertise | mahendran.e@gmail.com<br>CDAC, Chennai<br>Grid and Cloud computing (15 years of experience) |
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| Dr.K.Indra | kiit@tce.edu |

| 22CS1H0 | PROMPT ENGINEERING FOR AI APPLICATIONS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 1 | 0 | 0 | 1 |

Terminal: Practical Exam

## Preamble

Prompt engineering involves the design and refinement of inputs (prompts) for AI language models such as GPT to generate the intended outputs. It's an essential competency in the creation of AI-driven systems, particularly in Natural Language Processing (NLP), and is increasingly significant across diverse domains such as software development, data analysis, and automation. This course aims to equip students with foundational skills in prompt engineering, enabling them to effectively interact with AI models for solving real-world and technical problems.

## Prerequisite

Foundations of Artificial Intelligence

## Course Outcomes

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

| CO# | Course Outcome 1 (CO1) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Understand foundational principles of prompt engineering and differentiate between black-box and white-box LLMs.. | TPS2 | B | 75 |
| CO2 | Structure effective prompts for diverse tasks, adapting approaches for different LLM architectures. | TPS3 | B | 70 |
| CO3 | Adapt white-box models like LLaMA for specific engineering and technical applications. | TPS3 | B | 70 |
| CO4 | Evaluate ethical implications related to LLM transparency and prompt engineering. | TPS4 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC | M | L | | | | | | | | L | | L | L | | L |
| CO2 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO3 | S | M | L | | L | L | | L | M | M | | M | M | L | M |
| CO4 | S | S | M | L | M | M | L | L | M | M | | M | S | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Cognitive Level | Internal Exam | External /Terminal Exam |
|---|---|---|
| | Mini Project | Practical Exam |
| Remember | - | - |
| Understand | 30 | 30 |
| Apply | 40 | 40 |
| Analyse | 30 | 30 |
| Evaluate | - | - |
| Create | - | - |

## Syllabus

**Introduction to AI Language Models and Prompt Engineering:** Overview of black-box LLMs like ChatGPT, GPT-4, and basic white-box models like LLaMA, LLaMA-2, **Prompt Engineering Basics:** Importance of prompt engineering in AI interactions, key applications across various domains, **Types of Prompts:** zero-shot, few-shot, and multi-turn prompting.

**Prompting Techniques and White Box Models: Core Prompting Techniques:** Structuring questions, setting context, and specifying response format. **Advanced Prompt Structuring:** Adjusting tone, style, and length to refine responses. **Prompt Engineering in White-Box Models**: LLaMA and similar models, Architecture and customization for specific tasks.

**Transition from Black-Box to White-Box LLMs:** Overview of transparent models like LLaMA, their architecture, and practical applications in engineering. **Optimization and Adaptation Techniques for White-Box Models:** fine-tuning, parameter adjustments, and customizations that enhance model performance. **Applications in Engineering Tasks:** Case studies focused on technical writing, problem-solving, and data analysis using white-box LLMs.

**Ethical Considerations and Future Trends in AI and LLMs:** Addressing bias, ambiguity, and sensitivity in prompt engineering, especially when transitioning between black-box and white-box LLMs, Ethical challenges and emerging trends in white-box LLMs and AI.

### Mini Project:

- **Prompt Engineering Project Using White-Box and Black-Box LLMs**: Students will develop a structured prompt for an engineering or business task using both types of LLMs to compare and contrast performance and ethical implications.
- **Evaluation Focus**: The assignment will include prompt design, analysis of response differences, and ethical evaluation based on model transparency.

## Learning Resources


1. James Phoenix, Mike Taylor, "Prompt Engineering for Generative AI: Future-Proof Inputs for Reliable AI Outputs", O'Reilly Media; 1st edition, 2024
2. Da Sachin Sharma, "Prompt DOT AI (Artificial Intelligence): Art of writing Generative AI Prompts", Notion Press, 1st edition, 2023.
3. https://developers.google.com/machine-learning/resources/prompt-eng
4. https://www.promptingguide.ai/


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to AI Language Models and Prompt Engineering (3)** | |
| 1.1 | Overview of black-box LLMs like ChatGPT, GPT-4, and basic white-box models like LLaMA, LLaMA-2 | 1 |
| 1.2 | **Prompt Engineering Basics:** Importance of prompt engineering in AI interactions, key applications across various domains, | 1 |
| 1.3 | **Types of Prompts:** zero-shot, few-shot, and multi-turn prompting. | 1 |
| **2** | **Prompting Techniques and White Box Models(3)** | |
| 2.1 | **Core Prompting Techniques:** Structuring questions, setting context, and specifying response format. | 1 |
| 2.2 | **Advanced Prompt Structuring:** Adjusting tone, style, and length to refine responses. | 1 |
| 2.3 | **Prompt Engineering in White-Box Models**: LLaMA and similar models, Architecture and customization for specific tasks | 1 |
| **3** | **Transition from Black-Box to White-Box LLMs (3)** | |
| 3.1 | Overview of transparent models like LLaMA, their architecture, and practical applications in engineering | 1 |
| 3.2 | **Optimization and Adaptation Techniques for White-Box Models**: fine-tuning, parameter adjustments, and customizations that enhance model performance | 1 |
| 3.3 | **Applications in Engineering Tasks:** Case studies focused on technical writing, problem-solving, and data analysis using white-box LLMs. | 1 |
| **4** | **Ethical Considerations and Future Trends in AI and LLMs (5)** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.1 | Addressing bias, ambiguity, and sensitivity in prompt engineering - Transitioning between black-box and white-box LLMs | 1 |
| 4.2 | Ethical challenges and emerging trends in white-box LLMs and AI. | 1 |
| 4.3 | **Practical Lab** - structured prompt for an engineering or business task using both types of LLMs | 2 |
| 4.4 | Iterative Prompt Refinement- Iterating Prompts for Accuracy and Relevance | 1 |
| | **Total** | **14** |

## Course Designer(s):


1. Mr. S. Maheswaran Senior Manager R&D, Aptean India Pvt Ltd Maheswaran.Samuthiram@aptean.com
2. Dr B.Subbulakshmi, Assistant Professor, Dept. of Computer Science and Engineering — bscse@tce.edu
3. Dr. M. Nirmala Devi, Assistant Professor (Selection Grade), Dept. of Computer Science and Engineering — mnit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CS1J0** | **LOWCODE - NOCODE FOR APPLICATION MODERNIZATION** | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course examines the growing adoption of Low-Code/No-Code (LCNC) platforms and agile approaches by IT and Business teams. Participants will learn how to leverage the power of Generative AI to significantly accelerate their digital transformation journey.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the principles of Low-Code/No-Code (LCNC), including democratization and citizen programming, to evaluate its benefits for application development. | TPS3 | 70 | 70 |
| CO2 | Illustrate how industry reports evaluate the offerings, value proposition, challenges, and future trends of Low-Code/No-Code (LCNC) technology. | TPS3 | 70 | 70 |
| CO3 | Develop cloud-native, AI/ML and Computer Vision apps using LCNC platforms and GenAI | TPS3 | 70 | 70 |
| CO4 | Use LCNC platforms to build and modernize applications. | TPS3 | 70 | 70 |

## Mapping with Programme Outcomes

| **Cos** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | L | L | | L | M | L | | M | M | L | L |
| CO2 | S | M | L | | L | L | | L | M | L | | M | M | L | L |
| CO3 | S | M | L | L | M | L | | L | M | M | | M | M | L | L |
| CO4 | S | M | L | L | M | L | | L | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Internal | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO2 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO3 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO4 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** LCNC definition -Principles of LCNC -Democratization and Citizen Programming-Benefits-Reduced development time, Enhanced collaboration and other**.**

**Industry Reports Review:** Understand the offerings, Value, Challenges, Limitations and future trends.

**Building Applications with LCNC Tools:** Overview -Cloud Native Applications-Model driven AI/ML-Computer Vision applications using visual programming approach and generative AI capabilities like Co-Pilots.

**Platforms:** Mendix-Rapid Miner-H2O -Open Source -AutoMl-DataRobot-RobFLow-GitHub Copilot.

**UseCases:** Modernization of applications (LCNC AI/ML)

**Hands-on Lab Sessions –** LCNC platforms

## Reference Books & web resources


1. Björkholm, Mika; Petranen, Aleksi (January 2025). "Technology Report: Automated Code Generation & AI Tools on Low-Code/No-Code". *ResearchGate.*
2. https://www.g2.com/categories/no-code-development-platforms#learn-more
3. No-Code Low-Code Citizen Development eBooks Citizen Development - T https://quixy.com/blog/top-no-code-low-code-citizen-development-ebooks/op Essential Game Changing No-Code Low-Code Citizen Development eBooks in 2025 | Quixy


## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | LCNC definition | 1 |

| **Module No.** | **Topic** | **No. of Periods** |
|---|---|---|
| 1.2 | Principles of LCNC | |
| 1.3 | Democratization and Citizen Programming | |
| 1.4 | Benefits | 1 |
| **2** | **Industry Reports Review** | |
| 2.1 | Understand the offerings | 1 |
| 2.2 | Value, Challenges, Limitations and future trends. | 1 |
| **3** | **Building Applications with LCNC Tools** | |
| 3.1 | Overview | 1 |
| 3.2 | Cloud Native Applications | |
| 3.3 | Model driven AI/ML | 1 |
| 3.4 | Computer Vision applications using visual programming approach and generative AI capabilities like Co-Pilots | |
| 4 | **Platforms** | |
| 4.1 | Mendix | 1 |
| 4.2 | Rapid Miner | |
| 4.3 | H2O | 1 |
| 4.4 | Open Source | |
| 4.5 | AutoMl | 4 |
| 4.6 | DataRobot | |
| 4.7 | RobFLow | |
| 4.8 | GitHub , Copilot. | |
| **5** | **UseCases** | |
| 5.1 | Modernization of applications (LCNC AI/ML) | |
| 5.2 | **Hands-on Lab Sessions** – LCNC platforms | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | | |
| | Total | 14 |

**Course Designers:**

1. Dr.Sambath Narayanan Parthasarathy
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   Dataever Consulting,Bangalore.
2. Dr.C.Santhiya
   Assistant Professor
   csit@tce.edu

| | | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|---|
| **22CS1K0** | **ENTERPRISE APPLICATION DEVELOPMENT** | | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course objective is to strengthen the individual's knowledge and practical skills in full stack web development, encompassing of creating dynamic, responsive, and secure web applications. This course provides the hands-on training on how to use React components to create interactive interfaces, connecting with ORM Data model, Creating and Consuming APIs and finally host the application in the CI/CD pipeline.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Illustrate the basic principles of Front-End, Back-End and their working framework for an application. | TPS3 | 70 | 80 |
| CO2 | Experiment with the features of React Components and State management for an interactive application. | TPS3 | 70 | 80 |
| CO3 | Apply the basic CRUD operation and consuming the API with secured authentication mechanism for an application. | TPS3 | 70 | 80 |
| CO4 | Build an application and consuming RESTful APIs service and integrate with user authentication methods. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| **COs** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO2. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO3. | S | M | L | | L | L | | M | M | M | | M | M | L | M |
| CO4. | S | M | L | L | L | L | | M | M | M | | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | INTERNAL | | | | | | TERMINAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **TPS SCALE** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | 5 | 5 | - | - | - | - | 5 | 5 | - | - | - | - |
| **CO2** | 5 | 5 | 25 | - | - | - | 5 | 5 | 25 | - | - | - |
| **CO3** | 5 | 5 | 20 | - | - | - | 5 | 5 | 20 | - | - | - |
| **CO4** | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction:** Front-end and back-end Technologies-Development tools and Environment-Version Control

**React**: Typescript: components and Props-Tree Shaking –Bundling-State management-interactive web applications

**Data Connectivity:** Django and Python-Setup-Views-Routing-URL.

**API Connectivity**: RESTful Endpoints-Serializing Data-CRUD-Authentication and Authorization.

**Integration:** Consuming RESTful APIs with React-User authentication and JWT in React-Django apps.

**Data and Deployment Management**: ORM- Data Modeling- Migrating database models Continuous integration and Continuous deployment.

## Text Book

1. Mangabo, Kolawole. Full Stack Django and React: Get Hands-on Experience in Full-stack Web Development with Python, React, and AWS. United Kingdom, Packt Publishing, 2023.
2. Bhowmick, Snehadeep. The Full Stack Development Book. India, WHITE FALCON PUB, 2019.
3. Andrawos, Mina. Hands-On Full Stack Development with Go: Build Full Stack Web Applications with Go, React, Gin, and GopherJS. United Kingdom, Packt Publishing, 2019.

## Reference Books & web resources

1. Hinkula, Juha. Full Stack Development with Spring Boot and React: Build Modern and Scalable Full Stack Applications Using the Power of Spring Boot and React, 3rd Edition. United Kingdom, Packt Publishing, 2022.
2. Zammetti, Frank. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker. United States, Apress, 2020.
3. https://www.coursera.org/learn/the-full-stack#modules

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction** | |
| 1.1 | Front-end and back-end Technologies- | 1 |
| 1.2 | Development tools and environment | |
| 1.3 | Version Control | |
| **2** | **React**: | |
| 2.1 | Typescript: components and Props-Tree Shaking – Bundling | 1 |
| 2.2 | State management | |
| 2.3 | Interactive web applications | 1 |
| **3** | **Data Connectivity** | |
| 3.1 | Django and Python | 1 |
| 3.2 | Setup-Views | |
| 3.3 | Routing-URL. | 1 |
| **4** | **API Connectivity** | |
| 3.1 | RESTful Endpoints | 2 |
| 3.2 | Serializing Data | 1 |
| 3.3 | CRUD-Authentication and Authorization. | |
| 3.4 | **Integration** | |
| 3.5 | Consuming RESTful APIs with React | 1 |
| 3.6 | User authentication and JWT in React | |
| 3.7 | Django apps. | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | | |
| **4** | **Data and Deployment Management**: | |
| 4.1 | ORM | 2 |
| 4.2 | Data Modeling | |
| 4.3 | Migrating database models | 2 |
| 4.4 | Continuous integration and Continuous deployment. | |
| | **Total** | **14** |

**Course Designer(s):**


1. Mr.Vijay Shankar,Software Developer,Ericson,Bangalore.
2. Dr.RajaLavanya, Assistant Professor, Computer Science and Engineering, rlit@tce.edu
3. Ms.G.Bhavani, Assistant Professor, Computer Science and Engineering, gbicse@tce.edu

| 22CS1L0 | CLOUD COMPUTING WITH AWS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | PEES | 1 | 0 | 0 | 1 |

## Preamble

This course aims to provide basic understanding of deploying cloud applications using Amazon Web Service.

## Prerequisite

- Computer Networking fundamentals

## Course Outcomes

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

| CO | Course Outcome Statement | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Comprehend the basic terminologies in cloud computing and AWS | TPS2 | 70 | 80 |
| CO2 | Create and deploy server less functions. | TPS3 | 70 | 75 |
| CO3 | Examine the working of AWS storage and network services. | TPS3 | 70 | 75 |
| CO4 | Comprehend the basic terminologies in cloud computing and AWS | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | | M | L | L | M | M | | L |
| CO2 | S | M | L | | L | L | | | M | L | L | M | M | L | L |
| CO3 | S | M | L | | M | L | | | M | M | L | M | M | L | L |
| CO4 | S | M | L | | M | L | | | M | M | L | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | INTERNAL | | | | | | TERMINAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS SCALE | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 5 | 10 | - | - | - | - | 5 | 10 | - | - | - | - |
| CO2 | 5 | 10 | 10 | - | - | - | 5 | 10 | 10 | - | - | - |
| CO3 | 5 | 10 | 15 | - | - | - | 5 | 10 | 15 | - | - | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 5 | 10 | 15 | - | - | - | 5 | 10 | 15 | - | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to AWS & Cloud Computing -**Overview of cloud computing. Benefits of using cloud- Introduction to AWS.

**AWS compute services** - EC2: creating, configuring, and launching Instances-Elastic Beanstalk: deploying and managing web Applications-Lambda: creating and deploying server less functions-Auto Scaling: automatic scaling of EC2 instances

**AWS storage services** -S3: creating and managing buckets, objects, and lifecycles-EBS: creating and attaching volumes to Instances-Glacier: creating and managing archives

**AWS networking services** - VPC: creating and configuring virtual private clouds-Route 53: creating and managing DNS records-CloudFront: creating and managing content delivery networks

**AWS security & Identity services** -IAM: creating and managing users, groups, and policies-Security Groups: managing inbound and outbound traffic rules-CloudTrail: logging AWS account activity- KMS: managing encryption keys

## Reference Books & web resources

1. Mark Wilkins,“Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud” First Edition, Pearson, 2019.
2. https://www.coursera.org/specializations/aws-fundamentals
3. https://www.coursera.org/professional-certificates/aws-cloud-solutions-architect

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Hours |
|---|---|---|
| 1 | **Introduction to AWS & Cloud Computing** | |
| 1.1 | Overview of cloud computing, Benefits of using cloud. | 1 |
| 1.2 | Introduction to AWS. | 1 |
| 2 | **AWS compute services** | |
| 2.1 | EC2: creating, configuring, and launching Instances. | 1 |
| 2.2 | Elastic Beanstalk: deploying and managing web Applications | 1 |
| 2.3 | Lambda: creating and deploying server less functions | 1 |
| 2.4 | Auto Scaling: automatic scaling of EC2 instances | 1 |
| 3 | **AWS storage services** | |
| 3.1 | S3: creating and managing buckets, objectsand lifecycles | 1 |
| 3.2 | EBS: creating and attaching volumes to Instances | 1 |
| 3.3 | Glacier: creating and managing archives | 1 |
| 4 | **AWS networking services** | |
| 4.1 | VPC: creating and configuring virtual private clouds, Route 53: creating and managing DNS records. | 1 |
| 4.2 | CloudFront: creating and managing content delivery networks. | 1 |
| 5 | **AWS security & Identity services** | |
| 5.1 | IAM: creating and managing users, groups, and policies. | 1 |
| 5.2 | Security Groups: managing inbound and outbound traffic rules. | 1 |
| 5.3 | CloudTrail: loggingAWS account activity, KMS: managing encryption keys. | 1 |

| | | | |
|---|---|---|---|
| | | TOTAL | 14 |

**Course Designers**


| | | |
|---|---|---|
| 1. | Mr. T. Sasi Kumar,<br>Lead Consultant,<br>ThoughtWorks | tmsasikumar@gmail.com |
| 2. | Dr. C. Senthil Kumar | cskcse@tce.edu |
| 3. | Dr. M. Vijayalakshmi | mviji@tce.edu |


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| | |
|---|---|
| **22CS1M0** | **RETRIEVAL-AUGMENTED GENERATION** |

| Category | L | T | P | Credit |
|---|---|---|---|---|
| PEES | 1 | 0 | 0 | 1 |

## Preamble

This course covers Retrieval-Augmented Generation (RAG), enhancing AI with real-world info. It explores how RAG works through retrievers and generators, using tools like LangChain, FAISS, and ChromaDB. Students will learn about LLMs, vector databases, and real-world applications in chatbots, education, and support. The course also touches on ethical issues and future trends in AI.

## Prerequisite

- Basic understanding of large language models

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the core concepts of Retrieval-Augmented Generation (RAG) by integrating retrieval mechanisms with language models to improve response accuracy. | TPS3 | 70 | 75 |
| CO2 | Apply vector-based search techniques and embedding models to retrieve relevant documents from large corpora using tools like FAISS and ChromaDB. | TPS3 | 70 | 75 |
| CO3 | Determine the ability to build and implement RAG pipelines using retrievers and generators for real-world applications such as chatbots and educational assistants. | TPS3 | 70 | 75 |
| CO4 | Apply best practices in grounding language models with external data while addressing ethical concerns related to data privacy, hallucination, and fairness. | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| COs | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS 01 | PS 02 | PS 03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | M | M | | M | M | | | M | M | L | L |
| CO2 | S | M | L | | L | M | | M | M | | | M | M | L | L |
| CO3 | S | M | L | | M | M | | M | M | M | | M | M | L | L |
| CO4 | S | M | L | | L | M | | M | M | M | | M | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | Internal | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO2 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO3 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |
| CO4 | 5 | 5 | 15 | - | - | - | 5 | 5 | 15 | - | - | - |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to RAG -** Retrieval-Augmented Generation- RAG importantance in modern AI - Real-world examples (ChatGPT w/ browsing, Perplexity.ai)-Case study: Use RAG to fetch and explain current medical literature to doctors.

**Basics of Language Models -** Large Language Models (LLMs) - Limitations of LLMs (hallucination, outdated data) - Difference between Retrieval-based and Generation-based systems-Case study:Use RAG to pull recent papers or citations into research writing assistants.

**Information Retrieval Concepts -** Introduction to document search and retrieval - Vector Database- How embeddings help in finding relevant info-Case study: Match user queries with product catalogues using dense vector search.

**Components of a RAG System -** Retriever: Fetching relevant documents - Generator: Creating answers based on documents - Overview of the RAG architecture.

**Applications of RAG -** Use cases: Chatbots, Customer Support, Education - Industry examples using RAG - Benefits of grounding LLMs in real data.

**Tools & Ecosystem (Brief Overview) -** Popular tools: La.ngChain, Haystack, FAISS, ChromaDB - Language model providers: OpenAI, HuggingFace, Meta AI (RAG model).

**Future Trends & Ethical Considerations** - Future of grounded generation - Ethical concerns: accuracy, privacy, and data handling.

## Text Book

1. Christopher D. Manning, PrabhakarRaghavan, and HinrichSchütze, “Introduction to Information Retrieval,” Cambridge University Press, 2008.

## Reference Books& web resources

1. https://mallahyari.github.io/rag-ebook/intro.html
2. https://huggingface.co/learn/cookbook/en/advanced_rag
3. https://arxiv.org/pdf/2501.09223v1

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to RAG** | |
| 1.1 | Retrieval Augmented Generation- RAG importance in modern AI | 1 |
| 1.2 | Real-world examples. Case study: Use RAG to fetch and explain current medical literature to doctors. | 1 |
| **2** | **Basics of Language Models** | |
| 2.1 | Large Language Models (LLMs) - Limitations of LLMs (hallucination, outdated data) - | 1 |
| 2.2 | Difference between Retrieval-based and Generation-based systems- Case study: Use RAG to pull recent papers or citations into research writing assistants. | 1 |
| **3** | **Information Retrieval Concepts** | |
| 3.1 | Introduction to document search and retrieval - Vector Database | 1 |
| 3.2 | How embeddings help in finding relevant info- Case study: Match user queries with product catalogues using dense vector search. | 1 |
| **4** | **Components of a RAG System** | |
| 4.1 | Retriever: Fetching relevant documents | 1 |
| 4.2 | Generator: Creating answers based on documents - Overview of the RAG architecture. | 1 |
| **5** | **Applications of RAG** | |
| 5.1 | Use cases: Chatbots, Customer Support, Education | 1 |
| 5.2 | Industry examples using RAG - Benefits of grounding LLMs in real data. | 1 |
| 6 | **Tools & Ecosystem (Brief Overview)** | |
| 6.1 | Popular tools: LangChain, Haystack, FAISS | 1 |
| 6.2 | ChromaDB - Language model providers: OpenAI, HuggingFace, Meta AI (RAG model) | 1 |
| **7** | **Future Trends & Ethical Considerations** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 7.1 | Future of grounded generation | 1 |
| 7.2 | Ethical concerns: accuracy, privacy, and data handling. | 1 |
| | **Total** | 14 |

**Course Designer(s):**


1. Ashokkumar Pudhuraja ZOHO
2. Dr.K.Sundarakantham, Professor, CSE kskcse@tce.edu
3. Mrs.S.Saradha,AP,CSE ssacse@tce.edu

# CURRICULUM AND SYLLABI

# FOR

# INTERDISCIPLINARY ELECTIVES

**FOR THE STUDENTS ADMITTED IN THE**

**ACADEMIC YEAR 2023 - 2024**

**THIAGARAJAR COLLEGE OF ENGINEERING**
(A Government Aided Autonomous Institution affiliated to Anna University)
**MADURAI – 625 015, TAMILNADU**

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Web: www.tce.edu

| 22CSGA0 | APPLICATIONS OF VIRTUAL REALITY |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| IE | 3 | 0 | 0 | 3 |

## Preamble

Students will gain a foundational knowledge of virtual reality environment, the ways to interact, and their various areas of applications. Students will gain a foundational knowledge of building VR projects

## Prerequisite

Nil.

## Course Outcomes

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

| CO Number | Course Outcome Statement | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the components, benefits of Virtual Reality. | TPS2 | B | 75 |
| CO2 | Demonstrate the working of the input and output devices that are interfaced with virtual reality Environments | TPS2 | B | 75 |
| CO3 | Design and implement the suitable virtual reality modelling techniques for the given problem | TPS2 | B | 75 |
| CO4 | Identify the applications of VR in Business, Manufacturing, Architecture and Construction and Entertainment and other applications | TPS3 | B | 70 |
| CO5 | Develop an application in AR/VR using Unity game engine for a suitable problem given. | TPS3 | B | 70 |
| CO6 | Design and implement a team-project for developing AR/VR project using any Game engine. | TPS3 | B | 70 |

## Mapping with Programme Outcomes and Programme Specific Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | | | L | | L | M | | L |
| CO2 | M | L | | | L | | | L | L | L | | L | M | L | L |
| CO3 | M | L | | | L | | | L | L | L | | L | M | | L |
| CO4 | S | M | L | | M | L | L | L | L | L | | M | M | L | L |
| CO5 | S | M | L | | M | L | L | L | L | L | | M | M | L | L |
| CO6 | S | M | L | L | M | L | L | L | L | L | M | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern: Cognitive Domain

| CO | CAT | | | | | | | | | | Assignment | | | | | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | | | 2 | | | | | 1 | | | | | 2 | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 7 | 20 | | - | - | - | - | - | - | - | | 10 | - | - | - | - | - | - | - | - | 4 | 10 | | - | - | - |
| CO2 | 7 | 20 | | - | - | - | - | - | - | - | | 10 | - | - | - | - | - | - | - | - | 4 | 10 | | - | - | - |
| CO3 | 6 | 20 | 20 | - | - | 7 | 20 | 20 | - | - | - | 10 | - | - | - | - | - | - | - | - | 4 | 10 | | - | - | - |
| CO4 | - | - | - | - | - | 7 | 20 | 20 | - | - | - | - | 10 | - | - | | | - | - | - | 4 | 10 | 15 | - | - | - |
| CO5 | - | - | - | - | - | 6 | 20 | | - | - | - | - | 10 | - | - | | | 30 | - | - | 4 | 10 | 15 | - | - | - |
| CO6 | - | - | - | - | - | | | | - | - | - | - | 50 | - | - | | 20 | 70 | - | - | - | - | | | - | - |

## Syllabus

**VIRTUAL REALITY ENVIRONMENTS**: The development of VR: Computer Graphics, Real-time computer graphics, Virtual environments, Requirements for VR, benefits of Virtual reality. Augmented Reality **–** Computer Generated Worlds, Understanding Virtual Space. Defining Visual Space and Content. Defining Position and Orientation.

**3D USER INTERFACES**

Head-Mounted Displays, Augmenting Displays, Binocular Displays, Smartphone-Based displays, Sensors for Tracking Position, Orientation, and Motion, Trackers, 2D Versus 3D Interaction and Navigation, Hand and Gesture Tracking, Whole Body Tracking.

**AR/VR Programming** – Creation of VR environment, Digital twin and VR/AR, Unity 3D, setting up the Unity project, Unity Editor and its interface, Understanding Game Objects and Components, creating a basic scene in Unity and adding objects, setting up an AR project in Unity, Using AR Foundation, Deploying AR experiences onto mobile devices, Visual scripting in Unity.

**AR VR Applications-** Business and Manufacturing, Areas of application Product development and Marketing, Real Estate Sales Applications, Entertainment Applications and production. Education Applications, Automotive Engineering, Aerospace Engineering, Nuclear Engineering and Manufacturing. Public Safety and Military Applications flight simulation and training.

**AR VR Project Development-** Exploring a VR Model in a HMD and navigation. A game scene to demonstrate a player movement to demonstrate Rigibody, collider and C# scripts. Development of Mobile AR applications using AR Core template.

## Text books

1. Anna Braun, Raffael Rizzo, Birmingham, “XR Development with Unity A beginner’s guide to creating virtual, augmented, and mixed reality experiences using Unity”, 2023.
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, 2018.

## REFERENCES:

1. Steven M. LaValle, “Virtual Reality”, Cambridge University Press, 2023.
2. Steve Aukstakalnis, “Practical Augmented Reality”, Addision Wesley 2017.

3. Alan B. Craig, William R. Sherman, Jeffrey D. Will, “Developing Virtual Reality Applications”, 2017.
4. Matjaz Mihelj, Domen Novak, Samo Begus, "Virtual Reality Technology and Applications", 1st Edition, Springer Netherlands, 2014.
5. Grigore C. Burdea, Philip Coiffet, “Virtual Reality Technology”, 2nd Edition, Wiley India, 2017.
6. Gerard Jounghyun Kim, "Designing Virtual Reality Systems, the Structured Approach" , Springer London, 2005.

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Hours | Course Outcome |
|---|---|---|---|
| 1 | **VIRTUAL REALITY ENVIRONMENTS** | | CO1 |
| 1.1 | The development of VR: Computer Graphics, Real-time computer graphics, | 1 | CO1 |
| 1.2 | Virtual environments, Requirements for VR, benefits of Virtual reality. | 1 | CO1 |
| 1.3 | Augmented Reality – Computer Generated Worlds, Understanding Virtual Space. | 2 | CO1 |
| 1.4 | Defining Visual Space and Content. Defining Position and Orientation. | 2 | CO1 |
| | | | |
| 2 | **Interactive devices** | | CO2 |
| 2.1 | Head-Mounted Displays, Augmenting Displays, Binocular Displays. | 2 | CO2 |
| 2.2 | Smartphone-Based displays, Sensors for | 1 | CO2 |
| 2.3 | Tracking Position, Orientation, and Motion, Trackers, 2D Versus 3D Interaction and Navigation, | 1 | CO2 |
| 2.4 | Hand and Gesture Tracking, Whole Body Tracking. | 2 | CO2 |
| | | | |
| 3 | **VR Programming** | | CO3 |
| 3.1 | Creation of VR environment, Digital twin and VR/AR, | 1 | CO3, CO6 |
| 3.2 | Unity 3D, setting up the Unity project, Unity Editor and its interface, | 2 | CO3, CO6 |
| 3.3 | Understanding Game Objects and Components, | 2 | CO3, CO6 |
| 3.4 | Creating a basic scene in Unity and adding objects, Setting up an AR project in Unity, | 2 | CO3, CO6 |
| 3.5 | Using AR Foundation, Deploying AR experiences onto mobile devices, | 2 | CO3, CO6 |
| 3.6 | Visual scripting in Unity. | 1 | CO3, CO6 |
| . | | | |
| 4.1 | Business and Manufacturing, Areas of application Product development and Marketing, | 1 | CO 4 |
| 4.2 | Real Estate Sales Applications, Entertainment Applications and production. | 1 | CO4 |
| 4.3 | Education Applications, Automotive Engineering, Aerospace Engineering, Nuclear Engineering and Manufacturing. | 1 | CO4 |

| | | | |
|---|---|---|---|
| 4.4 | Public Safety and Military Applications flight simulation and training. | 1 | CO4, |
| | | | |
| 5.1 | Exploring a VR Model in a HMD and navigation. template. | 3 | CO5, CO6 |
| 5.2 | A game scene to demonstrate a player movement to demonstrate Rigibody, collider C# scripts and | 3 | CO5, CO6 |
| 5.3 | visual scripting. | 2 | |
| 5.4 | Development of Mobile AR applications using AR Core | 2 | CO5, CO6 |
| | **Total** | 36 | |

**Course Designers:**

1. Dr.N.Shivakumar shiva@tce.edu
2. Ms. G. Bhavani gbicse@tce.edu

| 22CSGB0 | CLOUD ESSENTIALS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| IE | 3 | 0 | 0 | 3 |

## Preamble

This course covers the history and background of cloud computing the essential technical knowledge needed to build applications in the cloud and how to utilize the cloud services for architecting a cloud application environment. Students will able to learn how to build, deploy and manage applications on cloud.

## Prerequisite

NIL

## Course Outcomes

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

| CO. No | Course Outcomes (COs) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Articulate the main concepts, key technologies, strengths, limitations of cloud computing and the possible applications for state-of-the-art cloud computing | TPS2 | B | 75 |
| CO2 | Identify the architecture and infrastructure of cloud computing, including cloud delivery and deployment models | TPS3 | B | 70 |
| CO3 | Examine the virtualization technology that enhance cloud computing | TPS3 | B | 70 |
| CO4 | Analyze the various cloud resource management techniques to identify the optimal solution for allocation and scheduling | TPS3 | B | 70 |
| CO5 | Identify threats and assess risks associated with cloud services | TPS3 | B | 70 |
| CO6 | Simulate and create cloud environments | TPS3 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | | | | | | | | L | | |
| CO2 | S | M | L | | | | | L | L | L | | L | M | | L |
| CO3 | S | M | L | | | | | L | L | L | | L | M | | L |
| CO4 | S | M | L | | | | | L | L | L | | L | M | | L |
| CO5. | S | M | L | | | | | L | L | L | | L | M | | L |
| CO6 | S | M | L | | L | L | | L | L | L | L | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT 1 (Theory Component) | | | | | | CAT2 (Theory Component) | | | | | | Terminal (Theory Component) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | | | | | | 100 | | | | | | 100 | | | | | |
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | | | | | | | | | | | 10 | | | | | |
| CO2 | 10 | 10 | 20 | | | | | | | | | | | 10 | | | | |
| CO3 | 10 | | 30 | | | | | | | | | | | 10 | 20 | | | |
| CO4 | | | | | | | 20 | 10 | | | | | 10 | 10 | | | | |
| CO5 | | | | | | | 10 | 10 | 15 | | | | | | 20 | | | |
| CO6 | | | | | | | 10 | 10 | 15 | | | | | | 10 | | | |

***Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

| CO | Assignment 1 | | | | | | Assignment 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| **CO1** | | | | | | | | | | | | |
| **CO2** | | | | | | | | | | | | |
| **CO3** | | | 30 | | | | | | | | | |
| **CO4** | | | 40 | | | | | | 30 | | | |
| **CO5** | | | 30 | | | | | | 30 | | | |
| **CO6** | | | | | | | | | 40 | | | |

## Syllabus

**Introduction** - Cloud components - Essential characteristics - Architectural and Technological Influences – Operational Influences.
**Cloud Infrastructure** – Perspective of Data Centers – NIST Cloud Computing Reference Architecture and Types - Services: Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS) - Challenges and risks in cloud adoption. Cloud deployment model: Public clouds, Private clouds, Community clouds, Hybrid clouds.
**Virtualization** – Introduction – Implementation Levels of Virtualization-Virtualization Structures/Tools and Mechanism - Virtualization of CPU, Memory, I/O Devices – Porting Applications and VM Migration – Container based virtualization - Microservice deployment in Docker
**Cloud Resource Management –** Resource Management types and strategies **-** Allocation Methods – Policies – Tools for Resource Management (IBM Cloud Orchestrator, AWS Cloud Formation)
**Cloud Security** - Infrastructure Security – Data Security and Storage – Identity and Access Management -Trust, Reputation, Risk – Authentication in Cloud
**Cloud Middleware -** Simulating a cloud environment using cloudsim - Create a cloud environment using openstack.

**Reference Books & web resources**

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, “Cloud Computing: Concepts, Technology & Architecture”, Prentice Hall Service Technology Series, 2013.
2. John Rittinghouse, James Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press 2010.
3. Greg Schulz, “Cloud and Virtual Data Storage Networking”, CRC Press, 2012.
4. Nelson Ruest, Danielle Ruest, “Virtualization, A Beginner’s Guide”, McGraw-Hill Companies,2009.
5. https://www.edx.org/learn/cloud-computing.
6. https://www.coursera.org/browse/information-technology/cloud-computing
7. https://docs.docker.com/

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of. Lectures | CO |
|---|---|---|---|
| **1** | **Introduction (4)** | | |
| 1.1 | Cloud components | 1 | CO1 |
| 1.2 | Essential characteristics | 1 | |
| 1.3 | Architectural and Technological Influences | 2 | |
| 1.4 | Operational Influences | | |
| **2** | **Cloud Infrastructure (7)** | | |
| 2.1 | Perspective of Data Centers | 1 | CO2 |
| 2.2 | NIST Cloud Computing Reference Architecture and types | 1 | |
| 2.3 | Services – SaaS, PaaS, IaaS | 2 | |
| 2.4 | Challenges and risks in cloud adoption | 1 | |
| 2.5 | Cloud deployment model - Public clouds, Private clouds Community clouds, Hybrid clouds | 2 | |
| **3** | **Virtualization (8)** | | |
| 3.1 | Introduction | 1 | CO3 |
| | Implementation Levels of Virtualization | | |
| 3.2 | Virtualization Structures/Tools and Mechanism | 2 | CO3 |
| 3.3 | Virtualization of CPU, Memory, I/O Devices | 1 | |
| 3.4 | Porting Applications and VM Migration | 2 | |
| 3.5 | Container based virtualization | 1 | |
| 3.6 | Microservice deployment in Docker | 1 | |
| 4 | **Cloud Resource Management (6)** | | |
| 4.1 | Resource Management types and strategies | 1 | CO4 |
| 4.2 | Allocation Methods | 2 | |
| 4.3 | Policies | 1 | |
| 4.4 | Tools for Resource Management | 2 | |
| **5** | **Cloud security and storage (5)** | | |
| 5.1 | Infrastructure Security | 1 | CO5 |
| 5.2 | Data Security and Storage | 1 | |
| 5.3 | Identity and Access Management | 1 | |
| 5.4 | Trust, Reputation, Risk | 1 | |

| | | | |
|---|---|---|---|
| 5.5 | Authentication in Cloud | 1 | |
| **6** | **Cloud Middleware (6)** | | |
| 6.1 | Simulating a cloud environment using cloudsim | 3 | CO6 |
| 6.2 | Create a cloud environment using openstack | 3 | |
| | **Total** | **36** | |

**Course Designers:**

1. Ms. C.Santhiya, Assistant Professor, CSE csit@tce.edu

| 22CSGC0 | ESSENTIALS OF PYTHON FOR ARTIFICIAL INTELLIGENCE | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | IE | 3 | 0 | 0 | 3 |

## Preamble

Python is a preferred language for developing Artificial Intelligence(AI) applications because of its ease of use and robust library set of pre-built functions, for deep learning, machine learning, and data analysis. The main objective of this course is to train the students on solving AI challenges. The students will explore the use of Python's advanced module features and apply them in probability, statistical testing, signal processing, financial forecasting, and various other applications and they can quickly build AI models.

## Prerequisite

- Basic knowledge of Programming

## Course Outcomes

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

| COs | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Interpret the key concepts of AI and AI Project Lifecycle to solve real time challenges | TPS2 | B | 75 |
| CO2 | Implement Python Variables, Expressions, Control Structures and Data Structures | TPS3 | B | 70 |
| CO3 | Demonstrate Python Modules, Functions, Packages, Object Oriented Concepts and Exception Handling | TPS3 | B | 70 |
| CO4 | Prepare AI datasets using Numpy and Pandas libraries | TPS3 | B | 70 |
| CO5 | Develop AI Applications using Visualization and AI Modelling libraries | TPS3 | B | 70 |
| CO6 | Choose suitable AI Frameworks to solve real time projects | TPS4 | B | 70 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | | | L | L | L | L | L | L | L | L |
| CO2. | S | M | L | | L | | | M | M | M | M | M | M | L | M |
| CO1 | S | M | L | | L | | | M | M | M | M | M | M | L | M |
| CO2 | S | M | L | | L | | | M | M | M | M | M | M | L | M |
| CO3 | S | M | L | | L | | | M | M | M | M | M | M | L | M |
| CO4 | S | M | L | L | M | L | L | M | M | M | M | M | M | M | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 15 | | | | | | | | | | | | | 30 | | | | | | | | | | 2 | 5 | | | | |
| CO2 | 5 | 10 | 25 | | | | | | | | | | | | 30 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 5 | 10 | 25 | | | | | | | | | | | | 40 | | | | | | | | | | 2 | 5 | 15 | | | |
| CO4 | | | | | | | 5 | 10 | 20 | | | | | | | | | | | | 30 | | | | 2 | 5 | 15 | | | |
| CO5 | | | | | | | 5 | 10 | 20 | | | | | | | | | | | | 30 | | | | 2 | 5 | 10 | | | |
| CO6 | | | | | | | 5 | 10 | 15 | | | | | | | | | | | | 10 | 30 | | | | 5 | 10 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Artificial Intelligence**
History and Transition to AI Era- AI in Modern World - Key Concepts in AI- Understanding Machine Learning: Supervised- Classification, Regression -Unsupervised – Clustering, Dimension Reduction, Anomaly Detection- Reinforcement learning- Deep Learning

**Introduction to Python: Python Variables, Expressions, Control Structure, Data Structures**
Jupyter Notebooks-Data Types- Expressions- Operators - Control Structure and statements: Conditionals- Iteration - Data Structures: Lists, Tuple, Set, Dictionary-operations- methods- parameters- Advanced list processing – Strings Operations.

**Python Modules, Functions, Packages, Object Oriented Concepts and Exception Handling**:
Function: parameters and arguments- Fruitful functions-return values- local and global scope- recursion- lambda- filter- reduce- map- zip- Concepts of Packages- class- objects- Exception Handling: Assertion, except- try-finally- user defined exception.

**AI Project Lifecycle**
Idea and Conceptualization-Defining Objectives-Research and Feasibility Analysis- Data Collection and Preparation- Choosing Right Framework and Libraries - Designing the AI Model- Training the AI Model- Model Optimization and Tuning-Integration and Deployment - Testing and Quality Assurance-Ethical Considerations and Compliance

**Python for AI**
Data Handling- **Numpy:** NDARRAYS- Reshape-Flatten- Expand-Stack-Concatenate -Linear Algebra- **Pandas:** Access data from Series- object attributes –Data Frame-Attributes and Operations-Data Manipulation: Feature Aggregation-Pivot Tables-Combine Dataset-Data Cleaning

**Visualization, AI Modelling and AI Applications**
Matplotlib and Seaborn for Data Visualization- Scikit-Learn for Machine Learning- TensorFlow and PyTorch for Deep Learning- Keras for Neural Networks-Image Classification- Classification with Pre-Trained Models -Classification with Custom Trained Models

**Case study:** Coffee Preference Prediction App- Analysis based on various factors like taste preferences, consumption habits, and contextual data

**Mini project Topics [Not limited to]:**
**Healthcare:** Predictive Diagnostics, Personalized Medicine, Robotic Surgeries.
**Finance:** Credit Scoring, Fraud Detection.
**Retail:** Customer Segmentation, Inventory Management, Personalized Recommendation Systems.
**Manufacturing:** Production Processes, Predictive Maintenance, Supply Chain Management.

## Text Book

1. Pramod Gupta, Anupam Bagchi, "Essentials of Python for Artificial Intelligence and Machine Learning", Synthesis Lectures on Engineering, Science, and Technology Series, Springer, First Edition, 2023.
2. Patrick J, "Python AI Programming: Navigating fundamentals of ML, deep learning, NLP, and reinforcement learning in practice", GitforGits Publishers, First Edition,2024

## Reference Books & web resources

1. Allen Downey, Jeffrey Elkner, Chris Meyers, "Learning with PYTHON: How to Think Like a Computer Scientist", O'Reilly Publishers, 3rd Edition(GNU), 2020.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modelling and Understanding Data", Third Edition, MIT Press 2021
4. Eric Matthes, "Python Crash Course, A Hands-on Project Based Introduction to Programming", 3rd Edition, No Starch Press, US, 2023.
5. Paul Deitel, Dr. Harvey Deitel "Python for Programmers: with Big Data and Artificial Intelligence Case Studies" , Pearson Higher Ed, First Edition, 2019
6. https://www.python.org/

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Artificial Intelligence** | |
| 1.1 | History and Transition to AI Era, AI in Modern World, Key Concepts in AI | 1 |
| 1.2 | Understanding Machine Learning: Supervised-Classification, Regression | 2 |
| 1.3 | Unsupervised – Clustering, Dimension Reduction, Anomaly Detection- Reinforcement learning- Deep Learning | 3 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **2** | **Introduction to Python: Python Variables, Expressions, Control Structure, Data Structures** | |
| 2.1 | Jupyter Notebooks, Data Types, Expressions, Operators | 1 |
| 2.2 | Control Structure and statements: Conditionals, Iteration | 1 |
| 2.3 | Data Structures: Lists, Tuple, Set, Dictionary-operations- methods- parameters | 3 |
| 2.4 | Advanced list processing , Strings Operations | 1 |
| **3** | **Python Modules, Functions, Packages, Object Oriented Concepts and Exception Handling** | |
| 3.1 | Function: parameters and arguments, Fruitful functions: return values- local and global scope | 2 |
| 3.2 | Recursion, lambda, filter, reduce, map, zip, Concepts of Packages | 2 |
| 3.3 | Class- objects- Exception Handling: Assertion, except- try-finally- user defined exception | 2 |
| **4** | **Understanding AI Project Lifecycle** | |
| 4.1 | Idea and Conceptualization, Defining Objectives, Research and Feasibility Analysis, Data Collection and Preparation | 2 |
| 4.2 | Choosing Right Framework and Libraries , Designing the AI Model , Training the AI Model , Model Optimization and Tuning | 2 |
| 4.3 | Integration and Deployment , Testing and Quality Assurance ,Ethical Considerations and Compliance | 2 |
| **5** | **Python for AI** | |
| 5.1 | Data Handling - **Numpy:** NDARRAYS, Reshape, Flatten, Expand, Stack, Concatenate, Linear Algebra | 3 |
| 5.2 | **Pandas:** Access data from Series, object attributes, Data Frame ,Attributes and Operations ,Data Manipulation: Feature Aggregation, Pivot Tables, Combine Dataset, Data Cleaning | 3 |
| **6** | **Data Visualization, AI Modelling and AI Applications** | |
| 6.1 | Matplotlib and Seaborn for Data Visualization | 1 |
| 6.2 | Scikit-Learn for Machine Learning, TensorFlow and PyTorch for Deep Learning, Keras for Neural Networks | 2 |
| 6.3 | Image Classification, Classification with Pre-Trained Models , Classification with Custom Trained Models | 2 |
| 6.4 | **Case study:** Coffee Preference Prediction App-Analysis based on various factors like taste preferences, consumption habits, and contextual data | 1 |
| | **Mini Project** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| | Total | 36 |

## Course Designer(s):

1. Dr.M.Nirmala Devi mnit@tce.edu

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSGD0** | **DRONE SYSTEMS** | IE | 3 | 0 | 0 | 3 |

## Preamble

This course provides a foundational understanding of drone systems, including their design, control, and navigation. It covers key topics like UAV communication, regulations, and emerging technologies. Students will gain insights into real-world applications and the future scope of drone innovations.

## Prerequisite

- Basic Knowledge of Electronics, Automation and Communication systems.

## Course Outcomes

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

| CO | Course Outcome 1 | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Apply the fundamental principles of UAV architecture, types, and power systems to identify appropriate drone configurations for various applications. | TPS3 | 75 | 80 |
| CO2 | Illustrate the principles of drone aerodynamics and control strategies including PID tuning and sensor integration for stable flight. | TPS3 | 75 | 80 |
| CO3 | Construct suitable navigation approaches using SLAM, Kalman filters, and obstacle avoidance for autonomous drone operations. | TPS3 | 75 | 80 |
| CO4 | Select appropriate communication protocols and interpret UAV regulatory frameworks, including DGCA and international norms | TPS3 | 75 | 80 |
| CO5 | Classify different modes of drone coordination and analyze safety measures, fault tolerance, and reliability in swarm-based operations. | TPS4 | 75 | 80 |
| CO6 | Examine drone applications across sectors and evaluate the use of AI, IoT, and Blockchain technology. | TPS4 | 75 | 80 |

## Mapping with Programme Outcomes

| Cos | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | | | | | | | L | L | | |
| CO2 | S | M | L | | L | | | | | L | | M | M | | M |
| CO3 | S | M | L | | L | | | | | L | | M | M | | M |
| CO4 | S | M | L | | M | | M | M | M | | | M | M | | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO5 | S | S | M | L | | | M | M | M | L | | M | M | | M |
| CO6 | S | S | M | L | M | L | | M | M | L | L | M | S | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Ass1 | | Ass2 | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **3** | **4** | **3** | **4** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 10 | 10 | - | - | - | - | - | - | - | - | - | 20 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO2 | 5 | 10 | 25 | - | - | - | - | - | - | - | - | - | 40 | - | - | - | 2 | 5 | 10 | - | - | - |
| CO3 | - | 10 | 25 | - | - | - | - | - | - | - | - | - | 40 | - | - | - | - | 5 | 10 | - | - | - |
| CO4 | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | - | - | 20 | - | 2 | 5 | 10 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 10 | - | 20 | - | - | - | - | - | 40 | 2 | 5 | - | 10 | - | - |
| CO6 | - | - | - | - | - | - | 5 | 10 | - | 20 | - | - | - | - | - | 40 | 2 | 5 | - | 10 | - | - |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Drone Systems –** Overview of UAVs – Types and classifications – Major components and functions – Power Systems – Applications and Characteristics

**Aerodynamics and Control Systems –** Multirotor Aerodynamics – Forces and moments – Flight modes - Basic Motion Control – Basics of PID control – Sensor integration (IMU, GPS, GNSS) – Stability and tuning of controllers.

**Autonomous Navigation and Path Planning –** SLAM and localization – Path planning – Obstacle detection and avoidance using LiDAR/vision sensors – Kalman filter

**Communication and Regulations –** Drone communication protocols (Wi-Fi, LoRa, 5G) – D2D and D2X – DGCA and global UAV regulations – Regulatory Aspects and Ethical Considerations.

**Swarm Robotics, Safety, and Reliability –** Introduction to Swarm Robotics - Principles of Multi-Agent Coordination. Safety Considerations: Potential Hazards, Basic Safety Procedures. Reliability - Fault Tolerance.

**Emerging Applications and Technologies –** Use cases in agriculture, surveillance, logistics – AI in drones – IoT integration – Blockchain for drone identity and data security.

## Text Book

1. Paul Gerin Fahlstrom, Thomas James Gleason, Mohammad H. Sadraey, “Introduction to UAV Systems”, Wiley Fifth Edition, 2022
2. Randal W. Beard and Timothy W. McLain, “Small Unmanned Aircraft: Theory and Practice", Princeton and Oxford University Press, 2012
3. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots", MIT Press 2011.

## Reference Books

1. Nikolaus Correll, Bradley Hayes, Christoffer Heckman, Alessandro Roncone, "Introduction to Autonomous Robots: Mechanisms, Sensors, Actuators, and Algorithms" MIT Press, 2022.
2. A. R. Jha, “Theory, Design and Applications of Unmanned Aerial Vehicles”, CRC Press, Taylor & Francis Group 2017
3. Kimon P. Valavanis, George J. Vachtsevanos, “Handbook of Unmanned Aerial Vehicles”, Springer 2015
4. Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, “Introduction to Unmanned Aircraft Systems”, CRC Press, Taylor & Francis Group 2012.
5. Reg Austin, “Unmanned Aircraft Systems Uavs Design, Development and Deployment”, Wiley 2010.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Drone Systems** | |
| 1.1 | Overview of UAVs | 1 |
| 1.2 | Types and classifications | 1 |
| 1.3 | Major components and functions | 1 |
| 1.4 | Power Systems | 1 |
| 1.5 | Applications and Characteristics | 1 |
| **2** | **Aerodynamics and Control Systems** | |
| 2.1 | Multirotor Aerodynamics, Forces and moments. | 2 |
| 2.2 | Flight modes, Basic Motion Control - PID control | 2 |
| 2.3 | Sensor integration (IMU, GPS) | 2 |
| 2.4 | Stability and tuning of controllers. | 1 |
| **3** | **Autonomous Navigation and Path Planning** | |
| 3.1 | SLAM and localization | 1 |
| 3.2 | Path planning | 1 |
| 3.3 | Obstacle detection and avoidance using LiDAR/ vision sensors | 2 |
| 3.4 | Kalman filter | 2 |
| **4** | **Communication and Regulations** | |
| 4.1 | Drone communication protocols (Wi-Fi, LoRa, 5G) | 2 |
| 4.2 | D2D and D2X | 2 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 4.3 | DGCA and global UAV regulations | 2 |
| 4.4 | Regulatory Aspects and Ethical Considerations. | 1 |
| **5** | **Swarm Robotics, Safety, and Reliability** | |
| 5.1 | Introduction to Swarm Robotics, Principles of Multi-Agent Coordination. | 2 |
| 5.2 | Safety Considerations: Potential Hazards, Basic Safety Procedures. | 1 |
| 5.3 | Reliability, Fault Tolerance | 2 |
| **6** | **Emerging Applications and Technologies** | |
| 6.1 | Use cases in agriculture, surveillance, logistics | 2 |
| 6.2 | AI in drones – IoT integration | 2 |
| 6.3 | Blockchain for drone identity and data security. | 2 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.K.Narasimhamallikarjunan (arjunkambaraj@tce.edu)
2. Mr.D.Nagendra Kumar (dnkcse@tce.edu)

| | | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| **22CSGE0** | **UI AND UX DESIGN** | IE | 3 | 0 | 0 | 3 |

## Preamble

This course equips students with essential skills in user-centered design thinking, wireframing and prototyping techniques, usability testing, and visual design principles. Through hands-on projects and real-world case studies, students will apply these skills to solve real user problems and develop innovative solutions, preparing them for careers in design and technology.

## Prerequisite

- NIL

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Show the differences between UI and UX, the history of UX, the key stages of design thinking and identify the user requirements. | TPS3 | 70 | 80 |
| CO2 | Demonstrate the user needs using research methods and develop personas, user stories, and problem statements. | TPS3 | 70 | 80 |
| CO3 | Apply UI design principles to design visually clear and consistent interfaces using patterns and style guides. | TPS3 | 70 | 80 |
| CO4 | Build wireframes, prototypes, and mockups using digital tools, and assess them through usability testing. | TPS3 | 70 | 80 |
| CO5 | Organize user flows and structure content using flow diagrams and information architecture methods. | TPS3 | 70 | 80 |
| CO6 | Construct UX solutions for AI, IoT, and voice interfaces, and recognize the role of DesignOps. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | M | L | | | | | M | M | | | M | M | | L |
| CO2 | S | M | L | | | L | L | M | M | M | | M | M | L | M |
| CO3 | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO4 | S | M | L | | L | L | L | M | M | M | | M | M | L | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 5 | S | M | L | | L | L | L | M | M | M | | M | M | L | M |
| CO 6 | S | M | L | L | M | M | L | M | M | M | L | M | M | M | M |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment 1 | | | | | | Assignment 2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TPS Scale** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** | **4** | **5** | **6** |
| CO1 | 5 | 5 | 20 | - | - | - | - | - | - | - | - | - | | | 30 | | | | | | | | | | 2 | 3 | 10 | | | |
| CO2 | 5 | 5 | 25 | - | - | - | - | - | - | - | - | - | | | 35 | | | | | | | | | | 2 | 3 | 15 | | | |
| CO3 | 5 | 5 | 25 | - | - | - | - | - | - | - | - | - | | | 35 | | | | | | | | | | 2 | 3 | 10 | | | |
| CO4 | - | - | - | - | - | - | 5 | 5 | 20 | - | - | - | | | | | | | | | 20 | | | | 2 | 3 | 10 | | | |
| CO5 | - | - | - | - | - | - | 5 | 5 | 25 | - | - | - | | | | | | | | | 20 | | | | 2 | 3 | 15 | | | |
| CO6 | - | - | - | - | - | - | 5 | 5 | 25 | - | - | - | | | | | | | | | 60 | | | | 2 | 3 | 10 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

**Syllabus**

**Foundations of design and User Requirements :** UI vs. UX Design - History of UX. Need of UI andUX -Core Stages of Design Thinking - Divergent and Convergent Thinking ,User requirements – Definition, Types of user research - Qualitative research, Quantitative research. Tools to collect user requirements – personal observation, interviews, questionnaire, User/ Expert reviews, User requirement analysis - Understanding target audience and client requirements, Competitive analysis, Affinity mapping
Case study: Use Design tool for user requirement collection and analysis of various interfaces

**UI Design**: Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles - Branding - Style Guides- Visual Communication Design - effective visual communication for graphical user interface
Case study: Design a Visually Consistent Mobile App Interface using tools like Figma, Adobe XD

**UX Design**: Introduction to User Experience – Importance of User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals
Case study: Conduct UX Research and Create Personas & Journey Map

**Wireframing, Prototyping And Testing** :Sketching Principles - Sketching Red Routes - Responsive Design - Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.
Case study: Translate wireframes into a working prototype and test it for usability using open source tools

**Conceptual Design and UX Structuring**: Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.
Case study: Use conceptual design techniques to map out UX structure before UI begins.

**UX for Emerging Technologies** : AI-driven UX Design (Designing for Chatbots, Smart Assistants) - Designing for IoT Interfaces - Voice, Gesture, and Biometric Interfaces- (DesignOps) Overview

**Text Book**

1.Joel Marsh, "UX for Beginners", O'Reilly , 2022
2. Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly 2021

**Reference Books & web resources**

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3 rd Edition , O'Reilly 2020
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018

**Course Contents and Lecture Schedule**

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Foundations of Design and User Requirements** | |
| 1.1 | UI vs. UX Design - History of UX - Need of UI andUX | 1 |
| 1.2 | Core Stages of Design Thinking | 1 |
| 1.3 | Divergent and Convergent Thinking | 1 |
| 1.4 | User requirements – Definition | 1 |
| 1.5 | Types of user research - Qualitative research, Quantitative research | 1 |
| 1.6 | Tools to collect user requirements – personal observation, interviews, questionnaire, User/ Expert reviews | 1 |
| 1,7 | User requirement analysis - Understanding target audience and client requirements, Competitive analysis, Affinity mapping | 2 |
| **2** | **UI Design** | |
| 2.1 | Visual and UI Principles | 1 |
| 2.2 | UI Elements and Patterns | 1 |
| 2.3 | Interaction Behaviors and Principles | 1 |
| 2.4 | Branding - Style Guides | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 2.5 | Visual Communication Design | 1 |
| 2.6 | Effective visual communication for graphical user interface | 1 |
| **3** | **UX Design** | |
| 3.1 | Introduction to User Experience – Importance of User Experience - Understanding User Experience | 1 |
| 3.2 | Defining the UX Design Process and its Methodology | 1 |
| 3.3 | Research in User Experience Design | 1 |
| 3.4 | Tools and Method used for Research | 1 |
| 3.5 | User Needs and its Goals- Know about Business Goals | 1 |
| **4** | **Wireframing, Prototyping And Testing** | |
| 4.1 | Sketching Principles- Sketching Red Routes | 1 |
| 4.2 | Responsive Design | 1 |
| 4.3 | Wireframing - Creating Wireflows | 1 |
| 4.4 | Building a Prototype | 1 |
| 4.5 | Building High-Fidelity Mockups- Designing Efficiently with Tools | 1 |
| 4.6 | Interaction Patterns | 1 |
| 4.7 | Conducting Usability Tests - Other Evaluative User Research Methods | 1 |
| 4.8 | Synthesizing Test Findings - Prototype Iteration. | 1 |
| **5** | **Conceptual Design and UX Structuring** | |
| 5.1 | Identifying and Writing Problem Statements | 1 |
| 5.2 | Identifying Appropriate Research Methods | 1 |
| 5.3 | Creating Personas - Solution Ideation | 1 |
| 5.4 | Creating User Stories - Creating Scenarios | 1 |
| 5.5 | Flow Diagrams - Flow Mapping | 1 |
| 5.6 | Information Architecture | 1 |
| **6** | **UX for Emerging Technologies** | |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 6.1 | AI-driven UX Design (Designing for Chatbots, Smart Assistants) | 1 |
| 6.2 | Designing for IoT Interfaces - Voice, Gesture, and Biometric Interfaces | 1 |
| 6.3 | DesignOps Overview | 1 |
| | Total | 36 |

**Course Designer(s):**

1. Dr.Raja Lavanya,Assistant Professor,CSE rlit@tce.edu

| 22CSGF0 | COMPUTER SECURITY ESSENTIALS | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | IE | 3 | 0 | 0 | 3 |

## Preamble

This course aims at providing an understanding of the fundamentals of the cyber security.

## Prerequisite

NIL

## Course Outcomes

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

| CO | Course Outcome (CO) | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Interpret the fundamental elements of cyber security. | TPS2 | 70 | 80 |
| CO2 | Administer the functioning of networks, internet and the concepts underlying network security.. | TPS3 | 70 | 75 |
| CO3 | Dramatize the different variants of cyber threats. | TPS3 | 70 | 75 |
| CO4 | Illustrate various security primitives of information security. | TPS3 | 70 | 75 |
| CO5 | Examine the concepts underlying system security. | TPS3 | 70 | 75 |
| CO6 | Discover the tools and techniques for digital forensics and incident response. | TPS3 | 70 | 75 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | - | | | | | | | | L | L | | |
| CO2 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |
| CO3 | S | M | L | - | M | L | L | L | L | L | | L | M | L | L |
| CO4 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |
| CO5 | S | M | L | - | - | L | L | M | L | L | | L | M | L | L |
| CO6 | S | M | L | - | - | L | L | L | L | L | | L | M | L | L |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | CAT2 | | | | | | Assignment1 | | | | | | Assignment2 | | | | | | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | | | | | | | | | | | | | | | | | | | | | | | 2 | 10 | | | | |
| CO2 | 10 | 10 | 10 | | | | | | | | | | | | 50 | | | | | | | | | | 2 | 5 | 10 | | | |
| CO3 | 10 | 20 | 20 | | | | | | | | | | | | 50 | | | | | | | | | | 4 | 5 | 10 | | | |
| CO4 | | | | | | | 10 | | 10 | | | | | | | | | | | | 30 | | | | 4 | 5 | 10 | | | |
| CO5 | | | | | | | 10 | 10 | 20 | | | | | | | | | | | | 30 | | | | 4 | 5 | 10 | | | |
| CO6 | | | | | | | 10 | 20 | 10 | | | | | | | | | | | | 40 | | | | 4 | | 10 | | | |

***** Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to Cybersecurity:** Introduction – Types of Cyber Threats – Basic Security Terminology: CIA Triad – Confidentiality – Integrity – Availability, Authentication – Access Policy.

**Network Security:** Overview – Overview - Network Basics - How the Internet Works - Basic Network Utilities - Transport layer security - Internet protocol security - Wireless security - Email security - Network monitoring - Intrusion detection system - Virtual private network and firewall.

**Cyber Threats:** DoS Attacks - Malware: Viruses, Trojan Horses, Buffer-Overflow Attack - Spyware – Other Forms of Malware - Detecting and Eliminating Viruses and Spyware - The Dark Web - Recent Cyber Threats - Twitter attack - GPT attack - Data leaks.

**Information Security:** Overview of Cryptography – Encryption: Caesar Cipher, Hill Cipher – Hash Function – Digital Signatures – Digital Certificates - Data Privacy - Blockchain.

**Systems Security** - Malware - Program analysis - Penetration testing - Embedded system and hardware security - Mobile security - Secure storage management - Cyber-physical system security - IoT security.

**Digital Forensics and Incident Response:** Incident Response – Preparation – Detection and Analysis – Recovery – Post-incident Activities; Digital Forensics – Data Collection and Examination – Analysis and Reporting - Cyber resilience - Assured Delays - Security Assessment.

## Text Books

1. Chuck Easttom, “Computer Security Fundamentals”, 2023.
2. William Stallings, “Cryptography and Network Security Principles and Practice”, 8th Edition, Pearson, 2023.

3. Behrouz A. Forouzan, “Data Communications and Networking with TCPIP Protocol Suite” 6th Edition, 2022.

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to Cybersecurity** | |
| 1.1 | Introduction – CIA Triad | 1 |
| 1.2 | Confidentiality – Integrity – Availability | 2 |
| 1.3 | Authentication – Access Policy | 2 |
| **2** | **Network Security** | |
| 2.1 | Overview - Network Basics | 1 |
| 2.2 | How the Internet Works | 1 |
| 2.3 | Basic Network Utilities | 1 |
| 2.4 | Transport layer security - Internet protocol security | 1 |
| 2.5 | Wireless security - Email security | 1 |
| 2.6 | Network monitoring - Intrusion detection system - Virtual private network and firewall | 2 |
| **3** | **Types of Cyber Threats** | |
| 3.1 | DoS Attacks | 1 |
| 3.2 | Malware: Viruses, Trojan Horses | 1 |
| 3.3 | Buffer-Overflow Attack | 1 |
| 3.4 | Spyware – Other Forms of Malware - Detecting and Eliminating Viruses and Spyware | 1 |
| 3.5 | The Dark Web | 1 |
| 3.6 | Recent Cyber Threats - Twitter attack - GPT attack - Data leaks | 1 |
| **4** | **Information Security** | |
| 4.1 | Overview | 1 |
| 4.2 | Encryption: Caesar Cipher, Hill Cipher | 1 |
| 4.3 | Hash Function | 1 |
| 4.4 | Digital Signatures | 1 |
| 4.5 | Digital Certificates - Data Privacy | 1 |
| 4.6 | Blockchain | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **5** | **Systems Security** | |
| 5.1 | Malware - Program analysis | 1 |
| 5.2 | Penetration testing | 1 |
| 5.3 | Embedded system and hardware security | 1 |
| 5.4 | Mobile security - Secure storage management | 1 |
| 5.5 | Cyber-physical system security | 1 |
| 5.6 | IoT security | 1 |
| **6** | **Digital Forensics and Incident Response** | |
| 6.1 | Incident Response – Preparation – Detection and Analysis | 1 |
| 6.2 | Recovery – Post-incident Activities | 1 |
| 6.3 | Digital Forensics – Data Collection and Examination | 1 |
| 6.4 | Digital Forensics – Analysis and Reporting | 1 |
| 6.5 | Cyber resilience | 1 |
| 6.6 | Assured Delays - Security Assessment | 1 |
| | Total | 36 |

**Course Designers:**


1. Dr. M. Vijayalakshmi mviji@tce.edu
2. Dr. J. Dharani jdicse@tce.edu

| 22CSGG0 | DEEP LEARNING FOR LANGUAGE PROCESSING | Category | L | T | P | Credit |
|---|---|---|---|---|---|---|
| | | IE | 3 | 0 | 0 | 3 |

## Preamble

This course focuses on enabling machines to understand and interact using human language. This course introduces the fundamental concepts of NLP, including text and speech processing, language modelling, and syntactic and semantic analysis. Students will explore both the theoretical foundations and practical tools used to build intelligent language applications. Special emphasis is placed on handling ambiguity, processing Indian languages, and applying NLP techniques to real-world domains such as education, law, and conversational AI.

## Prerequisite

Nil

## Course Outcomes

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

| | Course Outcomes | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Infer the fundamentals, origins, and challenges of Natural Language Processing, including various levels of language processing and grammar in both global and Indian language contexts. | TPS2 | 70 | 85 |
| CO2 | Apply basic text preprocessing techniques such as tokenization, stemming, lemmatization, and vector space modeling to prepare textual data for NLP tasks. | TPS3 | 70 | 80 |
| CO3 | Evaluate probabilistic language models including unigram, bigram, and trigram models for word prediction and text analysis. | TPS3 | 70 | 80 |
| CO4 | Apply foundational concepts of articulatory and acoustic phonetics along with digital signal processing techniques to segment and classify speech data. | TPS3 | 70 | 80 |
| CO5 | Implement popular NLP libraries and frameworks to develop and experiment with language processing tools and applications. | TPS3 | 70 | 80 |
| CO6 | Design NLP-based solutions for real-world applications such as sentiment analysis, text summarization, question answering, chatbots, and information extraction. | TPS3 | 70 | 80 |

## Mapping with Programme Outcomes

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1. | M | L | | | | L | | | | L | L | L | L | L | L |
| CO2. | S | M | L | | M | | | | M | M | M | M | M | M | M |
| CO3. | S | M | L | | M | | | | | M | M | | M | M | M |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4. | S | M | L | | M | | | | M | M | M | | M | M | M |
| CO5. | S | M | L | | M | M | | | | M | M | M | M | M | M |
| CO6. | S | M | L | | M | | | | M | M | M | M | M | L | M |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| CO | CAT1 | | | | | | Ass 1 | CAT2 | | | | | | Ass2 | Terminal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 | | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | 10 | 10 | - | - | - | - | 30 | - | - | - | - | - | - | - | 2 | 5 | - | - | - | - |
| CO2 | 10 | 10 | 20 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 5 | 12 | - | - | - |
| CO3 | 10 | 10 | 20 | - | - | - | 35 | - | - | - | - | - | - | - | 2 | 5 | 12 | - | - | - |
| CO4 | - | - | - | - | - | - | - | 5 | 10 | 20 | - | - | - | 20 | 2 | 5 | 12 | - | - | - |
| CO5 | - | - | - | - | - | - | - | 5 | 10 | 15 | - | - | - | 20 | 2 | 5 | 12 | - | - | - |
| CO6 | - | - | - | - | - | - | - | 10 | 10 | 15 | - | - | - | 60 | | 5 | 12 | - | - | - |

*****Terminal examination should cover all Course Outcomes in the appropriate TPS Scale level.

## Syllabus

**Introduction to NLP:** What is NLP- Origins and challenges of NLP- Generic NLP system - Introduction to various levels of natural language processing- Knowledge in language Processing- Ambiguity in Natural language-Computational requirements for NLP- Language and Grammar- Processing Indian Languages- The role of language Models

**Text Processing:** Text Processing Basics - Probability and NLP - Lower case conversion- Character Encoding-Word Segmentation- Sentence Segmentation-Stop Words Removal- Punctuation and digits removal- Stemming and lemmatization- Vector Space Models-Statistical Properties of words.

**Language Models:** What is word prediction- The definition of probabilistic language models - Estimating parameters -Basic Smoothing-Evaluating language models -Simple N-gram models - bigram and trigram language - Neural Language Models-RNN-LSTM-Transformers-BERT-GPT- Llama-DeepSeek- Out of vocabulary words.

**Speech Processing**: Speech fundamentals: articulatory phonetics – production and classification of speech sounds- Word Boundary Detection- acoustic phonetics – acoustics of speech production- review of digital signal processing concepts

**NLP Libraries**: Regex (Regular Expressions)-NLTK (Natural Language Toolkit)-spaCy-TextBlob-Textacy-VADER -Gensim-AllenNLP-Stanza-Pattern-PyNLPl-Hugging Face Transformer-flair Library-FastText-Polyglot

**Applications of NLP:** Text Summarization-Sentiment Analysis-Question answering-Information Extraction-Basic Dialogue Systems- Spam Detection-Building a chatbot-NLP in Education and Legal Systems

## Text Books

1.Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2.Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.
3. Lawrence Rabiner And Biing-Hwang Juang, “Fundamentals Of Speech Recognition”, Pearson Education, 2003.

## Reference Books

1. Frederick Jelinek, “Statistical Methods Of Speech Recognition”, MIT Press, 1997.
2. Breck Baldwin, “Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015
3. Richard M Reese, —Natural Language Processing with Java, OReilly Media, 2015

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Introduction to NLP** | |
| 1.1 | What is NLP- Origins and challenges of NLP- Generic NLP system | 1 |
| 1.2 | Introduction to various levels of natural language processing | 1 |
| 1.3 | Knowledge in language processing | 1 |
| 1.4 | Ambiguity in Natural language-Computational requirements for NLP | 1 |
| 1.5 | Language and Grammar-Processing Indian Languages- The role of language Models | 1 |
| **2** | **Basic Text Processing:** | |
| 2.1 | Text Processing Basics - Probability and NLP | 1 |
| 2.2 | Lower case conversion- Character Encoding | 1 |
| 2.3 | Word Segmentation- Sentence Segmentation-Stop words removal | 2 |
| 2.4 | Punctuation and digits removal | 1 |
| 2.5 | Stemming and lemmatization | 1 |
| **3** | **Language Models:** | |
| 3.1 | What is word prediction- The definition of probabilistic language models | 1 |
| 3.2 | Estimating parameters - Basic Smoothing- Evaluating language models | 1 |
| 3.3 | Simple N-gram models - bigram and trigram language | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| 3.4 | Neural Language Models-RNN-LSTM | 1 |
| 3.5 | Transformers-BERT-GPT- Llama-DeepSeek | 1 |
| 3.6 | Out of vocabulary words | 1 |
| **4** | **Basic Speech Processing**: | |
| 4.1 | Speech fundamentals: articulatory phonetics | 1 |
| 4.2 | production and classification of speech sounds | 1 |
| 4.3 | Word Boundary Detection | 1 |
| 4.4 | acoustic phonetics | 1 |
| 4.5 | acoustics of speech production | 1 |
| 4.6 | review of digital signal processing concepts | 1 |
| **5** | **Overview of NLP Libraries** | |
| 5.1 | Regex (Regular Expressions)-NLTK (Natural Language Toolkit) | 2 |
| 5.2 | spaCy-TextBlob-Textacy | 1 |
| 5.3 | VADER -Gensim-AllenNLP-Stanza-Pattern | 2 |
| 5.4 | PyNLPl-Hugging Face Transformer-flair Library-FastText-Polyglot | 2 |
| 6 | **Applications of NLP** | |
| 6.1 | Text Summarization-Sentiment Analysis-Question answering | 2 |
| 6.2 | Information Extraction-Basic Dialogue Systems- | 2 |
| 6.3 | Spam Detection-Building a chatbot | 1 |
| 6.4 | NLP in Education and Legal Systems | 1 |
| | **Total** | **36** |

**Course Designer(s):**

1. Dr. K. Sundarakantham kskcse@tce.edu
2. Mrs.S.Jeniba sjacse@tce.edu

| 22CHAA0 | ENVIRONMENTAL SCIENCE |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| BS | 1 | | 1 | 0 |

(Common to all branches)

**Preamble**

The objective of this course is to make the students learn the basic concepts of environment, ecology, and to create awareness on current environmental issues, and develop
a sustainable environment by participating in various activities on conserving natural resources and protecting the environment.

**Prerequisite**

Nil

**Course Outcomes**

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Describe the importance and progression of ecological system | TPS2 | A | 80 |
| CO2 | Explain the significance of natural resources | TPS2 | A | 80 |
| CO3 | Examine the effects of pollution on environment and human beings | TPS3 | A | 80 |
| CO4 | Practice the suitable solid waste management for segregation and reuse of waste | TPS3 | A | 80 |
| CO5 | Explain renewable energy resources for sustainable environment | TPS2 | A | 80 |
| CO6 | Perform Environment oriented group activities | TPS4 | A | 80 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1.** | M | L | - | - | - | L | S | - | - | - | - | - |
| **CO2.** | M | L | - | - | - | - | L | L | - | - | - | - |
| **CO3.** | S | M | L | - | - | - | S | - | - | - | - | - |
| **CO4.** | M | M | L | - | - | - | S | L | L | - | - | - |
| **CO5.** | M | L | - | - | - | - | S | - | L | - | - | - |
| **CO6.** | S | S | M | L | M | M | M | M | S | M | M | - |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| CO | CAT | | | | | | Assignment# | | | | | | Terminal*** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS Scale | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| CO1 | | 20 | | | | | NA | | | | | | Presentation on case study report | | | | | |
| CO2 | | 20 | | | | | | | | | | | | | | | | |
| CO3 | | | 20 | | | | | | | | | | | | | | | |
| CO4 | | | 20 | | | | | | | | | | | | | | | |
| CO5 | | 20 | | | | | | | | | | | | | | | | |
| CO6 | | | | | | | | | | | | | | | | | | |

# Assignment: Marks will be given for the review I &II of case study presentation.

*** Case study presentation and evaluation

- ❖ Each group comprise of maximum three students
- ❖ Students will submit the case study report similar to final year project report
- ❖ Evaluation of case study presentation is based on the approved rubrics

**Method of Evaluation**

**a)Internal assessment**

| S.No | Description | Max.marks | Final conversion |
|---|---|---|---|
| 1 | CAT | 60 | 30 |
| 2 | Assignment marks (from Review I&II) | 2×20 =40 | 20 |
| Total | | | 50 |

**b) End semester examination – Case study presentation**

| Performance Index | Marks per Individual |
|---|---|
| Originalityof the work | 20 |
| Data collected | 20 |
| Suggestion to overcomefor the identified issues | 20 |
| FinalPresentation | 40 |
| Total | 100 |

**Model Titles for Case Study**:

1. Environmental impacts of rubber industry in Virudhunagar district
2. Solid waste and waste water management in TCE hostel.
3. Status of workers in fireworks industry in Sivakasi region
4. A study on impacts of tanneries on ground water and soil quality in Dindigul district.
5. Effect of pharmaceutical industry on groundwater quality in poikaraipatty village, AlagarKovil.
6. Environmental impacts of quarry industries in MelurTaluk.
7. Environmental effect of Kudankulam atomic power plant.
8. Effect on ground water and soil quality by dyeing industries in Tiruppur.
9. Effect of textile wastes in Karur District.
10. Segregation of waste and its recycling by Madurai Municipality at Vellakkal

## Syllabus

**Environment and Ecosystem -** Multidisciplinary nature of environment- Ecosystem-Structure and Functions, Energy flow in ecosystem-Ecological succession- Natural resources -Over exploitation, Conservation. **Environmental pollution and control -** Environmental pollution – Types (Air, Water, Soil)and Effects–Control measures, Solid waste management, Environmental Impact Assessment.**Sustainable Environment–**Carbon footprint, Carbon and water neutrality, Sustainable development goals, Renewable energy resources (Solar, Wind, Tidal, Biomass), Atom economy,Carbon vs Hydrogen economy, Linear economy vs Circular economy, Environmental ethics – issues, solution

**Awareness and activities:**

- ✓ Lectures by Environmentalist
- ✓ Group meeting on water management
- ✓ Awareness on modern pollution control measures
- ✓ Drive on e-waste segregation and disposal
- ✓ Field visit to treatment systems
- ✓ Preparation of seed ball and plantation
- ✓ Slogan, Poster, Essay writing, Role play events

## Text Book

1. Kaushik, A &Kaushik, C.P, Environmental Science and Engineering, 6$^{th}$Edition, New Age International, 2018.
2. ErachBharucha, Text book of Environmental studies for Undergraduate courses, 2$^{nd}$Edtion, UGC, 2013.

## Reference Books& web resources

1. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
2. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
3. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
4. www.indiaenvironmentportal.org.in
5. www.teriin.org
6. www.cpcp.nic.in
7. www.sustainabledevelopment.un.org
8. www.conserve-energy-future.com

## Course Contents and Lecture Schedule

| Module No. | Topic | No. of Periods |
|---|---|---|
| **1** | **Environment and Ecosystem** | |
| 1.1 | Multidisciplinary nature of environment | 1 |
| 1.2 | Structure and Function of Ecosystem. Energy flow in ecosystem – Universal energy flow model | 2 |
| 1.3 | Ecological succession | 1 |
| 1.4 | Natural resources - Over exploitation, Conservation | 1 |

| Module No. | Topic | No. of Periods |
|---|---|---|
| **2** | **Environmental pollution and control** | |
| 2.1 | Environmental pollution – Types(Air, Water, Soil) and Effects | 2 |
| 2.2 | Control measures: Air pollution (Bag filter, Cyclone separator, Electrostatic Precipitator) | 1 |
| 2.3 | Industrial waste water treatment – Primary, Secondary, Tertiary | 1 |
| 2.4 | Solid waste management | 1 |
| 2.5 | Environmental Impact Assessment – Components, Processes and methods | 1 |
| **3** | **Sustainable Environment** | |
| 3.1 | Concept of carbon credit and carbon foot print, Carbon and water neutrality | 1 |
| 3.2 | Sustainable development goals – An overview | 1 |
| 3.3 | Renewable energy resources – Solar, Wind, Tidal, Biomass | 2 |
| 3.4 | Sustainable environment: Atom economy, Carbon vs Hydrogen economy, Linear economy vs Circular economy, | 1 |
| 3.5 | Environmental ethics: Issues and solution | 1 |
| **4** | **Awareness and activities** | |
| 4.1 | Lectures by environmentalist | 1 |
| 4.2 | Awareness on modern pollution control measures | 1 |
| 4.3 | Group activity on waste management | 1 |
| 4.4 | Drive on e-waste segregation and disposal | 1 |
| 4.5 | Field visit to treatment systems | 1 |
| 4.6 | Plantation using seed ball | 1 |
| 4.7 | Slogan, Poster, Essay writing, Role play events | 1 |
| | Total | 24 |

**Course Designer(s):**


1. Dr.M.Kottaisamy hodchem@tce.edu
2. Dr. V. Velkannan velkannan@tce.edu
3. Dr. M. Velayudham mvchem@tce.edu

# SYLLABI

# FOR

# AUDIT COURSES

**23CHAD0 INDIAN CONSTITUTION AND KNOWLEDGE SYSTEMS**

**23CHAE0 UNIVERSAL HUMAN VALUES AND ETHICS**

**B.E. / B.Tech. DEGREE PROGRAMME**

**FOR THE STUDENTS ADMITTED IN THE**

**ACADEMIC YEAR 2023-24 ONWARDS**

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**
**THIAGARAJAR COLLEGE OF ENGINEERING**
(A Government Aided Autonomous Institution Affiliated to Anna University)
**MADURAI – 625 015, TAMILNADU**
Phone : 0452 – 2482240, 41
Fax : 0452 2483427
Web : www.tce.edu

| 23CHAD0 | INDIAN CONSTITUTION AND KNOWLEDGE SYSTEMS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| AC | 2 | 0 | 0 | 0 |

## Preamble

This course offers a comprehensive exploration of India’s constitutional framework and its rich traditional knowledge systems, fostering a universal approach to value-based education. It helps students develop a deeper understanding of reality through self-exploration and value-based learning. The course highlights how ancient Indian practices in areas like literature, arts, science, healthcare, and agriculture align with modern governance principles. Students will learn to appreciate the relevance of these traditions in solving today’s challenges. By the end of the course, students will understand how India’s knowledge heritage and constitutional values work together to support sustainable and inclusive development.

## Prerequisite

Nil

## Course Outcomes

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

| CO | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Explain the core principles, features, and structure of the Indian Constitution, including its role in shaping modern democracy and governance. | TPS2 | 70 | 85 |
| CO2 | Interpret the fundamental rights, duties, and directive principles enshrined in the Constitution and their implications for individual and societal development. | TPS2 | 70 | 85 |
| CO3 | Assess the significance of the Constitution in addressing contemporary issues and promoting justice, equality, and sustainable development. | TPS2 | 70 | 85 |
| CO4 | Describe the key concepts, diversity, and significance of Indian traditional knowledge systems across various domains such as arts, sciences, and ecology. | TPS2 | 70 | 85 |
| CO5 | Compare Indian traditional knowledge with modern knowledge systems and identify their complementary roles in addressing societal challenges. | TPS2 | 70 | 85 |
| CO6 | Demonstrate the application of traditional knowledge in modern contexts, emphasizing sustainability, holistic living, and cultural reservation. | TPS2 | 70 | 85 |

## Mapping with Programme Outcomes

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | M | L | | | | M | | | L | M | |
| CO2 | M | L | | | | M | | | L | M | |
| CO3 | M | L | | | | M | | | L | M | |
| CO4 | M | L | | | | M | | | L | M | |
| CO5 | M | L | | | | M | | | L | M | |
| CO6 | M | L | | | | M | | | L | M | |

S- Strong; M-Medium; L-Low

## Assessment Pattern

| Bloom's category | Continuous Assessment Tests | | Seminar |
|---|---|---|---|
| | 1 | 2 | - |
| Remember | 40 | 40 | 0 |
| Understand | 60 | 60 | 100 |
| Apply | 0 | 0 | 0 |
| Analyze | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 |
| Create | 0 | 0 | 0 |

## Syllabus

**Indian Constitution**

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

**Indian Knowledge Systems**

**Traditional and Modern Knowledge: Two Worlds of Knowledge**

Phases of Exploration: Contributions of Sir Arthur Cotton in irrigation, smallpox vaccination advancements, and agricultural reforms by Voelcker and Howard.

Indian Art and Science: Havell's work in Indian art, Gaekwad of Baroda's push for technical education, and contributions to Ayurveda (Hakim Ajmal Khan) and indigenous drugs (R.N. Chopra).

**Linking Science and Rural Development**

Pioneering Models: Tagore's Sriniketan experiment, YMCA's Marthandam model, Gandhi's rural development ideas, and Nehru's perspectives on growth.

Post-Independence and Global Recognition

**Modernization of Knowledge**: Integration of traditional practices in modernization efforts and the rise of activism for traditional knowledge recognition.

Global Mechanisms: Efforts by UNESCO, WHO, UNEP, WIPO, and WTO for protecting and sharing traditional knowledge.

**Intellectual Property Rights (IPR) and Traditional Knowledge**

Theoretical Background: Strategies for safeguarding traditional knowledge through positive protections and defensive mechanisms.

**Traditional Knowledge for Basic Needs**

Cultural Practices: Midwifery traditions (Dai System), surface flow irrigation tanks, and community housing rights.

Biodiversity and Genetic Resources: Success stories like Jeevani (Kanis' herbal medicine) and AYUSH-based cosmetics.

**Traditional Knowledge in Manufacturing and Industry**

Notable Contributions: Channa Patna toys, Payyanur sacred rings, and innovations in drug discovery.

**Cultural Expressions**

Heritage and Modern Relevance: Banarasi sarees, classical music, yoga's evolution, and Sanskrit's role in artificial intelligence.

**Text Book**


- Durga Das Basu, 'Introduction to The Constitution of India', LexisNexis Butterworths Wadhwa, 20th Edition, Reprint 2011.
- Constitution of India, National Portal of India, Web link: https://www.india.gov.in/my-government/constitution-india
- Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms" Springer, 2019.


**Reference Books & web resources**


- Amit Jha, "Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.
- Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
- Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.
- NPTEL video lecture on "Ayurvedic Inheritance of India", Video link: https://nptel.ac.in/courses/121/106/121106003/#.
- YouTube video on "Introduction to Indian Knowledge Systems", Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.
- YouTube video on "12 Great achievements of Indian Civilization", Video link: https://www.youtube.com/watch?v=xmogKGCmclE)


**Course Designers**

Adopted from AICTE MODEL CURRICULUM 2022

| 23CHAE0 | UNIVERSAL HUMAN VALUES AND ETHICS |
|---|---|

| Category | L | T | P | Credit |
|---|---|---|---|---|
| AC | 2 | 0 | 0 | 0 |

## Preamble

This course presents a universal approach to value education by developing the right understanding of reality through the process of self-exploration. The course primarily focus es on affecting a qualitative transformation in the life of the student rather than just a transfer of information. The course introduces the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

## Prerequisite

Nil

## Course Outcomes

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

| COs | Course Outcome | TCE Proficiency Scale | Expected Proficiency in % | Expected Attainment Level % |
|---|---|---|---|---|
| CO1 | Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society. | TPS2 | 70 | 85 |
| CO2 | Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body. | TPS2 | 70 | 85 |
| CO3 | Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society | TPS2 | 70 | 85 |
| CO4 | Understand the harmony in nature and existence and work out their mutually fulfilling participation in nature | TPS2 | 70 | 85 |
| CO5 | Distinguish between ethical and unethical practices. | TPS2 | 70 | 85 |
| CO6 | Prepare strategy to actualize a harmonious environment wherever they work and lead an ethical life Course | TPS2 | 70 | 85 |

**Mapping with Programme Outcomes**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | M | | | L | M | |
| CO2 | | | | | | M | | | L | M | |
| CO3 | | | | | | M | | | L | M | |
| CO4 | | | | | | M | | | L | M | |
| CO5 | | | | | | M | | | L | M | |
| CO6 | | | | | | M | | | L | M | |

S- Strong; M-Medium; L-Low

**Assessment Pattern**

| Bloom's category | Continuous Assessment Tests | | Seminar |
|---|---|---|---|
| | 1 | 2 | - |
| Remember | 40 | 40 | 0 |
| Understand | 60 | 60 | 100 |
| Apply | 0 | 0 | 0 |
| Analyze | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 |
| Create | 0 | 0 | 0 |

**Syllabus**

**INTRODUCTION TO VALUE EDUCATION**

Value Education – Need, Basic Guidelines, Content and Process, Self-Exploration – meaning, importance and process, Continuous Happiness and Prosperity – A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities – The basic requirements, Understanding Happiness and Prosperity – A critical appraisal of the current scenario, Method to fulfil the above human aspirations – UNDERSTANDING and living in harmony at various levels.

**HARMONY IN THE HUMAN BEING**

An understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' – Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

**HARMONY IN THE FAMILY AND SOCIETY**

Understanding harmony in the family – The basic unit of human interaction, understanding values in a human-to-human relationship; Understanding Trust – The foundational value in relationship, Difference between intention and competence, Understanding Respect – as the right evaluation, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society – comprehensive Human Goals, Visualizing a universal harmonious order in society– Undivided Society, Universal Order – From family to world family!

**HARMONY IN NATURE AND EXISTENCE**

Understanding the harmony in Nature, Interconnectedness, self-regulation and mutual fulfilment among the four orders of nature – recyclability, Understanding Existence as Coexistence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

**IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in

Professional Ethics – augmenting universal human order, the scope and characteristics of people-friendly and eco-friendly, Holistic Technologies, production systems and management models – Case studies, Strategy for the transition from the present state to Universal Human Order – At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.

**Text Book**

- R R Gaur, R Sangal, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books, New Delhi, 2nd Revised Edition, 2019.

**Reference Books & web resources**

- A Nagaraj, "Jeevan Vidya: Ek Parichaya", Jeevan Vidya Prakashan, Amarkantak, 1999.
- A N Tripathi, "Human Values", New Age Intl Publishers, New Delhi, 2004.
- "The Story of Stuff" (Book).
- Mohandas Karamchand Gandhi, "The Story of My Experiments with Truth".
- E F Schumacher, "Small is Beautiful"
- Cecile Andrews, "Slow is Beautiful"
- J C Kumarappa, "The Economy of Permanence"
- Pandit Sunderlal, "Bharat Mein Angreji Raj"
- Dharampal, "Rediscovering India"
- Mohandas K Gandhi, "Hind Swaraj or Indian Home Rule"
- Maulana Abdul Kalam Azad, "India Wins Freedom"
- Romain Rolland, "Vivekananda" (English)
- Romain Rolland, "Gandhi" (English)

**Course Designer(s):**

Adopted from AICTE Model Curriculum 2022

22TAAA0 தமிழர் மரபு

| | L | T | P | C |
|---|---|---|---|---|
| | 1 | 0 | 0 | 1 |

**அலகு I: மொழி மற்றும் இலக்கியம்: 3**

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

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

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

**அலகு III: நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3**

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

**அலகு IV: தமிழர்களின் திணைக் கோட்பாடுகள்: 3**

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

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

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

TOTAL : 15 PERIODS

**TEXT-CUM-REFERENCE BOOKS**


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book

and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## 22TAAA0 HERITAGE OF TAMILS

1. Language and Literature: Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

2. Heritage - Rock art paintings to modern art - Sculpture: Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

3. Folk and Martial arts - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

4. Thinai concept of Tamils – Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

5. Contribution of Tamils to Indian National Movement and Indian Culture: Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

## TEXT-CUM-REFERENCE BOOKS


1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)

(Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22TAAB0 **<u>தமிழரும் தொழில்நுட்பமும்</u>** L T P C

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அலகு I: **நெசவு மற்றும் பானைத் தொழில்நுட்பம்:** 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II: **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:** 3

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

அலகு III: **உற்பத்தித் தொழில் நுட்பம்:** 3

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

அலகு IV: **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்:** 3

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

அலகு V: **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:** 3

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

TOTAL : **15** PERIODS

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## PAPER – 2
## 22TAAB0 TAMILS AND TECHNOLOGY

1. **Weaving and Ceramic Technology**: Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

2. **Design and Construction Technology:** Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

3. **Manufacturing Technology**: Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

4. **Agriculture and Irrigation Technology:** Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

5. **Scientific Tamil & Tamil Computing**: Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

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