# Curriculum for UG Degree Course in

# CYBER SECURITY

## Regulation 2022

CHENNAI INSTITUTE OF TECHNOLOGY
Transforming Lives

CHENNAI INSTITUTE OF TECHNOLOGY

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## Section 1: General Course Structure

### A. Definition of Credit:

| | |
|---|---|
| 1 Hour Lecture (L) per week | 1 Credit |
| 1 Hour Tutorial (T) per week | 1 Credit |
| 1 Hour Practical (P) per week | 0.5 Credit |

## B. Structure of Program

| S. No. | Category | Credits |
|---|---|---|
| 1 | Humanities & Social Science Courses (HSMC) | 12 |
| 2 | Basic Science Courses (BSC) | 24 |
| 3 | Engineering Science Courses (ESC) | 14 |
| 4 | Program Core Courses (PCC) | 66 |
| 5 | Professional Elective Courses (PEC) | 18 |
| 6 | Open Elective Courses (OEC) | 06 |
| 7 | Employability Enhancement Skills (EES) | 17 |
| 8 | Mandatory Course (MC) | 00 |
| | **TOTAL** | **157** |

## C. Course code and definition

| Code | Definition |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| C | Credits |
| <CS> | Professional core courses |
| <CS> PE | Professional Elective courses |
| <CS> OE | Open Elective Courses |
| <CS> MC | Mandatory Courses |

- **Course level coding scheme:** Four-digit number used as suffix with the Course Code for identifying the level of the course. Thousand's place denotes regulation number (we use "3" for 2022-23 Regulation) Digit at hundred's place signifies the semester in which course is offered. Last two digits represent the serial order of course within the semester. For example, 3101, 3102, are courses offered during first semester.

## D. Category-wise Courses

**Humanities & Social Science Courses (HSMC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|
| 1. | Communicative English – I | I | 3-0-2-4 |
| 2. | Communicative English – II | II | 2-0-2-3 |
| 3. | தமிழர்மரபு /Heritage of Tamils | III | 1-0-0-1 |
| 4. | தமிழரும்தொழில்நுட்பமும் /Tamil and Technology | IV | 1-0-0-1 |
| 5. | Professional Ethics & Human Values | VII | 3-0-0-3 |
| | | **Total Credits** | **12** |

**Basic Science Courses (BSC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1. | Matrices and Calculus | I | 3-1-0-4 |
| 2. | Engineering Physics | I | 3-0-2-4 |
| 3. | Engineering Chemistry | I | 3-0-2-4 |
| 4. | Probability and statistics | II | 3-1-0-4 |
| 5. | Linear Algebra | III | 3-2-0-4 |
| 6. | Discrete Mathematics | IV | 3-2-0-4 |
| | | **Total Credits** | **24** |

**Engineering Science Courses (ESC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|
| 1. | Problem Solving Using Python | I | 3-0-2-4 |
| 2. | Digital System Design | II | 3-0-2-4 |
| 3. | Engineering Graphics | II | 0-0-4-2 |
| 4. | Fundamental of Data Science | V | 3-0-2-4 |
| | | **Total Credits** | **14** |

**Program Core Courses (PCC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|
| 1. | Application Development Practices | II | 3-0-2-4 |
| 2. | C Programming and Data Structures | II | 3-0-2-4 |
| 3. | Advanced Data Structures and Algorithms | III | 3-0-2-4 |
| 4. | Modern Database Technology | III | 3-0-2-4 |
| 5. | Web Technology | III | 3-0-2-4 |
| 6. | Cryptography and Cyber security | III | 3-0-2-4 |
| 7. | Advanced Java Programming | III | 3-0-2-4 |
| 8. | Operating System | IV | 3-0-2-4 |
| 9. | Introduction to Artificial Intelligence and Machine Learning | IV | 3-0-2-4 |
| 10. | Computer Networks | IV | 3-0-2-4 |
| 11. | Web Frameworks | IV | 3-0-2-4 |
| 12. | Software Engineering | IV | 3-0-2-4 |
| 13. | Computing Theory and Compiler Design | V | 3-0-0-3 |
| 14. | Computer Architecture | V | 3-0-0-3 |
| 15. | Core Course Project – I | V | 0-0-2-1 |
| 16. | Cyber Crime and Forensics | VI | 2-0-2-3 |
| 17. | Malware Analysis | VI | 2-0-2-3 |
| 18. | Cryptocurrency and Blockchain Technologies | VI | 3-0-2-4 |
| 19. | Core Course Project – II | VI | 0-0-2-1 |
| | | **Total Credits** | **66** |

**Professional Elective courses**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Professional Elective – I | V | 3-0-2-3 |
| 2 | Professional Elective – II | V | 3-0-2-3 |
| 3 | Professional Elective – III | V | 3-0-2-3 |
| 4 | Professional Elective – IV | VI | 3-0-2-3 |
| 5 | Professional Elective –V | VI | 3-0-2-3 |
| 6 | Professional Elective –VI | VI | 3-0-2-3 |
| | | **Total Credits** | **18** |

**Open Elective Courses (OEC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|
| 1 | Open Elective – I | VI | 3-0-0-3 |
| 2 | Open Elective – II | VII | 3-0-0-3 |
| | | **Total Credits** | **06** |

**Mandatory Course (MC)**

| S. No. | Course Title | Semester | L-T-P-C |
|---|---|---|---|
| 1. | Mandatory Courses I | I | 2-0-0-0 |
| 2. | Mandatory Courses II | II | 2-0-0-0 |
| | | | |
| | | | |
| | | | |
| | | **Total Credits** | **00** |

**A. Induction Program**

***Catapult*** is a dynamic week-long event designed for our incoming first-year students, offering an immersive introduction to the diverse array of clubs and activities across the college campus. In addition to familiarizing them with our labs and Centers of Excellence (COEs), Catapult aims to acclimate first-year students to college life, ensuring they feel at ease with the forthcoming experiences of their four-year journey.

This initiative fosters meaningful connections between seniors and juniors, providing a platform for them to explore departmental projects and engage in collaborative activities, thereby enhancing camaraderie and knowledge sharing within the college community.

**B. Evaluation Scheme**

**a. For Theory Courses:**

The weightage of internal assessment is 40% and for End Semester Exam is 60%. The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

**b. For Practical Courses:**

The weightage of internal assessment is 60% and for End Semester Exam is 40%
For Theory cum Lab
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass.

**c. For Theory Cum Practical Courses:**

The weightage of internal assessment is 50% and for End Semester Exam is 50%
The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass

**Note**: The internal assessment is based on the student's performance in 3 Internal Assessment (IA) exams, quizzes, assignments, class performance, attendance, etc.

**d. For Project works:**

Assessment of project works comprises three internal reviews and an end-of-semester evaluation. Internal reviews, worth 40 marks in total, encompass assessment criteria such as Project Synopsis/Proposal Evaluation, Methodology and Design of Existing System, Feasibility of Project Proposal, Planning of Project Work, and Team Work. At the conclusion of the semester, 20 marks are designated for assessing the quality of the report, while the remaining 40 marks are reserved for evaluating performance in viva-voce, demonstration of the work, and other relevant factors.

**C. Learning Beyond Class Room**

a. Students should be encouraged to visit Centers of Excellences (COEs) in the campus and learn additional technical skills
b. Students should be encouraged to participate in internal / external competitions, hackathons, etc. on a regular basis

## Section 2: Semester wise Structure and Curriculum for UG Course in CYBER SECURITY

| Semester I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1. | T | IP2100 | Induction Programme | 0 | 0 | 0 | 0 |
| 2. | T | HS2101 | Communicative English - I | 3 | 0 | 0 | 3 |
| 3. | T&P | MA2102 | Matrices and Calculus | 3 | 1 | 0 | 4 |
| 4. | T&P | PH2103 | Engineering Physics | 3 | 0 | 0 | 3 |
| 5. | T&P | CH2104 | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 6. | T&P | CS2105 | Problem Solving using Python | 3 | 0 | 0 | 3 |
| 7. | T&P | ES2106 | Employability Enhancement Skills | 0 | 0 | 2 | 1 |
| 8. | T&P | BS2107 | Physics and Chemistry Laboratory | 0 | 0 | 4 | 2 |
| 9. | P | CS2108 | Problem-Solving using Python Laboratory | 0 | 0 | 4 | 2 |
| 10. | P | HS2109 | Communicative English - I | 0 | 0 | 2 | 1 |
| | | | | | | **Total** | **22** |

| Semester II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1. | T | MA2201 | Probability and Statistics | 3 | 2 | 0 | 4 |
| 2. | T | HS2201 | Communicative English - II | 2 | 0 | 2 | 3 |
| 3. | T&P | CS2201 | Application Development Practices | 3 | 0 | 2 | 4 |
| 4. | T&P | CS2202 | Programming and Data Structures using C | 3 | 0 | 2 | 4 |
| 5. | T&P | CS2203 | Digital Principles and Computer Organization | 3 | 0 | 2 | 4 |
| 6. | T&P | ME2211 | Engineering Graphics | 0 | 0 | 4 | 2 |
| 7. | P | ES2201 | Employability Enhancement Skills - II | 0 | 0 | 2 | 1 |
| 8. | P | GE2201 | Environmental Sciences and Sustainability | 2 | 0 | 0 | 0 |
| | | | | | | **Total** | **22** |

| Semester III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1. | T | HS2301 | தமிழர்மரபு /Heritage of Tamils | 1 | 0 | 0 | 1 |
| 2. | T | MA2301 | Linear Algebra | 3 | 1 | 0 | 4 |
| 3. | T&P | CY2301 | Advanced Data Structures and Algorithms | 3 | 0 | 2 | 4 |
| 4. | T&P | CY2302 | Modern Database Technology | 3 | 0 | 2 | 4 |
| 5. | T&P | CY2303 | Web Technology | 3 | 0 | 2 | 4 |
| 6. | T&P | CY2304 | Cryptography and Cyber security | 2 | 0 | 2 | 3 |
| 7. | T&P | CY2305 | Advanced Java Programming | 3 | 0 | 2 | 4 |
| 8. | P | ES2301 | Employability Enhancement Skills - III | 0 | 0 | 2 | 1 |
| 9. | P | MC2301 | Core Course Project | 2 | 0 | 0 | 1 |
| | | | | | | **Total** | **26** |

| Semester IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1 | T | MA2401 | Discrete Mathematics | 3 | 1 | 0 | 4 |
| 2. | T&P | CY2401 | Operating Systems | 3 | 0 | 2 | 4 |
| 3. | T&P | CY2402 | Introduction to Artificial Intelligence and Machine Learning | 3 | 0 | 2 | 4 |
| 4. | T&P | CY2403 | Computer Networks | 3 | 0 | 2 | 4 |
| 5. | T&P | CY2404 | Web Frameworks | 3 | 0 | 2 | 4 |
| 6. | P | CY2405 | Software Engineering | 3 | 0 | 2 | 4 |
| 7. | P | ES2401 | Employability Enhancement Skills - IV | 0 | 0 | 2 | 1 |
| 8. | T | HS2401 | தமிழ-தெதாழி□¤yபJ/Tamils and Technology | 1 | 0 | 0 | 1 |
| | | | | | | **Total** | **26** |

| Semester V |
|---|

| S. No | Theory/ Practical / T&P | Course Code | Course Title | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1. | T | CZ2501 | Computing Theory and Compiler Design | 3 | 0 | 0 | 3 |
| 2. | T | CZ2502 | Computer Architecture | 3 | 0 | 0 | 3 |
| 3. | T&P | CZ2503 | Fundamental of Data Science | 3 | 0 | 2 | 4 |
| 4. | T&P | CZPE25XX | Professional Elective-I | 2 | 0 | 2 | 3 |
| 5. | T&P | CZPE25XX | Professional Elective-II | 2 | 0 | 2 | 3 |
| 6. | T&P | CZPE25XX | Professional Elective-III | 2 | 0 | 2 | 3 |
| 7. | P | ES2501 | Employability Enhancement Skills – V | 0 | 0 | 2 | 1 |
| 8. | P | CC2501 | Core Course Project - I | 0 | 0 | 2 | 1 |
| | | | | | | **Total** | **21** |

| **Semester VI** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1 | T | CZOE26XX | Open Elective I | 3 | 0 | 0 | 3 |
| 2 | T&P | CZ2601 | Cyber Crime and Forensics | 2 | 0 | 2 | 3 |
| 3 | T&P | CZ2602 | Malware Analysis | 2 | 0 | 2 | 3 |
| 4 | T&P | CZ2603 | Cryptocurrency and Blockchain Technologies | 3 | 0 | 2 | 4 |
| 5 | T&P | CZPE26XX | Professional Elective- IV | 2 | 0 | 2 | 3 |
| 6 | T&P | CZPE26XX | Professional Elective-V | 2 | 0 | 2 | 3 |
| 7 | P | CC2601 | Core Course Project - II | 0 | 0 | 2 | 1 |
| | | | | | | **Total** | **20** |

| **Semester VII** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1 | T | CZOE27XX | Open Elective-II | 3 | 0 | 0 | 3 |
| 2 | T | HS2701 | Professional Ethics and Universal Human Values | 3 | 0 | 0 | 3 |
| 3 | T | CZPE27XX | Professional Elective-VI | 2 | 0 | **2** | 3 |
| 4 | P | ES2701 | Internship | 0 | 0 | 8 | 4 |
| | | | | | | **Total** | **13** |

| **Semester VII** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No** | **Theory/ Practical / T&P** | **Course Code** | **Course Title** | **L** | **T** | **P** | **C** |
| 1 | P | ES2801 | Project | 0 | 0 | 24 | 8 |
| | | | | | | **Total** | **8** |

| Course Code | COMMUNICATIVE ENGLISH | L | T | P | C |
|---|---|---|---|---|---|
| HS2102 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

**CO1**: To enhance vocabulary competency.
**CO2**: To learn to use basic grammatical structures in suitable contexts.
**CO3**: To identify syntax errors in a written text.
**CO4**: To make learners write instructions, recommendations, and product descriptions.
**CO5**: To develop learners' ability to write summaries, articles, blogs, definitions and essays.

**Unit I - Introduction to Effective Communication 9**

What is effective communication? Why is communication critical for excellence during, Study, research, and work? What are the seven C's of effective communication**- Fundamentals of communication: Vocabulary** – Synonyms & Antonyms and One Word Substitutes, **Grammar** – Parts of speech Tenses and Active and Passive Voice, **Writing** – E-mail writing, Letter of Introduction and Paragraph Writing.

**Unit II – Definitions and Instructions 9**

**Vocabulary** – Abbreviation & Acronyms. Word Forms (Prefixes and Suffixes), **Grammar** – Question Types Prepositions and Imperatives. **Writing** – Instructions and Definitions.

**Unit III – Description of a Process / Product 9**

**Vocabulary** – Homonyms & Homophones, Phrasal Verbs and Compound Nouns. **Grammar** – Adjectives, Degrees of Comparison and Articles. **Writing** – Product Description, Process Description and Recommendations.

**Unit IV – Decoding Non-Verbal Data 9**

**Vocabulary** – Fixed & Semi-fixed expressions, Discourse Markers and Collocation. **Grammar** – Possessive & Relative Pronouns and Punctuation. **Writing** – Decoding Pictorial Data

**Unit V – Exposition 9**

**Vocabulary** – Cause & Effect Expressions, Content words and Function Words. **Grammar** – Negation, Types of Sentences & Error Spotting. **Writing** – Descriptive Essay, Argumentative Essay & Repository Essays.

**TOTAL: 45PERIODS**

**COURSE OUTCOMES:**

At the end of the course, learners will be able

**CO1**: To use appropriate words in a professional context
**CO2**: To gain an understanding of basic grammatical structures and use them in the right context.
**CO3**: To communicate and write without syntax errors.
**CO4**: To write recommendations, instructions, and product descriptions.
**CO5**: To write summaries, articles, blogs, definitions, and essays.

**Text Books:**

1. English for Engineers & Technologists Orient Blackswan Private Ltd.Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021.Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

**References:**

1. Technical Communication – Principles and Practices by Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English by Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.

| Course Code | MATRICES AND CALCULUS | L | T | P | C |
|---|---|---|---|---|---|
| MA2102 | | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVE**

- To develop the use of matrix algebra techniques that is needed by engineers for Practical applications
- To familiarize the students with differential calculus.
- To familiarize the student with the functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

**UNIT I MATRICES** **9+3**

Eigen values and Eigen vectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigen vectors–Cayley- Hamilton theorem Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms– Applications: Stretching of an elastic membrane.

**UNIT II DIFERNTIAL CALCULUS** **9+3**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation –Applications: Maxima and Minima of functions of one variable.

**UNIT III FUNCTIONS OF SEVERAL VARIABLES** **9+3**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

**UNIT IV INTEGRAL CALCULUS** **9+3**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals -Applications: Hydrostatic force and pressure, Arc length, Areas of surface of revolution.

**UNIT V MULTIPLE INTEGRALS** **9+3**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple

integrals – Applications: Moments and centres of mass, moment of inertia.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES**

At the end of the course the students will be able to

**CO1**: Recalling the matrix algebra methods for solving the PRACTICALS problems.

**CO2**: Apply differential calculus tools in solving various application problems.

**CO3**: Extending the differential calculus ideas on several variable functions.

**CO4**: Understanding different methods of integration in solving PRACTICALS problems.

**CO5**: Developing the multiple integral ideas in solving areas ,volumes and other PRACTICALS problems.

**TEXTBOOKS**


1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10thEdition, New Delhi,2016.
2. Grewal.B.S.,"Higher Engineering Mathematics", Hanna Publishers, NewDelhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8thEdition, New Delhi,2015. [For Units II&IV-Sections1.1, 2.2,2.3, 2.5,2.7 (Tangents problems only), 2.8,3.1to3.6, 3.11,4.1,4.3, 5.1(Area problems only),5.2,5.3,5.4 (excluding net change theorem),5.5, 7.1- 7.4and 7.8].


**REFERENCES**


1. Anton. H, Bivens.I and Davis.S, "Calculus ", Wiley,10thEdition,2016
2. Bali.N., Goyal.M., and Watkins. C, "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt ., Ltd.,), NewDelhi,7thEdition,2009.
3. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, NewDelhi, 5th Edition,2016.
4. Narayanan. S. and Manicavachagam Pillai.T.K. "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd. Chennai,2009.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt.Ltd, NewDelhi,2016.
6. Srimantha Pal and Bhunia. S.C," Engineering Mathematics "OxfordUniversityPress,2015.
7. Thomas.G.B.Hass. J, and Weir.M.D,"ThomasCalculus", 14th Edition, PearsonIndia,2018.

| Course Code | ENGINEERING PHYSICS | L | T | P | C |
|---|---|---|---|---|---|
| PH2103 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVE**

**CO1**: To make the students effectively to achieve an understanding of mechanics.

**CO2**: To enable the students to gain knowledge of Properties of matter and its applications.

**CO3**: To introduce the basics of Fibre optics.

**CO4**: To motivate the students towards the applications of Laser.

**CO5**: To equip the students to be successfully understand the importance of quantum physics.

**UNIT I MECHANICS** **9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M.I – moment of inertia of continuous bodies (Ring, Disc) - moment of inertia of diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - Gyroscope - Torsional pendulum.

**UNIT II PROPERTIES OF MATTER** **9**

Elasticity - Hooke's law - Relationship between three moduli of elasticity (quantitative) – stress-strain diagram – Poisson's ratio - Factors affecting elasticity – bending of beams - Bending moment – Depression of a cantilever: THEORY and experiment - Young's modulus by uniform bending and non-uniform bending: THEORY and experiment - I-shaped girders.

**UNIT III FIBRE OPTICS** **9**

Reflection and refraction of light waves – interference – Michelson interferometer - THEORY of air wedge and experiment - total internal reflection - Fiber optics: Principle, Numerical aperture and acceptance angle – types of optical fibers (material, refractive index, mode)- fiber optic communication – losses associated with optical fibers-fiber optic sensors: pressure and displacement-medical endoscope.

**UNIT IV LASER 9**

THEORY of laser - characteristics - Spontaneous and stimulated emission - Components of Laser-Pumping methods - Optical Resonator – Active medium and Active c entre - Einstein's coefficients -population inversion – Types of laser - Nd-YAG laser, $CO_2$ laser, Semiconductor lasers: homo junction and hetero junction laser– Applications of lasers in industry and military.

**UNIT V QUANTUM MECHANICS** **9**

Photons and light waves - Electrons and matter waves – Compton effect: THEORY and experimental verification - Concept of wave function and physical significance - The Schrödinger equation (Time-dependent and time-independent forms) - meaning of wave function - Normalization – Free particle - particle in an infinite potential well: 1D, 2D, and 3D Boxes – Barrier penetration and quantum tunneling (qualitative) - Tunneling microscope.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES**

After completion of this course, the students should be able to

CO1: Understand the importance of mechanics.

CO2: Express their knowledge in properties of matter.

CO3: Demonstrate a strong foundational knowledge in fibre optics.

CO4: Comprehend and apply laser principles.

CO5: Understand the importance of quantum physics.

**TEXTBOOKS**


1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition),2017.
2. Arthur Beiser, Shobhit Mahajan, S.RaiChoudhury, Concepts of Modern Physics, McGraw-Hill (IndianEdition),2017.
3. GaurR.K.andGuptaS.L. Engineering Physics. Dhanpat Rai publishers,2009


**REFERENCES**


1. R.Wolfson. Essential University Physics. Volume1&2.Pearson Education (IndianEdition),2009.
2. K.ThyagarajanandA.Ghatak.Lasers:Fundamentals and Applications, Laxmi Publications, (IndianEdition),2019.
3. D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley(IndianEdition),2015.
4. Searls and Zemansky. University Physics,2009

| Course Code | ENGINEERING CHEMISTRY | L | T | P | C |
|---|---|---|---|---|---|
| CH2104 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

CO1:To inculcate a sound understanding of water quality parameters and water treatment techniques.

CO2:To impart knowledge on the basic principles and preparatory methods of nanomaterials.

CO3:To facilitate the understanding of different types of fuels, their preparation, properties, and combustion characteristics..

CO4:To familiarize the students with the operating principles, working processes, and applications of energy conversion and storage devices.

CO5: The student should be conversant with the principles of electrochemistry, electrochemical cells, emf, and applications of emf measurements. Principles of corrosion control.

**UNIT I WATER AND ITS TREATMENT** **9**

Water: Sources and impurities, Water quality parameters: Definition and significance of pH, hardness, alkalinity, TDS, COD, and BOD. Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate, and calgon conditioning) and External treatment Ion exchange demineralization and zeolite process.

**UNIT II NANO CHEMISTRY** **9**

Basics: Distinction between molecules, nanomaterials, and bulk materials; Size-dependent properties (optical, electrical, mechanical, and magnetic); Types of nanomaterials: Definition, properties, and uses of – nanoparticle, nanocluster, nanorod, nanowire, and nanotube. Preparation of nanomaterials: laser ablation and electrospinning. An application of nanomaterials in medicine, agriculture, energy, electronics, and catalysis.

**UNIT III FUELS AND COMBUSTION** **9**

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking-octane number, diesel oil-cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Flue gas analysis-ORSAT Method. CO2 emission and carbon footprint.

**UNIT IV ENERGY SOURCES AND STORAGE DEVICES** **9**

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working, and applications of solar cells; recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery-dry cell, Secondary battery-lead acid battery, and lithium-ion battery; Electric vehicles-working principles; Fuel cells: H2-O2 fuel cell.

**UNIT V ELECTRO CHEMISTRY AND CORROSION**
**9**

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Calomel electrode – electrochemical series – significance Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods.

**TOTAL:45PERIODS**

**COURSE OUTCOMES:**

At the end of the course, the students will be able:

**CO1**: To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
**CO2**: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
**CO3**: To apply the knowledge of phase rule and composites for material selection requirements.
**CO4**: To recommend suitable fuels for engineering processes and applications.
**CO5:** To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

**TEXTBOOKS:**


1. P.C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
3. S.S. Dara, "A textbook of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018


**REFERENCES:**


1. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, "Textbook of Nanoscience and Nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry", McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry - Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry - A Textbook for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

| Course Code | PROBLEM SOLVING USING PYTHON | L | T | P | C |
|---|---|---|---|---|---|
| CS2105 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

CO1: To understand the basics of algorithmic problem statements.

CO2: To learn to solve problems using Python conditionals and loops.

CO3: To define Python functions and use function calls to solve problems.

CO4: To use Python data structures-lists, tuples, dictionaries to represent complex data.

CO5: To do input/output with files in Python.

**UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING** **9**

Identification of Computational Thinking, Algorithms, building blocks of algorithms (statements, state, control flow, functions), Algorithmic representation (pseudocode, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).

**UNIT II DATATYPES, EXPRESSIONS, STATEMENTS** **9**

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string and list; variables, expressions, statements, tuple assignment, Boolean values and operators, precedence of operators, comments.

**UNIT III CONTROLFLOW, FUNCTIONS, STRINGS** **9**

Conditionals: conditional(if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module.

**UNIT IV LISTS, TUPLES, DICTIONARIES**
**9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing-list comprehension, List as arrays.

**UNIT V FILES, MODULES & PACKAGES**

**9**

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, Modules, Packages.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals loops and functions for solving problems.
CO4: Process compound data using Python data structures.
CO5: Utilize Python packages in developing software applications.

**TEXTBOOKS:**


1. Reema Thareja, “Python Programming Using Problem Solving Approach” 2nd Edition, Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O’Reilly Publishers, 2016.
3. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.


**REFERENCES:**


1. JohnVGuttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, ThirdEdition, MITPress,2021
2. Paul Deitel and HarveyDeitel, “Python for Programmers”, Pearson Education,1st Edition,2021.
3. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
4. Eric Matthes, “Python Crash Course, A Hands-on Project-Based Introduction to Programming”, 2nd Edition, No Starch Press,2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”,4th Edition, Mc-GrawHill,2018.

| Course Code | EMPLOYABILITY ENHANCEMENT SKILLS- I | L | T | P | C |
|---|---|---|---|---|---|
| ES2106 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

CO1:To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.

C02:To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.

C03:To critically evaluate numerous possibilities related to puzzles.

**UNIT I Numbers** **9**

Introduction – Classification of numbers – Formation of Numbers (Small & Large) –Place Value – FaceValue – Divisibility Rule – Prime, Composite Numbers – Prime Factorization – Number of factors – Number of factors (Odd & Even) – Sum of factors – Successors and Predecessors – Greatest Integer Value – Vedic Mathematics – Trailing Zeroes – Unit Digits–Remainder Theorem – Real Number – Rational Numbers: Integers, Fractions – Comparison of Numbers – Operations on fractions – Scientific Notation.

**UNIT II Problems on Letters, Numbers and Symbols** **9**

Factors and Multiples, LCM and HCF – Relationship between LCM and HCF – Factorial – Simplification – VBODMAS – Square, Square Root – Cube, Cube Root – Exponents & Powers (Surds and Indices) – Sequence & Series: Arithmetic Progression – Geometric Progression – Special Progression, Letter Series, Number Series, Alpha – Numeric Series, Continuous Pattern Series

**UNIT III Verbal and Non-Verbal Reasoning** **9**

Verbal Reasoning – Analogy: Completing the Analogous pair, Direct Analogy, Choosing the Analogous pair, Double Analogy, Choosing a Similar Word, Detecting Analogies, Multiple word Analogy, Number Analogy, Alphabet Analogy – Classification: Odd Words and Numerals – Coding and Decoding: Letter, Number, Symbol, Matrix, Substitution, Deciphering Message Word, Number and Symbols. Non – Verbal Reasoning Figure Series – Missing figure, Incorrect figure – Analogy: Similarity Related Pair, Similarity Related figures, unrelated figures, Group of figures.

**UNIT IV Ratio and Proportion** **9**

Introduction – Ratio – Proportion: Direct and Indirect – Unitary Method – Problems on Ages – Chain Rule – Partnership – Mixture or Allegation – Time and Work: Individual, Group, Efficiency, Wages – Pipes and Cistern: Inlet, Outlet, and Leakage

**UNIT V Percentage** **9**

Introduction – Percentages in real life – Profit and Loss – Discount– Simple Interest – Compound Interest – Relationship between Simple Interest and Compound Interest – Overhead Expenses and GST

**COURSE OUTCOMES:**

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

CO1: Develop the arithmetic ability and properties of numbers that we use in day-to-day life.
CO2: Demonstrate the logic behind the formation of numbers, alphabets series.
CO3: Apply the reasoning methods logically and evaluate complex relationships between the variables and numbers
CO4: Use the concept of ratios and proportion in ages and partnership problems.
CO5: Apply the short cuts of the mathematical tricks to reduce the time duration in problem solving.

**TEXT BOOKS:**


1. Aggarwal, R.S, "Quantitative Aptitude for Competitive Examinations (Revised edition)", S Chand Publishing, 2017.
2. Arun Sharma, "Teach Yourself Quantitative Aptitude", McGraw Hill Education, 2017
3. Aggarwal, R.S, "A Modern Approach to Verbal & Non-Verbal Reasoning" 2nd edition, S Chand Publishing, 2018.


**REFERENCES:**


1. Akhilesh Khare,"Shortcuts in Mathematics", Createspace Independent Pub, 2015.
2. Ravi Shankar,"Vedic Maths for Competitive Exams", Pustak Mahal, 2016.
3. Abhijit Guha, "Quantitative Aptitude for Competitive Examinations", 7th edition, McGraw Hill Education, 2020.


**TOTAL: 30 PERIODS**

| Course Code | PHYSICS AND CHEMISTRY LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| BS2107 | | 3 | 0 | 0 | 3 |

**PHYSICS LABORATORY**

**(Any Five Experiments** to be conducted**)**

**COURSE OBJECTIVES:**

C01: To learn the proper use of various kinds of physics laboratory equipment.

C02: To learn how data can be collected, presented, and interpreted in a clear and concise manner.

C03: To learn problem-solving skills related to physics principles and interpretation of experimental data.

C04: To determine error in experimental measurements and techniques used to minimize such errors.

C05: To make the student an active participant in each part of all lab exercises.

C06: Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.

C07: Non-uniform bending - Determination of Young's modulus.

C08: Uniform bending – Determination of Young's modulus.

C09: Laser - Determination of the wavelength of the laser using grating.

C010: Air wedge - Determination of thickness of a thin sheet/wire.

C011: Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids.

**TOTAL :30PERIODS**

**COURSE OUTCOMES:**

Upon completion of the course, the students should be able to

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyze laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

**CHEMISTRYLABORATORY:**
**(Any Five experiments to be conducted)**

**COURSE OBJECTIVES:**

CO1: To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, dissolved oxygen, chloride, and copper.
CO2: To induce the students to familiarize with electroanalytical techniques such as pHmetry, potentiometry, and conductometry in the determination of impurities in aqueous solutions.
C03: To demonstrate the analysis of metals and alloys.
C04: To demonstrate the synthesis of nanoparticles.
C05: Determination of types and amount of alkalinity in water sample.
C06: Determination of total, temporary, and permanent hardness of water by EDTA method.
C07: Determination of chloride content of water sample by Argentometric method.
C08: Determination of strength of given hydrochloric acid using pH meter.
C09: Determination of HCl acid using conductivity meter.
C010: Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
C011: Estimation of iron content of the given solution using potentiometer.

**TOTAL :30PERIODS**

**COURSE OUTCOMES:**

- To analyze the quality of water samples with respect to their acidity, alkalinity, and hardness.
- To learn the amount of chloride present in the water sample by quantitative analysis.
- To quantitatively analyze the impurities in solution by electroanalytical techniques.

**TEXTBOOK:**

1.Mendham, R.C., Denney, J.D., Barnes, M., Thomas, M., & Sivasankar, B. (2009). Vogel's Textbook of Quantitative Chemical Analysis.

| Course Code | PROBLEM SOLVING USING PYTHON LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| CS2108 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

C01:To understand the problem solving approaches.
C02:To learn the basic programming constructs in Python.
C03:To practice various computing strategies for Python-based solutions to real world problems.
C04:To use Python data structures - lists, tuples, dictionaries.
C05:To do input/output with files in Python.

**EXPERIMENTS:**

1. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**

On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals loops and functions for solving problems.
CO4: Process compound data using Python data structures.
CO5: Utilize Python packages in developing software applications.

**TEXT BOOKS:**


1. Reema Thareja “Python Programming Using Problem-Solving Approach” 2nd Edition, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
3. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving andProgramming”,1st Edition, BCS Learning& Development Limited, 2017.

| Course Code | COMMUNICATIVE ENGLISH LABORATORY I | L | T | P | C |
|---|---|---|---|---|---|
| HS2109 | | 0 | 0 | 2 | 1 |

**REFERENCES:**


1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
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 Modeling and Understanding Data‘‘, Third Edition, MIT Press , 2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

**COURSE OBJECTIVES:**

| Course Code | PROBABILITY AND STATISTICS | L | T | P | C |
|---|---|---|---|---|---|
| MA2201 | | 3 | 1 | 0 | 4 |

C01:To improve the communicative competence of learners
C02:To learn to use basic grammatical structures in everyday communication.
C03:To listen and comprehend meaning in reference to the context.
C04:To acquire lexical competence and understand their meaning in a text
C05:To develop learners' ability to read complex texts, summaries, articles, blogs, definitions, essays, and user manuals.

**Module I – Speaking** **20**

Self-Introduction, Introducing Others, Product Description and Sales, Narrating Personal Experience, Panel Discussion, Just a Minute, and Movie Review

**Module II – Listening** **5**

Best of TED Talks, Podcasts, Celebrity Interviews, Speech by Native Speakers, and Short Films

**Module III – Reading** **5**

Brochure, User Manual, Biography, Autobiography, Novel, Short Story, News Paper, Gadget Review, and Blogs

**Course Outcome:**

At the end of the course, learners will be able

CO1: To introduce oneself and others.

CO2: To narrate and discuss ideas

CO3: To describe and communicate persuasively.

CO4: To understand a conversation and reply accordingly.

CO5: To read and infer the denotative and connotative meanings of technical and Non-technicaltexts.

**Text Books:**

1. Effective Communication Skill, KulbhusanKumar ,R S Salaria, Khanna Publishing House.

**References:**

1. English for Engineers & Technologists Orient Blackswan Private Ltd.Department of English,
   Anna University, (2020 edition)
2. Learning to Communicate–Dr.V.Chellammal, Allied Publishing House,

**SEMESTER–II**

**COURSE OBJECTIVES:**

**C01**: This course aims at providing the required skills to apply statistical tools to engineering problems.

**C02:** To introduce the basic concepts of probability and random variables.

**CO3:** To introduce the basic concepts of two-dimensional random variables.

**C04:** To acquaint the knowledge of testing of hypotheses for small and large samples, which plays an important role in real-life problems.

**C05:** To introduce the basic concepts of classification of design of experiments, which plays very important roles in the field of agriculture and statistical quality control.

**UNIT I ONE DIMENSIONAL RANDOM VARIABLES** **12**

Probability –Discrete and continuous random variables – Moments – Moment generating functions –Binomial,Poisson,Geometric,Uniform, Exponential and Normal distributions.

**UNIT II TWO DIMENSIONAL RANDOM VARIABLES** **12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linearregression–Transformation ofrandomvariables–Central limit theorem(excludingproof).

**UNIT III TESTING OF HYPOTHESIS** **12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests basedon Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance-Contingencytable(test for independent)-Goodness of fit.

**UNIT IV DESIGN OF EXPERIMENTS** **12**

One way and two-way classifications-Completely randomized design – Randomized blockdesign– Latin square design-$2^2$ factorial design.

**UNIT V STATISTICAL QUALITY CONTROL** **12**

Control charts for measurements (X and R charts) –Control charts for attributes (p, c and npcharts)– Tolerance limits – Acceptance sampling.

**TOTAL:60PERIODS**

**COURSE OUTCOMES:**

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

CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real-life phenomena.

CO2: Understand the basic concepts of one-and two-dimensional random variables and apply them in engineering applications.

CO3: Apply the concept of testing of hypotheses for small and large samples in real-life problems.

CO4: Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.

CO5: Have the notion of sampling distributions and statistical techniques used in engineering and management problems

**TEXTBOOKS:**


1. Johnson, R.A., Miller, I., and Freund, J. (2015). "Miller and Freund's Probability and Statistics for Engineers." Pearson Education, Asia, 8th Edition.
2. Milton, J.S., and Arnold, J.C. (2007). "Introduction to Probability and Statistics." Tata McGraw Hill, 4th Edition.


**REFERENCES:**


1. Devore, J.L. (2014). "Probability and Statistics for Engineering and the Sciences." Cengage Learning, New Delhi, 8th Edition.
2. Papoulis, A., and Unnikrishnapillai, S. (2010). "Probability, Random Variables and Stochastic Processes." McGraw Hill Education India, 4th Edition, New Delhi.
3. Ross, S.M. (2004). "Introduction to Probability and Statistics for Engineers and Scientists." 3rd Edition, Elsevier.
4. Spiegel, M.R., Schiller, J., and Srinivasan, R.A. (2004). "Schaum's Outline of Theory and Problems of Probability and Statistics." Tata McGraw Hill Edition.
5. Walpole, R.E., Myers, R.H., Myers, S.L., and Ye, K. (2007). "Probability and Statistics for Engineers and Scientists." Pearson Education, Asia, 8th Edition.

| Course Code | COMMUNICATION ENGLISH II | L | T | P | C |
|---|---|---|---|---|---|
| HS2201 | | 1 | 0 | 4 | 3 |

**COURSE OBJECTIVES:**

CO1: To engage learners in meaningful language activities to improve their LSRW skills.

C02: To enhance learners' awareness of general rules of writing for specific audiences.

C03: To help learners understand the purpose, audience, and contexts of different types of writing.

C04: To develop analytical thinking skills for problem-solving in communicative contexts.

C05: To demonstrate an understanding of job applications and interviews for internships and placements.

**UNIT I MAKING COMPARISONS** **6**

Listening – Evaluative Listening: Advertisements, Product Descriptions, -Audio / video; Listening and filling a Graphic Organiser (Choosing a product or service by comparison) Speaking–Marketing a product, Persuasive Speech Techniques. Reading-Reading advertisements, user manuals, brochures; Writing – Letter to the editor; Compare and Contrast Essay; Grammar – Mixed Tenses, Impersonal passive voice; Prepositional phrases Vocabulary–Contextual meaning of words

**UNIT II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING** **6**

Listening - Listening to longer technical talks and completing– gap filling exercises. Listening technical information from podcasts – Listening to process/event descriptions to identify cause &effects - Speaking – Describing and discussing the reasons of accidents or disasters based on news reports. Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints; Problem solution Essay Grammar –Subject-Verb agreement, Infinitive and Gerunds Vocabulary–Adverbs.

**UNIT III PROBLEM SOLVING** **6**

Listening – Listening to / Watching movie scenes/ documentaries depicting a technical problem and suggesting solutions. Speaking – Group Discussion (based on case studies), techniques and Strategies, Reading - Case Studies, excerpts from literary texts, news reports etc., Writing – Check lists, Argumentative Essay Grammar – Error correction; If conditional sentences Vocabulary - Compound Words, Sentence Completion.

**UNIT IV REPORTING OF EVENTS AND RESEARCH** **6**

Listening – Listening Comprehension based on news reports – and documentaries – Precise writing, Summarising, Speaking–Interviewing, Presenting an oral report, Mini presentations on select topics; Reading –Newspaper articles; Writing –Industrial visit Report, Accident Report, Survey Report Grammar–Reported Speech,Modals Vocabulary–Conjunctions-use of prepositions.

**UNIT V REPORTING OF EVENTS AND RESEARCH** **6**

Listening – Listening to TED Talks, Presentations, Formal job interviews, (analysis of the interview performance); Speaking – Participating in a Role play, (interview/telephone interview), virtual

interviews, Making presentations with visual aids; Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses Vocabulary – Idioms.

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

At the end of the course, learners will be able:

CO1: To compare and contrast products and ideas in technical texts.
CO2: To identify cause and effects in events, industrial processes through technical texts.
CO3: To analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.
CO4: To report events and the processes of technical and industrial nature.
CO5: To present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

**TEXT BOOKS:**

1. "English for Engineers & Technologists" (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. "English for Science & Technology" Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

**REFERENCE BOOKS:**


1. Raman, Meenakshi, Sharma, Sangeeta (2019). Professional English. Oxford University Press. New Delhi.
2. Improve Your Writing, ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003.
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd., 1990, Delhi.

| Course Code | APPLICATION DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| CS2201 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

C01: To develop the responsive websites using HTML, CSS.
C02: To implement complex functionalities on webpages using JavaScript.
C03: To set up and create a GitHub repository

**Unit I – HTML** **9**

Introduction to html – html document structure - text elements – lists - images and attributes – hyperlinks - structuring page - semantic html

**Unit II – CSS** **9**

Introduction to CSS - Inline, Internal and External CSS - Styling Text - Combining Selectors - Class and ID Selectors - Working with Colors - Styling Hyperlinks – Layouts: Float, Flexbox and CSS Grid – Web Design Rules and Frameworks

**Unit III – JavaScript** **9**

Introduction to JavaScript – Variables - Data Types – Operators - Strings and Template Literals, if /else Statements - switch Statement - Statements and Expressions – Functions – Arrays – Classes and Objects - Loops

**Unit IV – DOM** **9**

Introduction to DOM – DOM and Events Fundamentals – JavaScript: Behind the Scene.

**Unit V – Asynchronous JavaScript and Deployment** **9**

Asynchronous JavaScript: Promises, ASYNC/AWAIT and AJAX – Deployment – Setting Up Git and GitHub – Git Fundamentals - Pushing to GitHub

**TOTAL: 45 PERIODS**

**List of Experiments**

1. Design a webpage using HTML basic tags.
2. Develop website with suitable contents and links.
3. Design webpages using lists and tables.
4. Build a web client-side Login, Registration form and Dashboard with dropdown menus.
5. Develop a HTML form and validation using HTML5 features.

6. Create a website using HTML:
   To embed an image map in a webpage. To fix the hotspots.
   Show all the related information when the hotspots are clicked.
7. Apply style specification in HTML page using CSS.
8. Develop dynamic web application using HTML, CSS and JavaScript.

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**

Upon completion of the course,students will be able to:
CO1: Build responsive real-world websites with HTML.
CO2: Apply styling to HTML content using CSS.
CO3: Implement dynamic behavior using JavaScript.
CO4: Update the user interface via DOM API.
CO5: Deploy the webpage using Git.

**TEXTBOOKS:**

1. Jennifer Niederst Robbins, "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics", O'Reilly Media, 5th Edition, 2018.
2. "Responsive Web Design with HTML5 and CSS: Build future-proof responsive websites using the latest HTML5 and CSS techniques", 4th Edition, ©2023.
3. "JavaScript: The Definitive Guide: Master the World's Most-Used Programming Language", 7th Edition by David Flanagan.

Reference Books:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Prentice Hall, 6th Edition, 2020.
2. "HTML and CSS: Design and Build Websites", Jon Duckett, Wiley, 2011.

**Online Resources:**

1. https://www.udemy.com/course/design-and-develop-a-killer-website-with-html5-and-css3

**Web References:**

2. https://developer.mozilla.org/en-US/docs/Web/HTML
3. https://developer.mozilla.org/en-US/docs/Web/CSS
4. https://developer.mozilla.org/en-US/docs/Learn/JavaScript
5. https://www.w3schools.com/js

| Course Code | PROGRAMMING AND DATA STRUCTURES USING C | L | T | P | C |
|---|---|---|---|---|---|
| CS2202 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

C01:To learn the features of C.
C02: To learn the basics of array, function, pointers, and structure.
C03: To explore the applications of linear data structures.

**UNIT I BASICS OF C PROGRAMMING** **9**

Introduction to programming paradigms – Applications of C Language - Structure of C program – C programming: Data Types-Constants–Enumeration Constants - Keywords–Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements –Decision making statements - Switch statement - Looping statements – Preprocessor directives –Compilation process.

**UNIT I: ARRAYS AND FUNCTIONS** **9**

Introduction to Arrays: Declaration, Initialization – One-dimensional array – Two-dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search. Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions - Parameter passing: Pass by value, Pass by reference.

**UNIT III: POINTERS AND STRUCTURES** **9**

Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Storage classes and Visibility.

**UNIT IV: LINEAR DATA STRUCTURES – LIST** **9**

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 Manipulation – All operation (Insertion, Deletion, Merge, Traversal)

**UNIT V: LINEAR DATA STRUCTURES – STACKS, QUEUES** **9**

Stack ADT – Evaluating arithmetic expressions – other applications – Queue ADT – circular queue implementation – Double-ended Queues – applications of queues45PERIODS

**PRACTICALEXERCISES:30PERIODS**

1. Simple C Programs
2. Using if and Switch Constructs Programs
3. Looping Statements Problems
4. Functions and Recursive Programs
5. Arrays, Strings and Matrices Programs
6. Pointers and Arrays Programs

7. Stacks, Queues, Expression Evaluation Programs
8. Infix to Postfix Conversion
9. Linked List Programs: List, Merging Lists, Linked List, Single Linked List, Double Linked List, Header Linked List, Insertion and Deletion of Linked List, Traversing a Linked List.

**COURSE OUTCOMES:**

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

CO1: Develop the programming skills to solve given problem.
CO2: Use arrays and functions in C programming.
CO3: Apply the concept of Pointers and Structures in solving problems.
CO4: Write functions to implement linear data structure operations.
CO5: Apply appropriate linear data structure for solving a given problem.

**TOTAL: 75 PERIODS**

**TEXTBOOKS:**

1. Pradip Dey and Manas Ghosh, "Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

**REFERENCES:**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996.

2. Alfred V. Aho, John E. Hopcroft, and Jeffrey D. Ullman, "Data Structures and Algorithms, Pearson Education, 1983.

3. Robert Kruse, C.L. Tondo, Bruce Leung, Shashi Mogalla, "Data Structures and Program Design in C, Second Edition, Pearson Education, 2007.

4. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

| Course Code | DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION | L | T | P | C |
|---|---|---|---|---|---|
| CS2203 | | 3 | 0 | 2 | 4 |

**COURSEOBJECTIVES:**

**C01:**To analyze and design combinational circuits.

**C02:** To analyze and design sequential circuits.

**C03:** To understand the basic structure and operation of a digital computer.

**C04:** To study the design of data path unit, control unit for processor and to familiarize with the hazards.

**C05**:To understand the concept of various memories and I/O interfacing.

**UNIT I - COMBINATIONAL LOGIC** **9**

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers.

**UNIT II - SYNCHRONOUS SEQUENTIAL LOGIC** **9**

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters.

**UNIT III - COMPUTER FUNDAMENTALS** **9**

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High-Level Language.

**UNIT IV – PROCESSOR** **9**

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

**UNIT V - MEMORY AND I/O** **9**

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA

**TOTAL:45PERIODS**

**PRACTICALEXERCISES:30PERIODS**

1. Verification of Boolean Theorems Using Logic Gates
2. Design and Implementation of Combinational Circuits Using Gates for Arbitrary Functions
3. Implementation of 4-bit Binary Adder/Subtractor Circuits
4. Implementation of Code Converters
5. Implementation of BCD Adder, Encoder, and Decoder Circuits
6. Implementation of Functions Using Multiplexers
7. Implementation of the Synchronous Counters
8. Implementation of a Universal Shift Register
9. Simulator-based Study of Computer Architecture

**COURSEOUTCOMES:**

At the end of this course, the students will be able to:

CO1: Design various combinational digital circuits using logic gates.
CO2: Design sequential circuits and analyze the design procedures.
CO3: State the fundamentals of computer systems and analyze the execution of an instruction.
CO4: Analyze different types of control design and identify hazards.
CO5: Identify the characteristics of various memory systems and I/O communication.

**TOTAL: 75 PERIODS**

**TEXTBOOKS**

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", Sixth Edition, Pearson Education, 2018.
2. David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020.

**REFERENCES**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
2. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
3. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.

| Course Code | ENGINEERING GRAPHICS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| ME2211 | | 0 | 0 | 4 | 2 |

**COURSE OBJECTIVES:**

The main learning objective of this course is to prepare the students for:

**C01**:Learning the introduction of Engineering graphics, various equipment used, various scales, dimensions, and BIS codes used while making drawings for various streams of engineering disciplines.
**C02**:Understanding projection of lines and projection of planes.
**C03**:Understanding the projection of solids and development of surfaces.
**C04**:Understanding 3D projections. They will have an understanding of isometric and oblique projections.
**C05**:Having an understanding of perspective projections.
**C06**:Learning computer-aided drafting.

**LISTOFEXPERIMENTSFORENGINEERINGGRAPHICS-**

1. Lettering, Dimensioning, and Lines

2. Types of Scales

3. Curves and Special Curves

4. Projection of Lines

5. Projection of Planes

6. Development of Surface

7. Section of Solids

8. Isometric Projection

9. Oblique Projection

10. Perspective Projection

11. Conversion of 3D to 2D figures

12. Interfacing and Introduction to CAD software

13. 2D modeling using CAD software

14. 3D modeling using CAD software

**TOTAL:30PERIODS**

**COURSEOUTCOMES:**

On successful completion of this course, the student will be able to:

CO1: Use BIS conventions and specifications for engineering drawing.
CO2: Construct the curves and special curves.
CO3: Solve practical problems involving projection of lines.
CO4: Draw the orthographic, isometric, and perspective projections of simple solids.
CO5: Draw the Conversion of 3D to 2D figures.

**TEXTBOOKS:**

1.Engineering Drawing by N.D. Bhatt, 53rd Ed., Charotar Publishing House Pvt. Ltd., Gujarat, 2017.

**REFERENCES:**

1. Engineering Drawing by P.S. Gill, S.K Kataria & Sons, New Delhi, 2013.

2. Technical Drawing with Engineering Graphics by Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, and Cindy M. Johnson, 15th Ed., Prentice Hall, USA, 2016.

3. Engineering Drawing by M.B. Shah and B.C. Rana, 3rd Ed., Pearson Education, New Delhi, 2009.

4. AutoCAD 2017 for Engineers & Designers by Sham Tickoo, Dreamtech Press, 2016

| Course Code | Employability Enhancement Skills – II | L | T | P | C |
|---|---|---|---|---|---|
| ES2201 | Exploring Mathematical Concepts and Reasoning | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

- To categorize, apply and use thought process to understand the concepts of Quantitative methods to enhance problem solving skills.
- To prepare and explain the fundamentals related to various possibilities with numeric ability and probabilities related to quantitative aptitude.
- To critically evaluate numerous possibilities related to puzzles.

**UNIT I Time and Distance** **9**

Introduction – Speed: Late / Early / Usual Time – Average Speed – Chasing – Problems on Train: Crossing Pole, Crossing Platform, Train moving in same and different direction – Boats and Streams: Upstream, Downstream – Clock – Calendar.

**UNIT II Probability and Statistics** **9**

Introduction – Algebra of Events – Addition theorem of Probability – Permutation and Combinations – Problems based on choosing the objects – Statistics: Range – frequency, Arithmetic Mean – Median – Mode –Variance – Standard Deviation – Measures of Dispersion – Coefficient of Variation.

**UNIT III Arithmetic and Logical Reasoning** **9**

Introduction – Mathematical Operations – Blood Relations: Direct, Indirect, coded – Problems on Cubes and Dices: Face identification – Folding and cutting Images – Counting technique of figures – Distance & Direction.

**UNIT IV Applied Mathematics** **9**

Mensuration (2D&3D): Square, Rectangle, Triangle, Circle, Parallelogram, Rhombus, Trapezoid, Quadrilateral, Cube, Cuboid, Cylinder, Cone, Sphere, Miscellaneous – Trigonometry: Ratio, Identities, Heights and Distances – Algebra – Logarithm– Geometry.

**UNIT V Verbal and Logical Reasoning** **9**

Introduction – Venn diagram – Syllogism – Data Sufficiency – Decision Making – Puzzle: Number Puzzle, Letter Puzzle – Ranking Test – Data Arrangement: Linear, Circular, Miscellaneous – Critical Reasoning.

**COURSE OUTCOMES:**

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

CO1: Use their logical thinking and analytical abilities to solve Quantitative aptitude questions from company specific and other competitive tests.
CO2: Solve questions related to Time etc. from company specific and other competitive tests.
CO3: Illustrate and solve puzzle related questions from specific and other competitive tests.

**TEXT BOOKS:**


1. Aggarwal, R.S, "Quantitative Aptitude for Competitive Examinations (Revised edition)", S Chand Publishing, 2017.
2. Arun Sharma, “Teach Yourself Quantitative Aptitude”, McGraw Hill Education, 2017
3. Aggarwal, R.S, “A Modern Approach to Verbal & Non-Verbal Reasoning” 2nd edition, S Chand Publishing, 2018.


**REFERENCES:**


1. Akhilesh Khare,“Shortcuts in Mathematics”, Createspace Independent Pub, 2015.
2. Ravi Shankar, “Vedic Maths for Competitive Exams”, Pustak Mahal, 2016.
3. Abhijit Guha, “Quantitative Aptitude for Competitive Examinations”, 7th edition, McGraw Hill Education, 2020.


**TOTAL: 30 PERIODS**

| Course Code | ENVIRONMENTAL SCIENCES AND SUSTAINABILITY | L | T | P | C |
|---|---|---|---|---|---|
| GE2201 | | 2 | 0 | 0 | 0 |

**COURSE OBJECTIVES:**

- To study the nature and facts about environment.
- To find and implement scientific,technological,economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world;envision the surrounding environment,its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated the mes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT , ECOSYSTEM AND BIO-DIVERSITY 6**

Environment-definition, scope and importance of environment – need for public awareness.Eco-system – structure, function and energy flow in an ecosystem – Ecological succession.Types of biodiversity: genetic, species and ecosystem diversity–values of biodiversity, hot-spotsofbiodiversity–threatstobiodiversity:habitatloss,poachingofwildlife,man-wildlifeconflicts – endangered and endemic species of India – conservation of biodiversity: In-situand ex-situ.

**UNIT II POLLUTION AND ITS IMPACTON ENVIRONMENT 6**

Concept - Causes, Effects and Preventive measures of Water Pollution – Causes, Effects and Preventive measures of Soil Pollution - Causes, Effects and Preventive measures of Air Pollution – Causes, Effects and Preventive measures of Noise Pollution-case studies. Solid waste management, Hazardous waste management and E–Waste management. Role of an individual in prevention of pollution.

**UNIT III RENEWABLE RESOURCES OFENERGY 6**

Energy management and energy conservation, New Energy Sources: Need of new energy sources. Different types of new energy sources. Applications of–Hydrogen energy resources, Tidal energy conversion. Concept, origin, and power plants of geothermal energy.

**UNIT IV SUSTAINABILITY MANAGEMENT AND ITS PRACTICES 6**

Energy management and energy conservation, New Energy Sources: Need of new energy sources. Different types of new energy sources. Applications of – Hydrogen energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

**UNIT V GLOBAL CLIMATIC CHANGE AND MITIGATION 6**

Climate change-case studies, Sources, consequences and mitigation for Greenhouse effect, Sources, consequences and mitigation for Ozone layer depletion and Sources, consequences and mitigation for Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods. Polluters–pay principle and beneficiary–pay principle. Environmental Impact Assessment (EIA). Role of Information technology in environment.

**TOTAL:30 PERIODS**

**OUTCOMES:**

1.Environmental Pollution or problems cannot be solved by mere laws.
2.Public participation is an important aspect which serves environmental protection. One will obtain knowledge on the following after completing the course.
3.Public awareness of environmental is at infant stage.
4.Ignorance and incomplete knowledge has lead to misconceptions.
5.Development and improvement in standard of living has lead to serious environmental disasters.

**TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Anubha Kaushik and C.P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
3. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D.T. and Shonnard, D.R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley, A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage Learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

**REFERENCES:**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, EnviroMedia. 38th Edition, 2010.

2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ. House, Mumbai, 2001.

3. Dharmendra S. Sengar, 'Environmental Law', Prentice Hall of India PVT. LTD, New Delhi, 2007.

4. Rajagopalan, R, 'Environmental Studies - From Crisis to Cure', Oxford University Press, Third Edition, 2015.

5. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", Orient BlackswanPvt. Ltd., 2013.

| CourseCode | தமிழ்மரபு/HERITAGEOFTAMILS | L | T | P | C |
|---|---|---|---|---|---|
| HS2301 | | 1 | 0 | 0 | 1 |

**GE3152** **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 [illegible]க்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் [illegible]சன் ஆகியோரின் பங்களிப்பு.

HS2301

**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 ofArchaeology & 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.

HS2301

## HERITAGE OF TAMILS

L T P C
1 0 0 1

**UNIT I LANGUAGE AND LITERATURE** 3

Language Families in India - Dravidian Languages – Tamil as aClassical 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.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE** 3

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.

**UNIT III FOLK AND MARTIAL ARTS** 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS** 3

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.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE** 3

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.

**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 ofArchaeology & 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.

## Semester III

| CourseCode | LINEAR ALGEBRA | L | T | P | C |
|---|---|---|---|---|---|
| MA2301 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

1. To find the basis and dimension of vector space
2. To obtain the matrix of linear transformation and its Eigen values and eigen vectors
3. To find ortho normal basis of inner product space and find least square approximation
4. To find Eigen values of a matrix using numerical techniques and perform matrix decomposition
5. To solve QR and LU decomposition and to learn the applications of linear algebra in computer Science.

**UNIT-IVECTORSPACES** **12(9+3)**

Real and Complex fields - Vector spaces over Real and Complex fields - Subspace - Linear space – Linear independence and dependence –Basis and dimension.

**UNIT-IILINEARTRANSFORMATION** **12(9+3)**

Linear transformation- Rank space and null space -Rank and nullity- Dimension theorem –Matrix representation of linear transformation–Eigen values and eigen vectors of linear transformation

**UNIT-IIIINNERPRODUCTSPACES** **12(9+3)**

Inner product and norms - Properties - Orthogonal, Ortho normal vectors - Gram Schmidt ortho normalization process –Least square approximation.

**UNIT-IVEIGENVALUEPROBLEMSANDMATRIXDECOMPOSITION** **12(9+3)**

Eigen value Problems: Power method, Jacobi rotation method -Singular value decomposition –QR decomposition.

**UNIT-VAPPLICATIONSOFLINEARALGEBRA** **12(9+3)**

Singularvaluedecompositionandprincipalcomponentanalysis-Introductiontotheirapplications in image processing and machine learning - Coding and Decoding - Least Square solutions

**60PERIODS**

**COURSE OUTCOMES:**

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

CO1: Find the basis and dimension of vector space
CO2: Obtain the matrix of linear transformation and its Eigenvalues and eigenvectors
CO3: Find orthonormal basis of inner product space and find least square approximation
CO4: Find Eigenvalues of a matrix using numerical techniques and perform matrix decomposition
CO5: Learning the applications in Image processing, Machine learning, and Cryptography

**TOTAL:60PERIODS**

**TEXTBOOKS:**

1. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, New Delhi, 2004.

2. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002

**REFERENCES:**

1. Kumaresan S, Linear Algebra - Geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
2. Strang G, Linear Algebra and its applications, Thomson (Brooks/Cole), New Delhi, 2005.
3. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 2002.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Richard Branson, Matrix Operations, Schaum's outline series, 1989.
6. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations,, First Reprint,2009
7. R.C Gonzalez and R.E Woods, Digital Image Processing.

| Course Code | ADVANCED DATA STRUCTURES AND ALGORITHMS | L | T | P | C |
|---|---|---|---|---|---|
| CY2301 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. Here's the paragraph with aligned words:
2. To understand the different concepts in nonlinear data structures using various trees.
3. To understand the concept using Graph and hashing techniques.
4. To illustrate the basic notations, algorithms, and divide and conquer algorithms.
5. To know the concepts and apply in problem solutions using dynamic programming and greedy techniques.
6. To illustrate the methods using backtracking and branch and bound techniques..

**UNIT I INTRODUCTION TO NONLINEAR DATA STRUCTURES –TREES 9**

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees –binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap –Applications of heap.

**UNIT II GRAPHS AND HASHING TECHNIQUES 9**

Definition–RepresentationofGraph–Typesofgraphs–Breadth-firsttraversal–Depth-first traversal–TopologicalSort–Bi-connectivity–Cutvertex–Eulercircuits–Applicationsofgraphs. Hashing-HashFunctions–SeparateChaining–OpenAddressing–Rehashing–ExtendibleHashing.

**UNIT III FOUNDATION OF ALGORITHM ANALYSIS 9**

Complexity Notations - Big-O, Big-Omega, Big-Theta, and others. Complexity Analysis techniques - Basic Algorithms - Algorithm for GCD, Fibonacci Number, and analysis of their time and space complexity. Searching Algorithms - Sequential Search and its analysis. Sorting Algorithms - Bubble Sort, Selection Sort, and their Analysis. Divide and Conquer – Binary Search, Min-Max Finding and their Analysis. Sorting Algorithms - Merge Sort and Analysis, Quick Sort and Analysis, Randomized Quick sort and its Analysis.

**UNIT IV DYNAMIC PROGRAMMING & GREEDY ALGORITHM 9**

Introduction. The Principle of Optimality. Problem Solving using Dynamic Programming – Knapsack problem, All Points Shortest path, Matrix chain multiplication. General Characteristics of greedy algorithms. Problem solving using Greedy Algorithm - Activity selection problem, Knapsack Problem, Minimum Spanning trees - Kruskal’s algorithm, Prim’s algorithm

**UNITV BACKTRACKING&BRANCH AND BOUNDALGORITHM** **9**

Backtracking Algorithm – n-Queen's Problem – Hamiltonian Circuit problem – Subset-Sum problem. Branch and bound Algorithm – Assignment problem – Knapsack problem – Traveling salesman problem.

TOTAL:**45PERIODS**

**PRACTICALEXERCISES:**

**30PERIODS**

For the laboratory work, students should implement the following algorithms in C/C++/Python and perform their analysis for time and space complexity:

1. Implementation of Binary Tree and operations
2. Implementation of AVL Trees
2. Implementation of Heaps using Priority Queues
3. Implementation of Graph traversal
4. Basic iterative algorithms: GCD algorithm, Fibonacci Sequences, Sequential and Binary Search
5. Basic iterative sorting algorithms: Bubble Sort, Selection Sort, Insertion Sort
6. Binary Search with Divide and conquer approach
7. Merge Sort, Heapsort, QuickSort, Randomized Quick Sort
8. Selection Problem with divide and Conquer approach
9. Fractional Knapsack Problem, Job sequencing with deadline, Kruskal's algorithm, Prim's algorithm,
10. Dijkstra's Algorithm
11. Implement the dynamic programming algorithms
12. Algorithms using Backtracking approach. Design-based Problems (DP) / Open-Ended Problem:

1. From the given string find maximum size possible palindrome sequence
2. Explore the application of Knapsack in human resource selection and courier loading system using dynamic programming and greedy algorithm
3. BRTS route design, considering traffic, traffic on road, and benefits

**COURSE OUTCOMES:**

At the end of this course, the students will be able to:

CO1:Demystify the concepts of Tree data structure
CO2: Delineate the use of graph and hashing technique
CO3:Elucidate the basic notations, algorithms
CO4: Apply the dynamic programming and greedy techniques to solve the problem
CO5: Demonstrate backtracking and branch and bound algorithms

**TOTAL:75 PERIODS**

**REFERENCES:**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to algorithms”, Third Edition. The MIT Press, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekiaran, “Computer Algorithms”, Second Edition, Silicon Press, 2007.
3. Kleinberg, Jon, and Eva Tardos, “Algorithm Design”, Addison-Wesley, First Edition, 2005.
4. R.C.T. Lee, S.S. Tseng, R.C. Chang, and T. Tsai (2006), Introduction to Design and Analysis of Algorithms A strategic approach, McGraw-Hill, India.
5. Allen Weiss (2009), Data structures and Algorithm Analysis in C++, 2nd edition, Pearson Education, New Delhi

| Course Code | MODERN DATABASE TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| CY2302 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES**

1. Describe the fundamental elements of relational database management systems
2. Explain the basic concepts of entity-relationship model, relational database design and transactions.
3. Learn to create and write queries using PostgreSQL
4. Distinguish the different types of databases namely distributed and NoSQL databases
5. To understand the different models involved in database security and their applications in realtime world to protect the database

**Unit I RELATIONAL DATABASES 9**

Purpose of Database System – Views of data – Data Models – Database System Architecture –Keys – Relational Algebra – SQL fundamentals – Creating Database, Alter Database, Creating tables with Constraints, Alter Tables, Insert, select with aggregation functions, order by, andgroupby,different types of joins,nested queries, update and delete. Create and alter views.

**Unit II DATABASEDESIGNANDTRANSACTIONS 9**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – Normalization. Transaction Concepts – ACID Properties – Schedules – Serializability – Transaction support in SQL – Need for Concurrency–Concurrency control–Two Phase Locking- Timestamp.

**Unit III OBJECT-RELATIONAL DATABASE MANAGEMENT SYSTEMS 9**

PostgreSQL : Features of PostgreSQL, Basics, Data Types, Querying & Filtering Data, ManagingTables, Modifying Data, Conditionals, Control Flow, Transactions & Constraints, Working with JOINS & Schemas, Roles & Permissions, Working with Sets, Subquery & CTEs, User-defined Functions, Important In-Built Functions

**Unit IV DISTRIBUTED AND NOSQL DATABASES 9**

Distributed Databases: Architecture, DataStorage, Transaction Processing, Query processing and optimization – NOSQL Databases: Introduction – CAP Theorem – Document-Based NoSQL Systems and MongoDB– MongoDB Data Model– MongoDB Distributed Systems Characteristics

– Key value Stores– Column Based Systems– Graph Databases.

**UnitV DATABASE SECURITY** **9**

Security issues– Access control based on privileges– Role Based access Injection control–SQL

– Statistical Database security– Flow control– Encryption and Public Key infrastructures– Challenges.

**45PERIODS**

**PRACTICAL EXERCISES** **30PERIODS**

1. Create a database table, add constraints (primary key, unique, check, not null), insert rows, update and delete rows using SQL DDL and DML commands.
2. Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4. Query the database tables and explore subqueries and join operations. Execute complex transactions and realize DCL and TCL commands.
5. Write SQL Triggers for insert, delete, and update operations in a database table. Create View and index for database tables with a large number of records.
6. Installation of PostgreSQL.
7. Create a database table, insert rows, update and delete rows using PostgreSQL, an open-source Object-Relational Database Management System (ORDBMS).
8. Installation of NoSQL database like MongoDB.
9. Create Document, column, and graph-based data using NoSQL database tools.
10. Develop a simple GUI-based database application and incorporate all the above-mentioned features.

10. Case Study using any of the real-life database applications.

**Total–75PERIODS**

**COURSE OUTCOMES**

At the end of the course, the students will be able to:

CO1: Construct SQL Queries using relational algebra.
CO2: Design database using ER model, normalize the database, and construct queries
CO3: Construct SQL Queries using PostgreSQL.
CO4: Use the data control, definition, and manipulation languages of the NoSQL databases.
CO5: Design and Implement secure database systems.

**TEXT BOOKS**


1. Silberschatz,A.,Korth,H.F.,and Sudarshan, S.Database System Concepts, McGraw-Hill,7thEdition. 2019.
2. Elmasri,R.,& Navathe, S.B.Fundamentals of database systems, 7thEdition, PearsonEducation

,2017.

3. https://www.postgresql.org/docs/
4. https://dev.mysql.com/doc/workbench/en/

**REFERENCE BOOKS**


1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems, Eighth Edition, Pearson Education,2006
2. Raghu Ramakrishnan, Johannes Gehrke "Database Management Systems", FourthEdition,McGrawHillEducation,2015
3. Thomas Cannolly and Carolyn Begg,"Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015

| Course Code | WEB TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| CY2303 | | 3 | 0 | 2 | 4 |

**Course Objectives:**

1. To understand the representation of Web data and the processing of web elements.
2. To understand the advanced JavaScript concepts in terms of functional programming.
3. To develop a web application using javascript-based frameworks.
4. To understand the mechanism of web applications development using python
5. To develop a micro-service-based application using SpringBoot and Hibernate.

**UNIT I– XML** **9**

Representing Web Data:XML-Documents and Vocabularies-Versions and Declaration-Namespaces- DOM based XML processing Event-oriented Parsing: SAX-Transforming XMLDocuments-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers.

**UNIT II –Advanced JavaScript** **9**

Functional Programming in Javascript-Functional Declaration, Anonymous Function and Function Expression, Return and Undefined , Arrow Function- String Methods- Iterating over String-String methods: charAt & charCodeAt, IndexOf- Error Handling in Javascript-Javascript try catch- Console in Javascript- what is JSON- parse() JSON Javascript- Difference between JSON and XML.

**UNIT III–Node.jsandExpress.js** **9**

Introduction to Server side programming – Multi-tier architecture - Node.Js architecture –npm – Development environment – API.Express JS and features – Routing – HTTP request and response– Middleware –ErrorHandling.

**UNIT IV–PYTHON FRAMEWORKS** **9**

Introduction to frameworks on Python– Flask and Django

Django: Creating web application – handle request and response – views and templates –Forms and generic views–SQLAlchemy

**UNIT V –SPRING BOOTAND HIBERNATE** **9**

Introduction to Spring Boot – Creating Project – Spring Initializer – Download and Install STSIDE– SpringBootExample–SpringBootCLI-SpringBoot Annotations-SpringBoot Application Properties-Spring BootStarterWeb- SpringBootAOP

Hibernate – Hibernate Architecture - Hibernate with eclipse – Hibernate web application example–HibernateLog4j– Hibernate Inheritance Mapping–Hibernate and SpringIntegration.

**45PERIODS**

**PRACTICALEXERCISES:** **30PERIODS**

1. Project– Simple weather application
2. Project–URL shortener Application using SQL.
3. Project-Flight Ticket Booking

Create a web application for flight ticket booking. Use any tech stack for the backend and db.

Type of Users

a. User
b. Admin

User Use Cases

- Login
- Sign up
- Searching for flights based on date and time
- Booking tickets on a flight based on availability (assuming the default seat count is 60)
- MyBooking->to listout all the bookings made by that user
- Logout

AdminUseCases

- Login (Separate login for Admin)
- Add Flights
- Remove flights
- View all the booking based on flight number and time

**Course Outcomes:**

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

1. **CO1**: Represent the Web data to enable the Web elements processing.
2. **CO2**:Develop JavaScript concepts in terms of functional programming.
3. **CO3**:Develop a Web Application using javascript-based frameworks.
4. **CO4**:Develop strong Web Applications using python.
5. **CO5**:Develop robust Java Applications using Springboot and hibernate.

**TOTAL75PERIODS**

**TextBooks:**


1. JonathanWexler,"Get Programming with Node.js", Manning Publications, 2019.
2. Beginning Node.js, Express &MongoDB Development, Greg Lim, 1st Edition,2019.


**Online Resources:**

1. Djangodocumentation- https://docs.djangoproject.com/en/4.2/
2. MongoDBdocumentation-https://www.mongodb.com/docs/
3. Springbootdocumentation-https://spring.io/guides/gs/spring-boot/
4. Hibernatedocumentation-https://hibernate.org/

| CourseCode | CRYPTOGRAPHY AND CYBER SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| CY2304 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. Learn to analyse the security of in-built cryptosystems.
2. Know the fundamental mathematical concepts related to security.
3. Develop cryptographic algorithms for information security.
4. Comprehend the various types of data integrity and authentication schemes
5. Understand cyber crimes and cyber security.

**UNIT I INTRODUCTION TO SECURITY 9**

Computer Security Concepts–The OSI Security Architecture– Security Attacks–Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security–Information Theory –Product Cryptosystem –Cryptanalysis.

**UNIT II ASYMMETRIC CIPHERS 9**

Number theory – Algebraic Structures – Modular Arithmetic - Euclid‘s algorithm – Congruenceandmatrices–Group,Rings, Fields, FiniteFields,Symmetric Key.

CIPHERS: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis –Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators –RC4–Key distribution.

**UNIT III ASYMMETRIC CRYPTOGRAPHY 9**

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes–Primality Testing–Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem – Chinese RemainderTheorem– Exponentiation and logarithm

ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – DiffieHellmankey exchange –Elliptic curve arithmetic–Elliptic curve cryptography.

**UNIT IV INTEGRITY AND AUTHENTICATION ALGORITHMS 9**

Authentication requirement– Authentication function –MAC –Hashfunction – Security ofhash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS –Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics,Passwords,Challenge Response protocols– Authentication applications –Kerberos

MUTUALTRUST:Key management and distribution–Symmetric key distribution using symmetric and asymmetric encryption–Distribution of public keys– X.509 Certificates.

**UNIT V CYBER CRIMES AND CYBER SECURITY 9**

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – CloudSecurity– Web Security–Wireless Security.

**PRACTICAL EXERCISES: 30 PERIODS**

1. Write a program to implement the following cipher techniques to perform encryption and decryption
    i. Caesar Cipher
    ii. Playfair Cipher
    iii. Hill Cipher
2. Write a program to implement the following transposition techniques
    i. Rail fence technique –Row major transformation
    ii. Rail fence technique-Column major transformation
3. Write a program to implement DES algorithm
4. Write a program to implement AES algorithm
5. Write a program to implement RSA Encryption algorithm
6. Write a program to implement the Diffie-Hellman Key Exchange mechanism. Consider one of the parties as Alice and the other party as bob.
7. Write a program to calculate the message digest of a text using the SHA-1 algorithm.
8. Write a program to calculate the message digest of a text using the MD-5 algorithm.
9. Write a program to implement digital signature standard.

**COURSE OUTCOMES:**
At the end of this course, the students will be able to:

CO1: Understand the fundamentals of network security, security architecture, threats, and vulnerabilities.

CO2: Apply the different cryptographic operations of symmetric cryptographic algorithm.

CO3: Apply the different cryptographic operations of public key cryptography.

CO4: Apply the various authentication schemes to simulate different applications.

CO5: Understand various cybercrimes and cybersecurity.

**TOTAL: 75PERIODS**

**TEXT BOOKS:**


1. William Stallings,"Cryptography and Network Security-Principles and Practice", Seventh Edition,Pearson Education, 2017.
2. Nina Godbole, Sunit Belapure, “CyberSecurity: Understanding Cybercrimes, Computer Forensics and Legal Perspectives”,First Edition, Wiley India,2011.


**REFERENCES:**


1. Behrouz A.Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rdEdition, TataMc GrawHill, 2015.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", FifthEdition,Prentice Hall, NewDelhi, 2015.

| Course Code | ADVANCED JAVA PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| CY2305 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. To understand Object Oriented Programming concepts and basics of Java programming language
2. To know the principles of packages, inheritance and interfaces.
3. To develop a java application with threads and generics classes.
4. To define exceptions and use I/O streams.
5. To understand the fundamentals of collection framework and JDBC connectivity and implement in small applications.

**UNIT I FUNDAMENTALS OF JAVA** **9**

Overview of Object-Oriented Programming –– Features of Object-Oriented Programming –Java Buzzwords –The Java Programming Environment– Data Types, Variables, constants –Operators – Mathematical Functions and Constants-Conversions between Numeric Types-Casts- Parentheses and Operator Hierarchy- Enumerated Types-Control flow Statements –Arrays-Programming Structures in Java.

**UNIT II IMPLEMENTATION OF OOP CONCEPTS** **9**

Defining classes in Java – Constructors -Methods -Access specifiers – Static members- JavaDoc comments-Overloading Methods – Objects as Parameters – Returning Objects –Static,Nested and Inner Classes. Inheritance: Basics–Types of Inheritance-Super keyword-Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages –Interfaces.

**UNIT III EXCEPTION HANDLING AND MULTITHREADING** **9**

Exception Handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-inExceptions–User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities–Synchronization–Inter Thread Communication-Suspending –Resuming, and Stopping Threads–Multithreading.

**UNITIVI/O, GENERICS, STRING HANDLING** **9**

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: GenericProgramming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods ,String Buffer Class & StringBuilder class.

**UNIT V COLLECTIONS FRAMEWORK & DATABASE CONNECTIVITY** **9**

Collections Framework - Autoboxing - For-Each Style for Loop - Collection Interfaces - Collection Interface - List Interface - Set Interface - Sorted Set Interface - Collection Classes - ArrayList Class - LinkedList Class - HashSet Class - LinkedHashSet Class - TreeSet Class - EnumSet Class - Accessing a Collection via an Iterator - Using an Iterator - The For-Each Alternative to Iterators - Storing User-Defined Classes in Collections - Working with Maps - The Map Interfaces - The Map Classes - Arrays - Accessing databases using JDBC connectivity - DAO

**TOTAL: 45PERIODS**

**PRACTICAL EXERCISES: 30PERIODS**

1. Write a program to demonstrate the use of multidimensional arrays and looping constructs.
2. Write a program to demonstrate the application of String handling functions.
3. Write a program todemonstratetheuseofInheritance.
4. Write a program to demonstrate the application of user-defined packages and sub-packages.
5. Write a program to demonstrate the use of Java Exception handling methods.
6. Write a program to demonstrate the use of threads in Java.
7. Demonstrate with a program the use of File handling methods in Java.
8. Demonstrate the use of Java collection frameworks in reducing application development time.
9. Write a program to register students data using JDBC with MySQL Database.
10. Developa pplications to demonstrate the features of generics classes.
11. Develop a mini project for any application using Java concepts.

**Lab Requirements: for a batch of 30 students**

Operating Systems:Linux/Windows
Front End Tools: EclipseIDE/ NetbeansIDE

**COURSE OUTCOMES:**

At the end of this course, the students will be able to:

**CO1:** Apply the concepts of classes and objects to solve simple problems
**CO2:**Develop programs using inheritance,packages and interfaces
**CO3:** Make use of exception handling mechanisms and multithreaded model to solve real world problems
**CO4:** Build Java applications with I/O packages, string classes, Collections and generics concepts
**CO5:** Develop small applications with collection framework elements and manipulate with the SQL database

**TOTAL:75PERIODS**

**TEXT BOOKS:**


1. Herbert Schildt,"Java:The Complete Reference",11th Edition, McGraw Hill Education,NewDelhi,2019
2. CayS. Horstmann,"Core Java Fundamentals", Volume1,11thEdition,PrenticeHall,2018.


**REFERENCES:**


1.Paul Deitel HarveyDeitel, Java, How to Program, Prentice Hall;9th edition,201

| Course Code | Employability Enhancement Skills – III | L | T | P | C |
|---|---|---|---|---|---|
| ES2301 | Professional Communication and Teamwork Skills | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

- To familiarize students with various forms of communication.
- To develop effective team communication skills.
- To enhance stakeholder communication skills.
- To cultivate ethical communication practices.
- To explore digital communication tools and trends.

**UNIT I** **9**

Introduction to Communication - Verbal Communication Skills: - Written Communication Skills - Nonverbal Communication - Interpersonal Communication.

**UNIT II** **9**

Characteristics of Effective Teams - Team Building and Group Cohesion - Conflict Resolution - Decision Making in Teams - Cross-Cultural Communication.

**UNIT III** **9**

Stakeholder Communication - Presentation Skills - Effective Meetings - Feedback and Evaluation.

**UNIT IV** **9**

Professional Codes of Conduct - Integrity in Communication - Addressing Ethical Challenges - Analyzing real-world ethical communication dilemmas.

**UNIT V** **9**

Digital Communication Tools - Social Media and Networking - Emerging Trends in Communication.

**COURSE OUTCOMES:**

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

CO1: Demonstrate proficiency in various forms of communication.
CO2: Exhibit strong team communication skills.
CO3: Display competence in stakeholder communication.
CO4: Apply ethical communication principles.
CO5: Utilize digital communication tools effectively.

**TEXT BOOKS:**


1. Sharon J. Gerson and Steven M. Gerson. "Technical Communication: Process and Product", Pearson, 2014
2. Karl A. Smith. “Teamwork and Project Management”, McGraw-Hill Education, 2013
3. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins. "Engineering Ethics: Concepts and Cases", Cengage Learning, 2012
4. Christoph Meinel and Harald Sack. "Digital Communication: Communication, Multimedia, Security", Springer, 2014.


**REFERENCES:**


1. Katherine L. Adams and Gloria J. Galanes. "Communicating in Groups: Applications and Skills", McGraw Hill Education, 2018
2. Lawrence Holpp. "Managing Teams: Strategies for Success", McGraw Hill, 1998.
3. Caroline Whitbeck (ed) "Ethics in Engineering Practice and Research", Cambridge University Press, 2011.


**TOTAL: 30 PERIODS**

## Semester IV

| Code | DISCRETE MATHEMATICS | L | T | P | C |
|---|---|---|---|---|---|
| MA2401 | | 3 | 1 | 0 | 4 |

**COURSEOBJECTIVES:**

1. To familiarize the applications of algebraic structures
2. To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems
3. To understand the graph models and basic concepts of graphs
4. To study the characterization and properties of trees and graph connectivity
5. To extend students' logical and mathematical maturity and ability to deal with abstraction and understand the concepts, significance of Boolean algebra which are widely used in computer science and engineering..

**UNIT-I ALGEBRAIC STRUCTURES 12(9+3)**

Semigroup – Monoids – Groups – Subgroups – Abelian groups – Lagrange's theorem – Rings (examples only) –Integraldomain –Fields– Definitionandexamples.

**UNIT-II COMBINATORICS 12(9+3)**

Introduction to Basic Counting Principles, Formulae behind nPr, nCr - Balls and Pins problems - Pigeon Hole Principle - Recurrence relations – Generating Functions - Introduction to Proof Techniques - Mathematical Induction

**UNIT-III BASIC GRAPH THEORY 12(9+3)**

Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments.

**UNIT-IV TREES, PLANER GRAPH AND COLOURING OF A GRAPH 12(9+3)**

Trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem

**UNIT-V LOGIC AND BOOLEAN ALGEBRA 12(9+3)**

Propositional calculus- propositions and connectives, syntax;Semantics-truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness. Introduction of Boolean algebra, truth table, Basic logic gate ,basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map

**TOTAL:60PERIODS**

**COURSE OUTCOMES:**

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

1. Have an understanding in identifying structures on many levels
2. Understand the conceptsvof combinatorics
3. Understand the concepts of graph theory and its applications
4. Understand the importance of the natural applications of trees and apply the graph coloring concepts in partitioning problems
5. Learning logic and Boolean algebra and using these concepts to solve the problems

**TEXTBOOKS:**

1. Rosen.K.H.,"Discrete Mathematics and its Applications",7thEdition,Tata McGraw Hill Pub. Co. Ltd.,NewDelhi,Special Indian Edition,2017
2. Tremblay.J.P.andManohar.R,"Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub.Co.Ltd, NewDelhi,30thReprint,2011.

**REFERENCES:**

1. Grimaldi.R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction",5thEdition, Pearson Education Asia,Delhi,2013.
2. Koshy.T. "Discrete Mathematics with Applications", Elsevier Publications,2006
3. Lipschutz.S.and Mark Lipson., "Discrete Mathematics", Schaum's Outlines,TataMcGrawHillPub. Co. Ltd., NewDelhi,3rd Edition,2010
4. Gilberft Strang, "Introduction to Linear Algebra".
5. R.A.Brualdi, "Introductory Combinatorics",North-Holland,NewYork.
6. N.Deo, "Graph Theory with Applications to Engineering and Computer Science",PrenticeHall, Englewood Cliffs.

| Course Code | OPERATING SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| CY2401 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. To understand the basics and functions of operating systems.
2. To understand processes and threads.
3. To analyze scheduling algorithms and process synchronization.
4. To understand the concept of deadlocks.
5. To analyze various memory management schemes.
6. To be familiar with I/O management and file systems.
7. To be familiar with the basics of virtual machines and mobile operating systems like iOS and Android

**UNIT I INTRODUCTION** **9**

Computer System - Elements and organization; Operating System Overview - Objectives andFunctions - Evolution of Operating System; Operating System Structures – Operating SystemServices - User Operating System Interface - System Calls – System Programs - Design andImplementation-Structuringmethods.

**UNIT II PROCESS MANAGEMENT** **9**

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling - Scheduling criteria - Scheduling algorithms: Threads – Multithread Models–Threading issues; Process Synchronization-The Critical-Section problem-Synchronization hardware–Semaphores–Mutex-Classical problems of synchronization-Monitors; Deadlock-Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

**UNIT III MEMORY MANAGEMENT** **9**

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the PageTable - Segmentation, Segmentation with paging; Virtual Memory - Demand Paging – CopyonWrite-Page Replacement- Allocation of Frames –Thrashing.

**UNIT IV STORAGE MANAGEMENT** **9**

Mass Storage system–Disk Structure-Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization – File system mounting - File Sharing and Protection; File System Implementation - File SystemStructure - Directory implementation - Allocation Methods - Free Space Management; I/OSystems–I/O Hardware, Application I/O interface, KernelI/O subsystem.

**UNIT V VIRTUAL MACHINES AND MOBILE OS** **9**

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS –iOS and Android.

**45 PERIODS**

**PRACTICAL EXERCISES:** **30 PERIODS**

1. Installation of windows operating system
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls:Fork, Exit,Getpid,Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the interprocess communication strategy
6. Implement mutual exclusion by Semaphore
7. Write C programs to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program
11. Write C programs to implement the following Memory Allocation Methods
    a. First Fit b.Worst Fit c. BestFit
12. Write C programs to implement the various Page Replacement Algorithms
13. Write C programs to Implement the various File Organization Techniques
14. Implement the following File Allocation Strategies using C programs a.Sequential b.Indexed c. Linked
15. Write C programs for the implementation of various disk scheduling algorithms

**COURSE OUTCOMES:**

At the end of this course, the students will be able to:

1. **CO1:**Analyze various scheduling algorithms and process synchronization.
2. **CO2:**Explain deadlock prevention and avoidance algorithms.
3. **CO3:**Compare and contrast various memory management schemes.
4. **CO4:**Explain the functionality of filesystems, I/O systems, and Virtualization
5. **CO5:**Compare Ios and Android Operating Systems.

**TOTAL:75 PERIODS**

**TEXT BOOKS:**

1. Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems",Pearson,5thEdition,2022,NewDelhi.

**REFERENCES:**


1. Ramaz Elmasri, A. GilCarrick, David Levine, “Operating Systems–A Spiral Approach”, Tata McGraw Hill Edition, 2010.
2. William Stallings,"Operating Systems: Internals and Design Principles",7th Edition,Prentice Hall, 2018.
3. Achyut S.Godbole, Atul Kahate,“Operating Systems”,McGraw Hill Education,2016.

| Course Code | INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| CY2402 | | 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

1. Study about uninformed and Heuristic search techniques.
2. Learn Knowledge Representation and reasoning under uncertainty
3. Introduce Machine Learning and supervised learning algorithms
4. Study about ensembling and unsupervised learning algorithms
5. Learn the basics of deep learning using neural networks.

**UNIT I PROBLEM SOLVING** **9**

Introduction to AI- AI Applications- Problem solving agents–search algorithms–uninformed search strategies–Heuristic search strategies–Local search and optimization problems–adversarial search– constraint satisfaction problems(CSP).

**UNITII KNOWLEDGE REPRESENTATION** **9**

Knowledge, reasoning, and planning. Logical Agents, Knowledge-Based Agents, Propositional Logic: AVery Simple Logic Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First- Order Logic. **PROBABILISTIC REASONING:** Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning, Bayesian networks – exact inference in BN – approximate inference in BN –causal networks

**UNIT III SUPERVISED LEARNING** **9**

Introduction-Machine Learning, Designing a Learning Model–Examples of Machine Learning Applications-Supervised Learning, Learning a Class from Examples, Vapnik-Chervonenkis (VC) Dimension,PAC Learning, Noise Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm– Linear Regression Models:Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

**UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING** **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging,boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization. k-Nearest Neighbour Estimator, Generalization to Multivariate Data, Nonparametric Classification, Condensed Nearest Neighbour. Multiple Classes, Discrimination by Regression, Support Vector Machines, Optimal Separating Hyperplane, The Non-separable Case: Soft Margin Hyperplane, Kernel Functions, Support Vector Machines for Regression.

**UNIT V NEURAL NETWORKS** **9**

Perceptron-Multi layer perceptron, activation functions, network training–gradient descent optimization–stochastic gradient descent, error backpropagation, from shallow networks to deep networks–Unit saturation (aka the vanishing gradient problem)–ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

**45PERIODS**

**PRACTICAL EXERCISES:** **30 PERIODS**

1. Implementation of Uninformed search algorithms (BFS,DFS)
2. Implementation of Informed search algorithms (A*, memory-bounded A*)
3. Implement naïve Bayes models
4. Implement Bayesian Networks
5. Build Regression models
6. Build decision trees and random forests
7. Build SVM models
8. Implement ensembling techniques
9. Implement clustering algorithms
10. Implement EM for Bayesian networks
11. Build simple NN models
12. Build deep learning NN models

**COURSE OUTCOMES:**

At the end of this course, the students will be able to:

**CO1:** Use appropriate search algorithms for problem solving
**CO2:**Knowledge representation and apply reasoning under uncertainty
**CO3:**Build supervised learning models
**CO4:**Build ensembling and unsupervised models
**CO5:**Build deep learning neural network models

**TOTAL:75 PERIODS**

**TEXTBOOKS:**


1. Stuart Russell and Peter Norvig, "Artificial Intelligence–A Modern Approach", Fourth Edition, PearsonEducation,2021.
2. Ethem Alpaydin, "Introduction to Machine Learning", MITPress, Fourth Edition,2020.


**REFERENCES:**


1. Dan W.Patterson, "Introduction to Artificial Intelligence and Expert Systems", PearsonEducation,2007
2. Kevin Night,ElaineRich, and NairB., "Artificial Intelligence",McGrawHill, 2008
3. Patrick H.Winston,"Artificial Intelligence",Third Edition,Pearson Education,2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education,2013(http://nptel.ac.in/)
5. Christopher M.Bishop, "Pattern Recognition and Machine Learning",Springer,2006.
6. Tom Mitchell,"Machine Learning",McGrawHill, 3rdEdition,1997.
7. Charu C. Aggarwal,"Data Classification Algorithms and Applications",CRCPress,2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MITPress, 2012.
9. Ian Goodfellow, YoshuaBengio, AaronCourville, "Deep Learning", MITPress,2016.
10. S Sridhar, M Vijayalakshmi, Machine Learning, First Edition, Oxford University Press.

| Course Code | COMPUTER NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| CY2403 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

1. To understand the concept of layering in networks.
2. To know the functions of protocols of each layer of TCP/IP protocol suite.
3. To visualize the end-to-end flow of information.
4. To learn the functions of network layer and the various routing protocols
5. To familiarize the functions and protocols of the Transport layer

**Unit 1:DATA COMMUNICATION COMPONENTS 9**

Introduction: Data Communications, Networks, Network Types, Network Models: Protocol Layering, TCP/IP Protocol Suite, OSI Model

Introduction to Physical Layer: Data and signals, Digital Transmission, Bandwidth Utilization: Multiplexing and Spectrum Spreading.

Switching: Introduction, Circuit Switched Networks, Packet Switching

**Unit 2: DATA LINK LAYER AND MEDIUM ACCESS CONTROL 10**

Introduction to Data Link Layer. Error Detection and Correction: Introduction, Block Coding, Cyclic Codes,Checksum Data Link Control: DLC Services, Data-Link Layer Protocols Media Access Control. Wired LANs:Ethernet-Ethernet Protocol, StandardEthernet:Characteristics, Addressing

**Unit 3: NETWORK LAYER 9**

Introduction To Network Layer: Network Layer Services, Packet Switching, Network Layer Performance,IPV4 Addresses Network Layer Protocols: Internet Protocol, ICMPV4, Unicast Routing: Introduction,Routing algorithms, Unicast routing protocols: Internet Structure, Routing Information Protocol (RIP) NextGeneration IP: IPV6Addressing, IPV6Protocol, TransitionfromIPV4 to IPV6

**Unit 4: TRANSPORT LAYER 9**

Introduction to Transport Layer. Transport Layer Protocols Transport Layer Protocols: Introduction, User Datagram Protocol,Transmission Control Protocol.

**Unit 5: APPLICATION LAYER 9**

Domain Name Space(DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

**45 PERIODS**

**PRACTICAL EXERCISES:** **30 PERIODS**

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup, and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a webpage using TCP sockets.
3. Applications using TCP sockets like: a) Echo client and echo server b) Chat
4. Simulation of DNS using UDP sockets.
5. Use a tool like Wireshark to capture packets and examine the packets.
6. Write a code simulating ARP/RARP protocols.
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of Distance Vector/Link State Routing algorithm.
10. Simulation of an error correction code (like CRC)

**Course Outcomes:**

1. **CO1-**Apply the fundamentals of communication in networking aspects
2. **CO2-**Analyze the various protocols in Physical, Datalink, Network, Transport and Application layers and their mechanisms.
3. **CO3-**Design functional aspects for network applications.
4. **CO4-**Develop programs that demonstrate the operations of physical, DataLink, Network, Transport layers**.**
5. **CO4-**Develop programs that demonstrate the operations Application layers**.**

**TEXTBOOKS**


1. Data Communication and Networking,4thEdition, BehrouzA. Forouzan, McGrawHill.
2. Data and Computer Communication, 8thEdition,William Stallings,Pearson Prentice Hall India.
3. Computer Networks– A Systems Approach, 4th Edition, LarryL. Peterson and BruceS. Davie,Elsevier


**Reference Books:**


1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition. Course Code: BTCS504-18 Course Title: Computer Networks. 3L:1T:0P 3 Credits 42 Hours.
2. Internetworking with TCP/IP, Volume1, 6th Edition Douglas Comer, PrenticeHallofIndia.
3. TCP/IP Illustrated, Volume1, W.RichardStevens, Addison-Wesley, United States of America.


**E-Book**


1. An Introduction to Computer Networks Peter LDordal First-2020http://intronetworks.cs.luc.edu /current/ComputerNetworks

| Course Code | WEB FRAMEWORKS | L | T | P | C |
|---|---|---|---|---|---|
| CY2404 | | 3 | 0 | 2 | 4 |

**Course Objectives:**

1. To build scalable web applications using Angular
2. To import and export functionalities of modules using Angular
3. To create reusable UI components using React
4. To manage state of the application more efficiently using ReactHook
5. To containerize the applications using Dockerad Kubernetes

**UNIT I – ANGULARV 12** **9**

Introduction to Angular – TypeScript (Arrays, Functions, Classes) – JS vs TS – Angular CLI Installation – Components – Data Binding – Routing on Angular – Directives

**UNIT II –ANGULAR MODULES AND MATERIAL** **9**

Angular Modules–HTTPclient, FormsModule–Angular Service Files–Dependancy Injection–Angular Material– Connecting Angular with BackEnd

**UNIT III– REACTV18** **9**

Introduction to React – Setting development environment – Create app – JSX syntax – Properties and states – Components – React routing – API request

**UNIT IV –REACT HOOKS** **9**

React Hooks–useState–useEffect–useCallback–useMemo–useContext–useReducer–Introduction to ReactNative

**UNIT V– CONTAINERIZATION** **9**

Introduction toImageand Container– Docker –Containers–DockerImages, Dockerfile, DockerNetwork– DockerCompose - Kubernetes

**45 PERIODS**

**PRACTICAL EXERCISES:** **30 PERIODS**

1. Project–Create anangular app with n components and add routing
2. Project–Add functionalities, validation and database with above components
3. Project–Create Login System using React
4. Project–Create Flight Management system

**COURSEOUTCOMES:**

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

1. **CO1:**Build scalable web applications using Angular
2. **CO2:** Import and export functionalities of modules using Angular
3. **CO3:** Create reusable UI components using React

4. **CO4:**Manage state of the application more efficiently using ReactHook
5. **CO5:**Containerize the applications using Dockerad Kubernetes

**TEXTBOOKS:**


1. Nate Murray, Felipe Coury, Ari Lerner, Carlos Taborda, " The Ng book — The Complete Bookon Angular"
2. The RoadtoReact,RobinWieruch,2023.
3. The Docker Book:Containerization is the new virtualization, JamesTurnbull,2014.
4. The Kubernetes Book, NigelPoulton,2023.


**ONLINERESOURCES:**

1. https://angular.io/docs
2. https://react.dev/
3. https://react.dev/reference/react
4. https://docs.docker.com/
5. https://kubernetes.io/docs/home/

| Course Code | SOFTWARE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| CY2405 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

1. To understand Software Engineering Lifecycle Models
2. To Perform software requirements analysis
3. To gain knowledge of the System Analysis and Design concepts using UML.
4. To understand software testing and maintenance approaches
5. To work on project management scheduling using DevOps

**UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT** **9**

Introduction to Software Engineering, Software Process, Perspective, and Specialized Process Models – Introduction to Agility-Agile process-Extreme programming- XPProcess-Case Study.

**UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION** **9**

Requirement analysis and specification – Requirements gathering and analysis – Functional and Non-Functional requirements – Software Requirement Specification – Formal system specification – Finite State Machines – Petri nets – Object modeling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – Functional modeling – Data Flow Diagram - CASE TOOLS

**UNIT III SOFTWARE DESIGN** **9**

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence –Design patterns–Model-view-controller–Publish-subscribe–Adapter–Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client Server - Tiered - Pipe and filter- User interface design-Case Study.

**UNIT IV SOFTWARE TESTING AND MAINTENANCE** **9**

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing –Debugging-Program analysis – Symbolic execution–Model Checking-Case Study– Release Management

**UNIT V PROJECT MANAGEMENT** **9**

Software Project Management- Software Configuration Management-Project Scheduling-DevOps: Motivation- Cloud as a platform- Operations-Deployment Pipeline: Overall Architecture Building and Testing-Deployment-Tools-Case Study

**COURSE OUTCOMES:**

**CO1:** Compare various Software Development Lifecycle Models
**CO2:** Evaluate project management approaches as well as cost and schedule estimation strategies.
**CO3:** Perform formal analysis on specifications.
**CO4: Use** UML diagrams for analysis and design.
**CO5:** Architect and design using architectural styles and design patterns, and test the system

**45 PERIODS**

**PRACTICAL EXERCISES:** **30 PERIODS**

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams.
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design.
8. Test the software system for all the scenarios identified as per the use case diagram.
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios.

**SUGGESTED DOMAINS FOR MINI-PROJECT:**

1. Passport automation system.
2. Bookbank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

**TOTAL:75 PERIODS**

**TEXTBOOKS**


1. Bernd Bruegge and AllenH.Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education,2009.
2. Roger S.Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, McGraw-Hill lInternational Edition,2014.


**REFERENCES**


1. Carlo Ghezzi, MehdiJazayeri, DinoMandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt.Ltd.,2010.
2. Craig Larman, Applying UML and Patterns, 3rd, Pearson Education,2005.
3. LenBass, Ingo Weber and LimingZhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016
4. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd.,2009.
5. Stephen Schach, Object-Oriented and Classical Software Engineering, 8thed, McGraw-Hil

| Course Code | Employability Enhancement Skills – IV | L | T | P | C |
|---|---|---|---|---|---|
| ES2401 | Leadership and Project Management Skills | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

- To understand leadership within the context of project management.
- To differentiate between leadership and management roles.
- To learn project initiation processes and setting SMART objectives.
- To build high-performing teams through motivation, empowerment, and effective communication.
- To develop skills in project planning, estimation, resource allocation, risk management, and scheduling..

**UNIT I** **9**

Understanding Leadership - Introduction to Project Management - Leadership vs. Management - Project Initiation - Setting SMART Objectives.

**UNIT II** **9**

Building High-Performing Teams - Motivation Theories - Empowering Team Members - Leadership Communication - Handling Team Conflicts.

**UNIT III** **9**

Work Breakdown Structure (WBS) - Estimation Techniques - Gantt Charts and Network Diagrams - Resource Allocation - Risk Management.

**UNIT IV** **9**

Leading Project Teams - Monitoring and Controlling Progress - Change Management - Quality Management - Stakeholder Communication.

**UNIT V** **9**

Project Closure Activities - Lessons Learned - Celebrating Success - Transition Planning.

**COURSE OUTCOMES:**

**OUTCOMES:** Upon completion of the course, the students will be able to:

CO1: Apply leadership principles to project management scenarios.

CO2: Distinguish between leadership and management functions in project environments.

CO3: Initiate projects effectively by setting SMART objectives.

CO4: Foster high-performing teams through motivation, empowerment, and conflict resolution.

CO5: Proficiently plan, schedule, and manage project activities, resources, risks, and stakeholder communications.

**TEXT BOOKS:**


1. Peter G. Northouse. "Leadership: Theory and Practice", SAGE Publications, 2021
2. Patrick Lencioni. "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 2011
3. Robert K. Wysocki. "Effective Project Management: Traditional, Agile, Extreme", Wiley, 2019
4. Clifford F. Gray and Erik W. Larson. "Project Management: The Managerial Process", McGraw-Hill Education, 2017
5. Harold Kerzner. "Project Management Case Studies", Wiley, 2008.


**REFERENCES:**


1. Harold Kerzner. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 10th edition, Wiley, 2009
2. Gregory P. Shea and Cassie A. Solomon. "Leading Successful Change: 8 Keys to Making Change Work", Gildan Media, LLC, 2013.


**TOTAL: 30 PERIODS**

| Course Code | Tamils and Technology | L | T | P | C |
|---|---|---|---|---|---|
| HS2401 | | 1 | 0 | 0 | 1 |

HS2401

## தமிழரும் தொழில்நுட்பமும்

LTPC
1 0 0 1

**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**

**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 ofArchaeology & 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.


HS2401

## TAMILS AND TECHNOLOGY

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**UNIT I WEAVING AND CERAMIC TECHNOLOGY** 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY** 3

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.

**UNIT III MANUFACTURING TECHNOLOGY** 3

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.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY** 3

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.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING** 3

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.

**TOTAL : 15 PERIODS**

| CourseCode | HERITAGEOFTAMILS | L | T | P | C |
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## தமிழர் மரபு

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**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 ofArchaeology & 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.

HS2301

## HERITAGE OF TAMILS

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**UNIT I LANGUAGE AND LITERATURE** 3

Language Families in India - Dravidian Languages – Tamil as aClassical 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.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE** 3

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.

**UNIT III FOLK AND MARTIAL ARTS** 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS** 3

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.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE** 3

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.

**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)
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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.

**Semester V**

| Course Code | COMPUTING THEORY AND COMPILER DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| CZ2501 | | 3 | 0 | 0 | 3 |

**Course Objectives**:

The purpose of this course is to acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages.

**Course outcomes:**

Upon completion of this course, the student should be able to:

1. Construct automata for any given pattern and find its equivalent regular expressions
2. Understand different phases of the compiler and various parsing techniques
3. Learn how to generate machine codes.
4. Understand Turing machines and basics of theory of computation
5. Understand undecidability and semi-decidability

**UNIT I FINITE AUTOMATA** **9**

Introduction: Basic Mathematical Notation and techniques - Finite State Systems - Basic Definitions, Finite Automaton: DFA – NDFA – with ε-moves, Regular Languages: Regular Expression Equivalence of NFA and DFA – Equivalence of finite Automaton and regular expressions – Minimization of DFA – Pushdown Automata.

**UNIT II GRAMMARS** **9**

Grammar Introduction: Types of Grammar, Context Free Grammars and Languages, Derivations, Simplification of CFG: Elimination of Useless Symbols Simplification of CFG: Unit productions, Null productions, Chomsky normal form, Greibach Normal form – phases of a compiler – lexical analysis

**UNIT III LEXICAL AND SYNTAX ANALYSIS** **9**

Need and Role of the Parser –Top-Down parsing: Recursive Descent Parsing – Predictive Parsing - Bottom-up parsing: Shift Reduce Parsing, Operator Precedence Parsing, LR Parsers: Canonical LR Parser – LALR Parser - Error Handling and Recovery.

**UNIT IV CODE GENERATION AND TURING MACHINES** **9**

Intermediate Code Generation: Syntax Directed Definitions, Syntax Directed Translation Schemes – Three address code - Translation of Expressions- Principal sources of optimization, Optimization of basic blocks, peephole optimizationData flow analyses: constant propagation, liveness analysis, common sub-expression elimination ,Code Generation: Issues in Design of a Code Generator, A Simple Code Generator Algorithm. Turing Machines: Introduction - Instantaneous descriptions, Turing Machine as Acceptors - Turing Machine for computing functions (Transducer) - Turing Machine Constructions

**UNIT V UNDECIDABILITY** **9**

Undecidability: Basic definitions – Decidable Problems – Examples of undecidable problems – Semi-decidability – Rice's Theorem, problems about Turing Machine – Post's Correspondence Problem – Properties of Recursive and Recursively enumerable languages.

**TOTAL:45 PERIODS**

**COURSE OUTCOMES:**

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

1. Construct automata, regular expression for any pattern.
2. Write Context free grammar for any construct.
3. Build the different Phases of compiler and apply the various optimization techniques.
4. Design Turing machine for a given language
5. Explain decidability, semi-decidability, and undecidability

**TEXTBOOKS:**

1. John E Hopcroft and Jeffery D Ullman, Introduction to Automata Theory, Languages and Computations, Narosa Publishing House, 2002.

2. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, Compilers – Principles, Techniques and Tools, 2nd Edition, Pearson Education, 2007.

**REFERENCES:**

1. Michael Sipser, "Introduction of the Theory of Computation", Second Edition, Thomson Brokecole, 2006.

2. J. Martin, "Introduction to Languages and the Theory of Computation", Third Edition, Tata McGraw Hill, 2003.

3. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.

4. Muneeswaran. K, —Compiler Design, Oxford University Press, 2012

5. Steven S. Muchnick, —Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.

6. Randy Allen, Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence-based Approach, Morgan Kaufmann Publishers, 2002.

| Course Code | COMPUTER ARCHITECTURE | L | T | P | C |
|---|---|---|---|---|---|
| CZ2502 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To learn the basic structure and operations of a computer.
2. To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
3. To learn the basics of pipelined execution.
4. To understand parallelism and multi-core processors.
5. To understand the memory hierarchies, cache memories and virtual memories.
6. To learn the different ways of communication with I/O devices

**UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9**

Functional Units — Basic Operational Concepts — Performance — Instructions: Language of the Computer—Operations, Operands—Instruction representation—Logical operations—decision making —MIPS Addressing.

**UNIT II ARITHMETIC FOR COMPUTERS 9**

Addition and Subtraction—Multiplication—Division—Floating Point Representation—Floating Point Operations — Sub word Parallelism.

**UNIT III PROCESSOR ANDCONTROL UNIT 9**

A Basic MIPS implementation—Building a Data path—Control Implementation Scheme — Pipelining—Pipelined data path and control—Handling Data Hazards & Control Hazards—Exceptions.

**UNIT IV PARALLELISIM 9**

Parallel processing challenges—Flynn's classification—SISD, MIMD, SIMD, SPMD, and Vector Architectures—Hardware multithreading—Multi-core processors and other Shared Memory Multiprocessors—Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

**UNIT V MEMORY&I/OSYSTEMS 9**

Memory Hierarchy—memory technologies—cache memory—measuring and improving cache performance — virtual memory, TLB's — Accessing I/O Devices — Interrupts —Direct Memory Access—Bus structure—Bus operation—Arbitration—Interface circuits —USB.

TOTAL PERIODS: 45

**COURSE OUTCOMES:**

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

CO1 Understand the basics structure of computers, operations and instructions.
CO2 Design arithmetic and logic unit.
CO3 Understand pipelined execution and design control unit
CO4 Understand parallel processing architectures.
CO5 Understand the various memory systems and I/O communication.

**TEXTBOOKS:**

1. DavidA. Patterson and JohnL.Hennessy, Computer Organization and Design:TheHardware/SoftwareInterface,FifthEdition, Morgan Kaufmann/Elsevier,2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zakyand Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, TataMcGraw Hill,2012.

**REFERENCES:**

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition,PearsonEducation,2010.
2. JohnP. Hayes, Computer Architecture and Organization,Third Edition,TataMcGrawHill,2012.
3. JohnL.Hennessey and David A.Patterson, Computer Architecture–A Quantitative Approach||, MorganKaufmann/ ElsevierPublishers, Fifth Edition,2012.

| Course Code | FUNDAMENTALS OF DATA SCIENCE | L | T | P | C |
|---|---|---|---|---|---|
| CZ2503 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

• To understand the data science fundamentals and process.

• To learn to describe the data for the data science process.

• To learn to describe the relationship between data.

• To utilize the Python libraries for Data Wrangling.

• To present and interpret data using visualization libraries in Python

**Prerequisites**

- Basic knowledge of Mathematics, like probability, statistics, algebra, and calculus.
- Familiarity with a programming language like Python.

**UNIT I INTRODUCTION** **9**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data

**UNIT II DESCRIBING DATA** **9**

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data in Types of Data - Types of Variables - Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.

**UNIT III DESCRIBING RELATIONSHIPS** **9**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

**UNIT IV PYTHON LIBRARIES FOR DATA WRANGLING** **9**

Indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

**UNIT V DATA VISUALIZATION** **9**

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

**45 PERIODS**

**LAB EXPERIMENTS:**

Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.

1. Working with Numpy arrays

2. Working with Pandas data frames
3. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
4. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
    a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
    b. Bivariate analysis: Linear and logistic regression modeling
    c. Multiple Regression analysis
    d. Also compare the above analysis results for the two data sets.

6. Apply and explore various plotting functions on UCI data sets.
    a. Normal curves
    b. Density and contour plots
    c. Correlation and scatter plots
    d. Histograms
    e. Three-dimensional plotting

7. Visualizing Geographic Data with Basemap

**Tools:** Python, Numpy, Scipy, Matplotlib, Pandas, stat models, seaborn, plotly, bokeh

**Example datasets like Berklin, Iris, Pima Indians Diabetes, etc.**

**30 PERIODS**

**TOTAL:75 PERIODS**

**COURSE OUTCOMES:**

COURSE OUTCOMES: At the end of this course, the students will be able to:

CO1: Define the data science process

CO2: Understand different types of data description for data science process

CO3: Gain knowledge on relationships between data

CO4: Use the Python Libraries for Data Wrangling

CO5: Apply visualization Libraries in Python to interpret and explore data

**TEXT BOOKS :**

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units II and III) Padeepz App Padeepz App 69 3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)

**REFERENCES:**

**1.** Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press,2014.

| COURSE CODE | Employability Enhancement Skills – V:<br>Innovation and Entrepreneurship | L | T | P | C |
|---|---|---|---|---|---|
| ES2501 | | 0 | 0 | 2 | 1 |

**Course Objectives:**

- To understand the fundamentals of entrepreneurship and innovation.
- To explore the components of an innovation ecosystem.
- To learn the principles of the Lean Startup methodology and its application.
- To develop skills in identifying entrepreneurial opportunities.
- To cultivate creativity and ideation techniques for innovation

Unit 1: Understanding Innovation - Entrepreneurship Fundamentals - Innovation Ecosystem - The Lean Startup Methodology - Identifying Opportunities

Unit 2: Creativity and Ideation Techniques - Market Research and Validation -Customer Discovery - Prototype Development

Unit 3: Business Model Canvas - Revenue Models - Customer Acquisition and Retention - Pricing Strategies - Scalability and Growth

Unit 4: Financial Planning - Funding Options - Pitching Investors - Valuation Method - Financial Management

Unit 5:Go-to-Market Strategy - Building a Team - Scaling Operations - Managing Growth - Exit Strategies

**Course Outcomes:**

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

CO1: Demonstrate an understanding of entrepreneurship fundamentals and innovation principles.

CO2: Analyze and navigate innovation ecosystems.

CO3: Apply Lean Startup methodology to validate and iterate business ideas.

CO4: Identify and evaluate entrepreneurial opportunities effectively.

CO5: Generate creative ideas, conduct market research, validate concepts, and develop prototypes for entrepreneurial ventures.

**Textbooks**


1. Eric Ries. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Random Housey, 2011
2. Alexander Osterwalder and Yves Pigneur. "Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers", Wiley, 2010
3. Karen Berman and Joe Knight. "Financial Intelligence for Entrepreneurs: What You Really Need to Know About the Numbers"Harvard Business Review Press, 2008


**References**

1. Clayton M. Christensen. "The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail", Harvard Business Review Press, 2013
2. Steve Blank and Bob Dorf. "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company" Wiley, 2020
3. Peter Thiel and Blake Masters. "Zero to One: Notes on Startups, or How to Build the Future"Virgin Digital, 2014

## Semester VI

| Course Code | CYBERCRIME AND FORENSICS | L | T | P | C |
|---|---|---|---|---|---|
| CZ2601 | | 2 | 0 | 2 | 3 |

**Course Objective:**

The main objectives of this course are to

CO1:Understand the cyber-crime, preventing measures and range of cyber threats and the fundamental principles of cyber security

CO2: Focuses on developing policies, implementing risk management practices, and fostering a security-aware culture to mitigate cyber threats

CO3: Understand the methodologies, tools, and techniques employed in investigating various types of cybercrimes

CO4: Provide participants with a foundational understanding of digital forensics, covering essential concepts, methodologies, and tools

CO5:Advance participants' proficiency in cyber forensics by delving into advanced techniques and methodologies.

**Course Description**

This course provides an in-depth exploration of the evolving landscape of cybercrime and the methodologies employed in digital forensics to investigate and mitigate these threats. Participants will gain a comprehensive understanding of cybercrime trends, the anatomy of various cyber-attacks, and the tools and techniques used by digital forensics experts to analyze and respond to cyber incidents.

**Unit I: Cybercrime Types and Prevention** **6**

Overview- Introduction to Cybercrime - Types of Cybercrime - Cybersecurity Fundamentals - Prevention and Mitigation.

**Unit II: Cybersecurity Policies and Risk Management** **6**

Role-Based Access Control (RBAC) - Incident Response Plans (IRP) - Risk Assessment and Management -Security Awareness Training.

**Unit III: Cybercrime Investigation Techniques** **6**

Digital Evidence Collection and Preservation - Network Forensics and Traffic Analysis - Malware Analysis and Reverse Engineering - Incident Response and Cyber Threat Hunting.

**Unit IV: Digital Forensics Fundamentals** **6**

Basic concepts of Digital Forensics - Digital Forensics Process - Types of Digital Evidence - Digital Forensics Tools and Techniques.

**Unit V: Advanced techniques and emerging trends in digital forensics** **6**

Analysis of Sophisticated Cyber Incidents - Memory Forensics Beyond Basics - Anti-Forensics Challenges and Countermeasures - Machine Learning in Cyber Forensics.

**TOTAL PERIODS: 30**

**Course Format**

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

**Practical/ Projects (sample):**

1. Analyze a real-world cybercrime case and prepare a report. Include details such as the type of attack, forensics methods used, legal implications, and recommendations for preventing a similar incident.
2. Research and write a paper on the legal and ethical considerations in digital forensics. Discuss challenges, privacy concerns, and the impact of regulations on cybercrime investigations.
3. Provide a detailed analysis of a specific malware strain. Include information on its origins, functionality, and potential impact. Discuss mitigation strategies and preventive measures
4. Develop an incident response plan for a simulated cyber incident. Outline steps for detection, containment, eradication, recovery, and lessons learned.
5. Analyze a provided set of network traffic logs. Identify patterns of suspicious behavior, potential security incidents, and propose measures to enhance network security.
6. Conduct a forensic analysis of a mobile device. Recover and analyze data such as call logs, messages, and application data. Prepare a report outlining your findings.
7. Conduct a comprehensive cybercrime investigation using a simulated scenario. Apply digital forensics techniques to collect and analyze evidence. Prepare a detailed report outlining your findings and recommendations.
8. Research and compile a threat intelligence report on a specific cyber threat. Include information on the threat actor, tactics, techniques, and procedures (TTPs), and propose countermeasures.
9. Develop a digital forensics toolkit or toolset. This could include scripts, software, or a combination of tools designed to automate or enhance certain forensic processes.
10. Design and implement a security awareness campaign aimed at educating users about common cyber threats. Develop materials such as posters, infographics, and training modules.

**30 PERIODS**

**Course Outcomes:** **TOTAL: 60 PERIODS**

At the end of this course, the students will be able to:

CO1. Demystify the fundamental principles of cyber security.

CO2. Delineate the use of Cyber security Policies and Risk Management

CO3. Elucidate the basic tools, and techniques employed in investigating various types of cybercrimes

CO4.Apply the digital forensics, covering essential concepts, methodologies, and tools

CO5. Demonstrate the cyber forensics techniques and methodologies.

**Text Books & links**


1. Cyber Crime and Digital Forensics an introduction – ThomansJ.Holt, Adam M. Bossler and Kathryn C. Seigfried – Spellar.
   https://Downloads/cybercrime-and-digital-forensics-an-introduction-second-edition-2017017922-9781138238725-9781138238732-9781315296975-1138238724-1138238732_compress.pdf.
2. DIGITAL FORENSICS by Dr.Jeetendra Pande Dr. Ajay Prasad,
   **https://uou.ac.in/sites/default/files/slm/MIT(CS)-202.pdf**
3. Marjie T Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 2nd Edition, 2008.

**References /Online resources**


1. MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett Learning; 2nd Edition, 2014.
2. Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
3. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2005

4. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004

| Course Code | MALWARE ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| CZ2602 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

The main objectives of this course are to:

CO1 : understand scope of the malware borne cyber-attacks, various malware types, and platform-specific variations of malware

CO2 : learn how to install linux, and also be able to use basic tools to perform malware analysis.

CO3 : Explain the basic signs of malware infection and signs of intrusion from a security analyst's point of view

CO4 : Explain various machine learning techniques and tools used for malware analysis, and techniques such as memory forensics

CO5 : Implement tools for malware analysis employing machine learning tools and libraries and measure the efficacy of their tools on labeled and unlabeled data;

**Course Description**

This course is designed to equip students with the fundamental principles and practical skills necessary for analyzing and understanding malicious software, also known as malware. Students will delve into the techniques used by malware authors, learn how to analyze malware behavior, and develop strategies for effective detection and mitigation.

**UNIT I Introduction to Malware analysis** 6

Malware classification- types- and platform specific issues with malware- Intrusion into IT and operational network (OT) and their signs – Basics of malware detection – Intro to linux- Networks.

**UNIT II Linux and tools** **6**

Introduction to linux – Linux in Malware analysis – Tools used – IDA Pro-VirusTotal- Wireshark.

**UNIT III Basic Malware Analysis** **6**

Manual Malware Infection analysis - signature-based malware detection and classification – pros and cons- and need for machine learning based techniques

**UNIT IV Advanced Techniques Malware Analysis** **6**

Static Analysis- Dynamic Analysis - Hybrid Analysis of Windows Malware- Linux Malware and Android Malware

**UNIT V Malware Analysis using Machine Learning** **6**

Study Machine Learning libraries used for malware analysis- Machine learning application specifics- -Malware Analysis and Detection Using Machine Learning Algorithms -Material: Malware analysis using machine learning algorithms

**Course Format:**

Lectures and discussions, Hands-on coding exercises and projects, Guest lectures by industry Experts, Group discussions and presentations, Online resources and tutorials.

**Assessments & Grading**

Quizzes, Assignments/ Project, 2IAs ,Model, Final Examination

**30 PERIODS**

**Practical Exprement:**

1. File Signature Analysis
2. Strings Analysis
3. Header Analysis
4. Behavioral Analysis in a Sandbox
5. API Call Monitoring
6. Memory Analysis
7. Disassembly and Decompilation
8. Code Flow Analysis
9. Packet Capture and Analysis
10. DNS Analysis
11. Packer and Cryptex Analysis
12. Anti-VM and Anti-Sandbox Techniques

Exercise:

Upload Malware to Virustotal- Analyze the file Lab01-02.exe - [ Refer Lab 1-2 in Textbook] - Lab01-02.exe

1. This lab uses the file Lab01-04.exe. Analyze the file Lab01-04.exe. [ Refer Lab 1-4 in Textbook] - Lab01-04.exe
2. Analyze the malware found in the file Lab05-01.dll using only IDA Pro [Refer Lab 5-1 In Textbook] - Lab05-01.exe
3. Analyze the malware found in the file Lab07-02.exe [Refer Lab 07-02 in Textbook] - Lab07-02.exe
4. This lab uses the file Lab03-02.dll. Analyze this using basic dynamic analysis tool - [Refer Lab 03-02 in Textbook] - Lab03-02.exe

**30 PERIODS**

**Assignments / Projects**

1. Project - Simple Malware Detector using the Virustotal API - https://github.com/Nadeem-05/Virustotal-flask
2. Case Study analysis
3. Static Analysis Exercise

4. Dynamic Analysis Report
5. Code analysis Assignment
6. Network Traffic analysis.
7. Malware Family Classification.
8. Exploit Analysis Projects
9. Memory Forensics Project
10. Security Awareness Campaign
11. Tool Development Project.
12. Incident response plan

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES**:

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

CO1. Explain and introduce malware analysis efficiently.

CO2. Install and use linux and linux based tools to do basic malware analysis

CO3. Explain basic malware analysis and demonstrate some basic techniques

CO4.Explain advanced malware analysis and os based malware

CO5. Implement tools for malware analysis efficiently and measure the tools efficiency using machine learning libraries.

**TEXT BOOKS:**

1. Practical Malware Analysis By, Michael Siroski and Andrew Honig - Link
2. Introduction to Malware and Malware Analysis: A brief overview- Link
3. Systematic Approach to Malware Analysis (SAMA)- Link

**REFERENCES:**

1. Dynamic Malware Analysis in the Modern Era—A State of the Art Survey - Link
2. Practical Malware Analysis Lab Solutions - Lab Solutions - Solutions for all labs plus extra
3. Chris Eagle: The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler Second Edition. No Starch Press. ISBN: 978-1-59327-289-0

**YouTube Resources:**

1. Practical Malware analysis -Youtube
2. Building a Malware Analysis lab - Youtube

| **Course Code** | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|

| CZ2603 | CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES | 3 | 0 | 2 | 4 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**:

1. To understand the basics of Blockchain
2. To learn Different protocols and consensus algorithms in Blockchain
3. To learn the Blockchain implementation frameworks
4. To experiment the Hyperledger Fabric, Ethereum networks
5. To understand the Blockchain Applications

**Course Description:**

A syllabus for a course on Cryptocurrency and Blockchain Technologies should cover the foundational principles, technical aspects, and real-world applications of blockchain and cryptocurrencies

**UNIT I INTRODUCTION TO BLOCKCHAIN 9**

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

**UNIT II BITCOIN AND CRYPTOCURRENCY 9**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

**UNIT III BITCOIN CONSENSUS 9**

Bitcoin Consensus, Proof of Work (PoW)- HashcashPoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

**UNIT IV HYPERLEDGER FABRIC & ETHEREUM 9**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity. UNIT V BLOCKCHAIN APPLICATIONS 6 Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance- Case Study.

**UNIT V BLOCKCHAIN APPLICATIONS 9** Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance- Case Study.

**45 PERIODS**

**ASSIGNMENTS:**

1. Blockchain Use Case Analysis
2. Smart Contract development
3. Cryptocurrency security Audit
4. Regulatory compliancein cryptocurrency
5. Blockchain and social impact
6. Crytocurrency investment analysis
7. Initial coin offering (ICO) simulation

**PRACTICAL** **30 PERIODS**

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.

2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network. 3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.

4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan

**TOTAL:75 PERIODS**

**COURSE OUTCOMES:**

CO1: Understand emerging abstract models for Blockchain Technology
CO2: Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3: It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
CO4: Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.
CO5: To design and develop the Block chain Application.

**TEXT BOOKS**

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.

2.Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

3. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

**REFERENCES:**

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.

2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015 4. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing

**Semester VII**

| Course Code | PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES | L | T | P | C |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **HS2701** | | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVE:**

To enable the students to create an awareness of Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty, and to appreciate the rights of others.

**UNIT I HUMAN VALUES** **10**

Morals, values, and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS** **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION** **9**

Engineering as Experimentation – Engineers as Responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES, AND RIGHTS** **9**

Safety and Risk – Assessment of Safety and Risk – Risk-Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES** **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

**COURSE OUTCOME:**

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

CO1:Apply ethics in society, discuss the ethical issues related to engineering, and realize societal responsibilities and rights.

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt.Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

**Web sources:**

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

## Semester VIII

**APPENDIX A: PROFESSIONAL ELECTIVES**

| **Vertical I**<br>**Full Stack Development** | **Vertical II**<br>**Software Technologies** | **Vertical III**<br>**Cyber Security** | **Vertical IV**<br>**Artificial Intelligence and Data Science** | **Vertical V**<br>**Cloud Computing** | **Vertical VI**<br>**IoT Systems** | **Vertical VII**<br>**High-End Computing** |
|---|---|---|---|---|---|---|
| Web Development 5.0 | Software Engineering | Cryptography & Information Security | Data Analytics and Visualization | Cloud Technologies | Foundations of Embedded IoT Systems | Parallel Processing |
| App Development | Software Testing and Automation | Security and Privacy in Cloud | Mathematics of Machine Learning | Virtualization | IoT Networks | Hi-Performance Computing |
| UI and UX Design | Agile Methodologies | Web Application Security | Deep Learning | Cloud Architectures | Secure Hardware and Embedded Devices | Pervasive Computing |
| Cloud Services Management | Software User Interface Design & Analysis | Social Network Security | Natural Language Processing (NLP) | Cloud Platform Programming | IoT Processors | Pico Computing |
| DevOps | Software Architecture and Design Patterns | Digital Forensics and Malware Analysis | Computer Vision and Image Processing | Cloud Services Management | Mobile Applications Development | Nano Computing |
| Web Frameworks | Software Quality Management | Ethical Hacking | Reinforcement Learning | Stream Processing | Industrial IoT & Healthcare Systems | Edge and Fog Computing |
| Middle Tier Technologies | Software Project Management | Cryptocurrency & Blockchain Technologies | Big Data Analytics | Fog and Edge Computing | Smart Cities | AI and Cloud Computing |
| Web Application Security | Human-Computer Interaction | Security Auditing & Counter Hacking Techniques | Generative Adversarial Networks | Blockchain Concepts and Technologies | Advanced Intelligent Systems | Quantum Computing |

*Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. However, Students are restricted to select from not more than 2 verticals.

## Vertical 1: 1Full Stack Development

| Course Code | WEB DEVELOPMENT 5.0 | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2101 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To define the evolution of web development from static websites to modern web applications
2. To explore the concepts of components, JSX, and state management.
3. To define Node.js and Express.js and their roles in server-side development.
4. To integrate databases with web applications.
5. To understand various deployment strategies for web applications.

**Unit 1: Introduction to Modern Web Development** 6

Evolution of Web Development- Historical overview of web development- Introduction to Web Development 5.0 and its characteristics- Modern Web Development Ecosystem- Overview of front-end and back-end technologies- Introduction to popular frameworks and libraries

**Unit 2: Front-end Development with React.js** 6

Introduction to React.js- Overview of React.js and its key features- Understanding JSX syntax and component-based architecture- Components and State Management- Creating functional and class components- Managing state and props in React applications

**Unit 3: Back-end Development with Node.js and Express.js** 6

Introduction to Node.js and Express.js- Overview of Node.js and its event-driven architecture- Introduction to Express.js as a web application framework- Building RESTful APIs- Understanding RESTful principles- Creating a simple RESTful API with Express.js

**Unit 4: Database Integration and Authentication** 6

Database Integration- Overview of database options (MongoDB, MySQL, etc.)- Integrating MongoDB with Express.js- User Authentication and Authorization- Introduction to authentication and authorization- Implementing user authentication using Passport.js

**Unit 5: Deployment and Project Work** 6

Deployment Strategies- Traditional Server Hosting-Cloud Hosting-Containerization-Container Orchestration-Serverless Architecture-Continuous Deployment-Blue-Green Deployment-Feature Toggles- Best Practices- Project Work Guidelines- Tips for effective project planning, collaboration, and troubleshooting

TOTAL NUMBER OF PERIODS INCLUDING LAB: 60

SAMPLE LIST OF EXPERIMENTS 30

1. Installation and configuration of development tools.
2. Introduction to version control using Git.
3. Creating a basic HTML5 and CSS3 web page.
4. Introduction to responsive design principles.
5. Building a simple React application.
6. Implementing components and managing state.
7. Practical exercises on creating stateful and stateless components.
8. Implementing interactivity in React applications.
9. Creating a basic web server using Node.js.
10. Implementing asynchronous programming with callbacks and Promises.
11. Integration of MongoDB with Express.js.

**COURSE OUTCOMES:**

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

CO1 Understand and Apply Modern Web Development Concepts.
CO2 Create interactive and dynamic user interfaces with React.js.
CO3 Apply design patterns to new projects and re-factor existing code.
CO4 Implement secure user authentication and authorization using Passport.js.
CO5 Understand various deployment strategies and hosting platforms.

**TEXTBOOKS:**

1. "Learning React" by Alex Banks and Eve Porcello
2."Node.js Design Patterns" by Mario Casciaro
3. "The DevOps Handbook" by Gene Kim, Jez Humble, Patrick Debois, and John Willis.

**REFERENCES:**

1."Express in Action" by Evan Hahn
2."MongoDB: The Definitive Guide" by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow

| Course Code | APP DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2102 | | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. To learn the development of native applications with basic GUI Components
2. To developcross-platform applications with event handling
3. To develop applications with location and data storage capabilities
4. To develop web applications with database access

**UNIT I FUNDAMENTALS OF MOBILE & WEBAPPLICATION DEVELOPMENT** 6

Basics of Web and Mobile application development, NativeApp, HybridApp, Cross-platformApp, What is ProgressiveWeb App, Responsive Web design

6

**UNIT II NATIVEAPP DEVELOPMENT USING JAVA**

Native WebApp, Benefits of NativeApp,Scenarios to create NativeApp, Tools for creating NativeApp, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State,Props

**UNIT III HYBRID APP DEVELOPMENT** 6

Hybrid Web App, Benefits of Hybrid App, Criteria for creating NativeApp, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova

6

**UNIT IV CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platformApp, Tools for creating Cross-platformApp, Consof Cross-platformApp,Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native,Native Components, JSX,State,Props

6

**UNIT V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**

Comparison of different Appframeworks, Build Performance, AppPerformance, Debugging capabilities, TimetoMarket, Maintainability, EaseofDevelopment, UI/UX, Reusability

**TOTAL NUMBER OF PERIODS INCLUDING LAB: 60**

**SAMPLE LIST OF EXPERIMENTS**

1. Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system ( km to miles, kg to pounds etc.,)
4. Design and develop a cross-platform application for day-to-day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers.
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases
   For a simple library application.
   For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.

COURSE OUTCOMES:

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

CO1 Develop Native applications with GUI Components.

CO2 Develop hybrid applications with basic event handling.

CO3 Implement cross-platform applications with location and data storage capabilities.

TEXTBOOKS:

1.Head First Android Development, DawnGriffiths, O'Reilly,1st edition

2. Apache Cordovain Action,RaymondK. Camden,Manning.2015

3.Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native,Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, Full Stack publishing

REFERENCES:

1.Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition

2. Native Mobile Development by Shaun Lewis, Mike Dunn

3. Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras

4.Apache Cordova 4 Programming, John M Wargo, 2015

5.React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

| Course Code | UI AND UX DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2103 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To provide a sound knowledge in UI& UX
2. To understand the need for UI and UX
3. To understand the various Research Methods used in Design
4. To explore the various Tools used in UI&UX
5. Creating a wireframe and prototype

6

**UNIT I FOUNDATIONS OF DESIGN**

UI vs. UX Design - Core Stages of Design Thinking- Divergent and Convergent Thinking - Brainstorming and Game storming-Observational Empathy

6

**UNIT II FOUNDATIONS OF UI DESIGN**

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding-Style Guides

6

**UNIT III FOUNDATIONS OF UX DESIGN**

Introduction to User Experience - Why You Should Care about 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

6

**UNIT IV 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

6

**UNIT V RESEARCH, DESIGNING,IDEATING, & INFORMATION ARCHITECTURE**

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams – Flow Mapping-Information Architecture

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Designing a Responsive layout for a societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

COURSE OUTCOMES:

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

CO1 Build UI for user Applications
CO2 Evaluate UX design of any product or application
CO3 Demonstrate UX Skills in product development
CO4 Implement Sketching principles
CO5 Create Wire frame and Prototype

TEXTBOOKS:

1.Joel Marsh, "UX for Beginners",O'Reilly,2022
2.Jon Yablonski, "Laws of UX using Psychology to Design Better Product & Services" O'Reilly2021

REFERENCES:

1.Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rdEdition, O'Reilly2020
2.Steve Schoger, Adam Wathan "RefactoringUI",2018
3.Steve Krug, "Don't Make Me Think, Revisited: A Commonsense Approach to Web &Mobile",Third Edition,2015
4.https://www.nngroup.com/articles/
5.https://www.interaction-design.org/literature.

| Course Code | CLOUD SERVICES MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2104 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Introduce Cloud Service Management terminology, definition & concepts
2. Compare and contrast cloud service management with traditional IT service management.
3. Identify strategies to reduce risk and eliminate issues associated with the adoption of cloud services.
4. Select appropriate structures for designing, deploying, and running cloud-based services in a business environment.
5. Illustrate the benefits and drive the adoption of cloud-based services to solve real-world problems

**UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS** 6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

**UNIT II CLOUD SERVICES STRATEGY** 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

**UNIT III CLOUD SERVICE MANAGEMENT** 6

Cloud Service Reference Model, Cloud Service Lifecycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

6

**UNIT IV CLOUD SERVICE ECONOMICS**

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription-based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

6

**UNIT V CLOUD SERVICE GOVERNANCE & VALUE**

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the Value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

**TOTAL NUMBER OF PERIODS INCLUDING LAB: 60**

**SAMPLE LIST OF EXPERIMENTS**

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one.

**COURSE OUTCOMES**:

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

CO1 Exhibit cloud-design skills to build and automate business solutions using cloud technologies.

CO2 Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.

CO3 Solve the real-world problems using Cloud services and technologies.

**TEXTBOOKS:**

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. 3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

**REFERENCES:**

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

| Course Code | DevOps | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2105 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To introduce DevOps terminology, definition & concepts
2. To understand the different Version control tools like Git, Mercurial
3. To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
4. To understand Configuration management using Ansible
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

**UNIT I INTRODUCTION TO DEVOPS** 6

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

**UNIT II COMPILE AND BUILD USING MAVEN & GRADLE** 6

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, understand build using Gradle

6

**UNIT III CONTINUOUS INTEGRATION USING JENKINS**

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

6

**UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE**

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible

6

**UNIT V BUILDING DEVOPS PIPELINES USING AZURE**

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines' file

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1 | Understand different actions performed through Version control tools like Git. |
| CO2 | Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle. |
| CO3 | Ability to Perform Automated Continuous Deployment |
| CO4 | Ability to do configuration management using Ansible |
| CO5 | Understand to leverage Cloud-based DevOps tools using Azure DevOps |

TEXTBOOKS:


1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014


REFERENCES:


1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4. MariotTsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5. https://www.jenkins.io/user-handbook.pdf 7. https://maven.apache.org/guides/getting-started/


| Course Code | WEB FRAMEWORKS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2106 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To build scalable web applications using Angular
2. To import and export functionalities of modules using Angular
3. To create reusable UI components using React
4. To manage state of the application more efficiently using React Hook
5. To containerize the applications using Docker ad Kubernetes

**UNIT I ANGULAR V 12** 6

Introduction to Angular – Typescript (Arrays, Functions, classes) – JS vs TS – Angular CLI Installation – Components – Data Binding – Routing on Angular - Directives

**UNIT II ANGULAR MODULES AND MATERIAL** 6

Angular Modules – HTTP client, Forms Module – Angular Service Files – Dependancy Injection – Angular Material – Connecting Angular with Back End

**UNIT III REACT V 18** 6

Introduction to React – Setting development environment – create app – JSX syntax – properties and states – components – React routing – API request

**UNIT IV REACT HOOKS** 6

React Hooks – useState – useEffect – useCallback – useMemo – useContext – useReducer – Introduction to React Native

**UNIT V CONTAINERIZATION** 6

Introduction to Image and Container – Docker – Containers – Docker Images, Docker file, Docker Network – Docker Compose - Kubernetes

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS :**

1. Project – Create an angular app with n components and add routing
2. Project – Add functionalities, validation and database with above components
3. Project – Create Login System using React
4. Project – Create Flight Management system

**COURSE OUTCOMES**:

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

CO1 Build scalable web applications using Angular
CO2 Import and export functionalities of modules using Angular
CO3 Create reusable UI components using React
CO4 Manage state of the application more efficiently using React Hook
CO5 Containerize the applications using Docker ad Kubernetes

**TEXTBOOKS:**

1. Nate Murray, Felipe Coury, Ari Lerner, Carlos Taborda, " The Ng book — The Complete Book on Angular"
2. The Road to React, Robin Wieruch,2023.
3. The Docker Book: Containerization is the new virtualization, James Turnbull, 2014.
4. The Kubernetes Book, Nigel Poulton, 2023.

**REFERENCES AND ONELINE RESOURCES:**

1. https://angular.io/docs
2. https://react.dev/
3. https://react.dev/reference/react
4. https://docs.docker.com/
5. https://kubernetes.io/docs/home/

| Course Code | MIDDLE TIRE TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2107 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To study the set of services that a middleware system constitutes of.
2. To understand how middleware facilitates the development of distributed applications in heterogeneous environments
3. To study how it helps to incorporate application portability, distributed application component interoperability and integration.
4. To learn the object oriented middleware basics through the example of the following CORBA objects.
5. To understand the basics of Web services that is the most oft-used middleware technique

**UNIT I CLIENT/ SERVER CONCEPTS** 6

Client – Server – File Server, Database server, Group server, Object server, Web server .Middleware – General middleware – Service specific middleware. Client / Server Building blocks – RPC – Messaging – Peer – to- Peer.

**UNIT II EJB ARCHITECTURE** 6

EJB – EJB Architecture – Overview of EJB software architecture – View of EJB – Conversation – Building and Deploying EJBs – Roles in EJB.

**UNIT III EJB APPLICATIONS** 6

EJB Session Beans – EJB entity beans – EJB clients – EJB Deployment – Building an application with EJB.

**UNIT IV CORBA** 6

CORBA – Distributed Systems – Purpose – Exploring CORBA alternatives – Architecture overview – CORBA and networking model – CORBA object model – IDL – ORB – Building an application with CORBA.

**UNIT V COM** 6

COM – Data types – Interfaces – Proxy and Stub – Marshalling – Implementing Server / Client – Interface Pointers – Object Creation, Invocation , Destruction – Comparison COM and CORBA – Introduction to .NET – Overview of .NET architecture – Marshalling – Remoting.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Dynamic Mechanical Analysis
2. Tribometer Testing
3. Rheometry
4. Accelerated Aging Tests
5. Recent advances in MTT Laboratory Experiments

**COURSE OUTCOMES:**

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

CO1 Understanding the basic concepts of web application security and the need for it

CO2 Be acquainted with the process for secure development and deployment of web applications

CO3 Acquire the skill to design and develop Secure Web Applications that use Secure APIs

CO4 Be able to get the importance of carrying out vulnerability assessment and penetration testing

CO5 Acquire the skill to think like a hacker and to use hackers tool sets

**TEXTBOOKS:**


1. Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client/Server Survival Guide", Galgotia Publications Pvt. Ltd., 2002. (Unit 1)
2. Tom Valesky,"Enterprise Java Beans",Pearson Education, 2002.(Unit 2 & 3)
3. Jason Pritchard,"COM and CORBA side by side", Addison Wesley,2000 (Unit 4 & 5)
4. 4. Jesse Liberty, "Programming C#", 2nd Edition, O'Reilly Press, 2002. (Unit 5)


REFERENCES:


1. Mowbray,"Inside CORBA", Pearson Education, 2002.
2. Jeremy Rosenberger," Teach yourself CORBA in 14 days", Tec media, 2000


| Course Code | WEB APPLICATION SECURITY | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2108 | | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. To understand the fundamentals of web application security
2. To focus on wide aspects of secure development and deployment of web applications
3. To learn how to build secure APIs
4. To learn the basics of vulnerability assessment and penetration testing
5. To get an insight about Hacking techniques and Tools

**UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY** 6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

**UNIT IISECURE DEVELOPMENT AND DEPLOYMENT** 6

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

**UNIT III SECURE API DEVELOPMENT** 6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

**UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING** 6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

**UNIT VHACKING TECHNIQUES AND TOOLS** 6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

**TOTAL NUMBER OF PERIODS INCLUDING LAB: 60**

**SAMPLE LIST OF EXPERIMENTS**

1. Install wireshark and explore the various protocols
   a. Analyze the difference between HTTP vs HTTPS
   b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
   a. GET
   b. PUSH
   c. POST
   d. DELETE
4. Install Burp Suite to do following vulnerabilities:
   b.SQL injection
   a. cross-site scripting (XSS)
5. Attack the website using Social Engineering method

**COURSE OUTCOMES:**

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

CO1 Understanding the basic concepts of web application security and the need for it

CO2 Be acquainted with the process for secure development and deployment of web applications

CO3 Acquire the skill to design and develop Secure Web Applications that use Secure APIs

CO4 Be able to get the importance of carrying out vulnerability assessment and penetration testing

CO5 Acquire the skill to think like a hacker and to use hackers tool sets

**TEXTBOOKS:**


1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.


**REFERENCES:**


1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.


**Vertical 2: SOFTWARE TECHNOLOGIES**

| Course Code | SOFTWARE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2201 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. To understand Software Engineering Life cycle Models
2. To Perform software requirements analysis
3. To gain knowledge of the System Analysis and Design concepts using UML.
4. To understand software testing and maintenance approaches
5. To work on project management scheduling using DevOps

**UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT** 6

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process-Case Study.

**UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION** 6

Requirement analysis and specification – Requirements gathering and analysis – Functional and Non Functional requirements – Software Requirement Specification – Formal systemspecification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model– Class diagrams–Interaction diagrams–Activity diagrams–Functional modelling–DataFlow Diagram-CASE TOOLS.

**UNIT III SOFTWARE DESIGN** 6

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command
– Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client Server -Tiered-Pipe andfilter-User interface design-Case Study.

**UNIT IV SOFTWARE TESTING AND MAINTENANCE** 6

Testing–Unit testing–Black box testing–White box testing–Integration and System testing–Regression testing–Debugging-Program analysis–Symbolic execution–Model Checking-Case Study – Release Management

**UNIT V PROJECT MANAGEMENT** 6

Software Project Management- Software Configuration Management- Project Scheduling-DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture Building and Testing-Deployment-Tools-Case Study

**NUMBER OF THEORY PERIODS**: 30

**List of Practical Experiments:**

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams

6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the use case diagram
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.
10. Implement the modified system and test it for various scenarios.

**SUGGESTED DOMAINS FOR MINI-PROJECT:**

1. Passport automation system.
2. Book bank
3. Exam registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

**NUMBER OF PRACTICAL PERIODS: 30**
**TOTAL NUMBER OF PERIODS: 60**

**COURSE OUTCOMES:**

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

CO1 Compare various Software Development Lifecycle Models
CO2 Evaluate project management approaches as well as cost and schedule
CO3 Perform formal analysis on specifications.
CO4 Use UML diagrams for analysis and design.
CO5 Architect and design using architectural styles and design patterns, and test the system

**TEXTBOOKS:**


1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML,Patterns and Java", ThirdEdition, Pearson Education,2009.
2. Roger S.Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, McGraw-Hill International Edition,2014.


**REFERENCES:**


1. CarloGhezzi, MehdiJazayeri, DinoMandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education,2005.
3. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective",Pearson Education,2016
4. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.

5. Stephen Schach, Object-Oriented and Classical Software Engineering, 8th ed, McGraw- Hill

| Course Code | SOFTWARE TESTING AND AUTOMATION | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2202 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the basics of software testing
2. To learn how to do the testing and planning effectively
3. To build test cases and execute them
4. To focus on wide aspects of testing and understanding multiple facets of testing
5. To get an insight about test automation and the tools used for test automation

**UNIT I FOUNDATIONS OF SOFTWARE TESTING** 6

Why do we test Software? Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

**UNIT IITEST PLANNING** 6

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

**UNIT III TEST DESIGN AND EXECUTION** 6

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle

6

**UNIT IV ADVANCED TESTING CONCEPTS**

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

**UNIT VTEST AUTOMATION AND TOOLS** 6

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project:

a) Build a data-driven framework using Selenium and TestNG
b) Build Page object Model using Selenium and TestNG
c) Build BDD framework with Selenium, TestNG and Cucumber

**COURSE OUTCOMES**:

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

CO1 Understand the basic concepts of software testing and the need for software testing
CO2 Understand the basic concepts of software testing and the need for software testing
CO3 Design effective test cases that can uncover critical defects in the application
CO4 Carry out advanced types of testing
CO5 Carry out advanced types of testing

**TEXTBOOKS:**


1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018


**REFERENCES**:


1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons,Inc.
2. RonPatton, Software testing, 2nd Edition, 2006, Sams Publishing
3. Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor&Francis Group.
4. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing,2009,PearsonEducation,Inc.
6. SatyaAvasarala, Selenium Web Driver Practical Guide, 2014,PacktPublishing.
7. VarunMenon, TestNg Beginner's Guide,2013,PacktPublishing.

| Course Code | AGILE METHODOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2203 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
2. To provide a good understanding of software design and a set of software technologies and APIs.
3. To do a detailed examination and demonstration of Agile development and testing techniques.
4. To understand the benefits and pitfalls of working in an Agile team.
5. To understand Agile development and testing.

**UNIT I AGILE METHODOLOGY** 6

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations.

**UNIT II AGILE PROCESSES** 6

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

**UNIT III AGILITY AND KNOWLEDGE MANAGEMENT** 6

Agile Information Systems – Agile Decision Making - Earl_S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies .

**UNIT IV AGILITY AND REQUIREMENTS ENGINEERING** 6

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

**UNIT V AGILITY AND QUALITY ASSURANCE** 6

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Understand the background and driving forces for taking an Agile Approach to Software development.
2. Build out a backlog and user stories.
3. To study automated build tool.
4. To study version control tool.

5. To study Continuous Integration tool.
6. Apply Design principle and Refactoring to achieve agility.
7. Perform Testing activities within an agile project.

**COURSE OUTCOMES:**

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

CO1 Realize the importance of interacting with business stakeholders in determining the requirements for a software system

CO2 Perform iterative software development processes: how to plan them, how to execute them

CO3 Point out the impact of social aspects on software development success.

CO4 Develop techniques and tools for improving team collaboration and software quality

CO5 Perform Software process improvement as an ongoing task for development teams.

**TEXTBOOKS:**


1. David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. 2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.


**REFERENCES:**


1. Craig Larman, —Agile and Iterative Development: A Manager_s Guide, Addison-Wesley, 2004.
2. 2. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

| Course Code | SOFTWARE USER INTERFACE DESIGN & ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2204 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To understand the difference between UI and UX
2. To learn user-centered design principles.
3. To understand interaction design principles
4. To learn to create wireframes and prototypes
5. To explore advanced topics like responsive design.

6

**UNIT 1: INTRODUCTION TO UI/UX FUNDAMENTALS**

Introduction to UI/UX concepts- Definition and differentiation of UI and UX- The Impact of UI/UX on Software Success- Understanding user expectations and behavior- User-Centric Design Principles- Importance of user-centric design- The Impact on User Satisfaction- Understanding user expectations and preferences.

6

**UNIT 2: DESIGN PRINCIPLES AND METHODOLOGIES**

User-centered design principles- Definition and core principles of UCD- Historical context and evolution of UCD in design- Iterative Design Process- Usability heuristics- Definition and significance of usability heuristics -Application of Heuristics in Evaluation-

6

**UNIT 3: INTERACTION AND VISUAL DESIGN**

Principles of interaction design- Definition and significance of interaction design principles- Usability and Learn ability- Fundamentals of visual design- Introduction to Visual Design- The psychology of visual elements and their impact on user perception- Color Theory and Application

6

**UNIT 4: PROTOTYPING AND USABILITY TESTING**

Wire framing and prototyping- Definition and significance of wire framing and prototyping- Overview of their roles in the design process - Principles of Effective Wireframing- Usability testing methodologies

6

**UNIT 5: ADVANCED TOPICS - RESPONSIVE DESIGN, ACCESSIBILITY, AND GUIDELINES**

Responsive design principles- Definition and significance of responsive design - Principles of creating layouts with fluid grids - Techniques for making images responsive -Accessibility in UI design- UI guidelines and standards

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Conduct heuristic evaluations
2. Apply user-centered design to a simple project.
3. Design interactive elements
4. Create visually appealing UI components
5. Conduct a usability test on a prototype
6. Implement responsive design in a project
7. Design an accessible user interface

COURSE OUTCOMES:

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

CO1 Design effective and user-centered interfaces.
CO2 Evaluate and improve user interfaces using usability heuristics.
CO3 Apply visual design principles for aesthetically pleasing interfaces.
CO4 Create prototypes and conduct usability tests.
CO5 Implement responsive design, ensure accessibility, and adhere to UI guidelines.

TEXTBOOKS:

- "Don't Make Me Think" by Steve Krug
- "The Design of Everyday Things" by Don Norman
- "Seductive Interaction Design" by Stephen Anderson

REFERENCES:

- "Designing Interfaces" by Jenifer Tidwell
- "About Face: The Essentials of Interaction Design" by Alan Cooper
- "Universal Principles of Design" by William Lidwell, Kritina Holden, and Jill Butler

| Course Code | SOFTWARE ARCHITECTURE AND DESIGN PATTERNS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2205 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To define software architecture and its role in the development process
2. To understand the process of making architectural decisions.
3. To learn when and how to apply specific design patterns
4. To understand the principles and challenges of micro services architecture
5. To explore current trends and emerging paradigms in software architecture

**UNIT 1: INTRODUCTION TO SOFTWARE ARCHITECTURE** 6

Introduction to Software Architecture- Definition and significance of software architecture- Architectural Styles and Patterns - Overview of different architectural styles- Introduction to common design patterns.

**UNIT 2: ARCHITECTURAL DECISION MAKING** 6

Architectural Decision Process- Steps involved in making architectural decisions- Role of stakeholders in the decision making process- Trade-offs in Software Design- Evaluating trade-offs in terms of performance, scalability, and maintainability- Analyzing the impact of non-functional requirements on architecture.

6

**UNIT 3: DESIGN PATTERNS IN DEPTH**

Creational Design Patterns- Singleton, Factory Method, Abstract Factory patterns- When and how to use creational design patterns- Structural and Behavioral Design Patterns- Composite, Observer, Strategy patterns- Real-world examples illustrating the application of structural and behavioral design patterns.

**UNIT 4: ADVANCED TOPICS IN SOFTWARE ARCHITECTURE** 6

Micro services Architecture-Principles of micro services architecture-Case studies on successful implementations-Event-Driven Architecture-Understanding events and event-driven systems-Implementing event-driven architectures in software systems.

6

**UNIT 5: EMERGING TRENDS AND FUTURE DIRECTIONS**

Current Trends in Software Architecture-Overview of current trends, including serverless architecture, edge computing, etc-Case studies on how industry leaders are adapting to new trends-Continuous Learning and Professional Development-Importance of continuous learning in the field of software architecture-Resources, communities, and practices for staying updated and relevant.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Analyze real-world applications and identify their architectural styles.
2. Discuss the impact of architectural decisions on system properties.
3. Analyze a complex scenario and make architectural decisions as a group

4. Present and defend the chosen architecture.
5. Conduct performance testing on a software system.
6. Hands-on coding session: Applying design patterns to a sample project
7. Identify areas for refactoring in existing code
8. Designing and implementing a micro services-based system
9. Testing and troubleshooting micro services interactions.

**COURSE OUTCOMES:**

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

CO1 Understand and Apply Software Architecture Concepts.
CO2 Understand the architectural decision-making process.
CO3 Apply design patterns to new projects and re-factor existing code.
CO4 Understand micro services architecture and its advantages and challenges.
CO5 Explore emerging trends in software architecture.

**TEXTBOOKS:**

1. “Design Patterns: Elements of Reusable Object-Oriented Software" by Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides
2."Clean Architecture: A Craftsman's Guide to Software Structure and Design" by Robert C. Martin

**REFERENCES:**

1.”Microservices Patterns: With Examples in Java" by Chris Richardson
2."Building Micro services" by Sam Newman
3."Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions" by Gregor Hohpe and Bobby Woolf

| Course Code | SOFTWARE QUALITY MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2206 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To define software quality and its significance in software development.
2. To define software testing and its role in the software development life cycle.
3. To learn software quality metrics and their significance
4. To understand software process improvement (SPI) and its goals..
5. To explore current trends and emerging practices in software quality management.

**UNIT 1: INTRODUCTION TO SOFTWARE QUALITY MANAGEMENT** 6

Overview of Software Quality- Definition and dimensions of software quality- Case studies on the consequences of poor software quality- Quality Management Principles- Evidence-Based Decision Making- Relationship Management- System Approach to Management- Factual Approach to Decision Making- Mutually Beneficial Supplier Relationships- Introduction to quality management frameworks (e.g., ISO 9001)

**UNIT 2: SOFTWARE TESTING FUNDAMENTALS** 6

Basics of Software Testing-Importance of software testing-Overview of testing levels and types-Test Planning and Strategy-Objective and Scope-Test Levels and Types-Test Deliverables-Resource Planning-Schedule and Timeline-Risk Assessment and Mitigation-Test Environment-Entry and Exit Criteria-Testing Tools and Techniques-Test Execution Strategy-Best Practices for Test Planning and Strategy

**UNIT 3: SOFTWARE QUALITY METRICS AND MEASUREMENT** 6

Introduction to Quality Metrics-Defining key quality metrics-Relationship between metrics and project objectives-Measurement and Analysis-Principles of effective measurement-analysis in software quality-Informed decisions-Drive continuous improvement

**UNIT 4: SOFTWARE PROCESS IMPROVEMENT** 6

Introduction to Process Improvement-Basics of Software Process Improvement-Importance and benefits of SPI-Overview of common SPI models (e.g., CMMI, Six Sigma)-Process Models and Frameworks-Tailoring and Implementing Processes-Adapting process models-Best practices for implementing and sustaining process improvements

**UNIT 5: EMERGING TRENDS IN SOFTWARE QUALITY MANAGEMENT** 6

Current Trends in Software Quality -Overview of current trends-test automation-AI in testing-importance of staying updated on industry trends-Continuous Learning and Professional Development-Importance of continuous learning-Resources, communities, and practices for staying updated and relevant.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Creating a basic Software Development Life Cycle (SDLC) model.
2. Building a Quality Assurance Plan for a sample project.
3. Writing and executing basic test cases for a simple application

4. Executing test cases manually on a sample application..
5. Introduction to test automation tools – setting up and running basic automated tests.
6. Simulating the defect life cycle using a bug tracking tool.
7. Root cause analysis and corrective action for identified defects.
8. Conducting performance tests on a web application
9. Exploring basic security testing techniques on a sample system.

**COURSE OUTCOMES:**

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

CO1 Define and Apply Software Quality Management Concepts
CO2 Understand and Apply Software Testing Fundamentals.
CO3 Apply Quality Metrics and Measurement.
CO4 Tailor and implement processes using different models and frameworks.
CO5 Develop a plan for continuous learning and professional development.

**TEXTBOOKS:**

1. "Foundations of Software Testing" by Dorothy Graham and Erik Van Veenendaal
2. "Software Engineering: A Practitioner's Approach" by Roger S. Pressman

**REFERENCES:**

1. "Quality Software Management: Systems Thinking" by Gerald M. Weinberg
2. "Improving Software Organizations: From Principles to Practice" by Louis Poulin

| Course Code | SOFTWARE PROJECT MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2207 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the Software Project Planning and Evaluation techniques.
2. To plan and manage projects at each stage of the software development life cycle (SDLC).
3. To learn about the activity planning and risk management principles.
4. To manage software projects and control software deliverables.
5. To develop skills to manage the various phases involved in project management and people management.

**UNIT I PROJECT EVALUATION AND PROJECT PLANNING** 6

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation .

**UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION** 6

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II.

**UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT** 6

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation.

**UNIT IV PROJECT MANAGEMENT AND CONTROL** 6

Framework for Management and Control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change Control – Software Configuration Management.

**UNIT V STAFFING IN SOFTWARE PROJECTS** 6

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

Software Architecture and Design Patterns Lab

Setting up project management tools (e.g., Jira, Trello) and introducing a sample project.

2. Creating a project plan with milestones, tasks, and resource allocation.
3. Conducting a project kickoff meeting and defining project scope.

4. Developing a Work Breakdown Structure (WBS) for a given project.
5. Identifying and analyzing project risks.
6. Developing a quality management plan and implementing quality control measures.
7. Assigning tasks and responsibilities using project management tools.
8. Using collaboration tools for effective communication and document sharing.
9. Implementing Agile methodologies for project management.

**COURSE OUTCOMES:**

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

CO1 Understand Project Management principles while developing software.
CO2 Gain extensive knowledge about the basic project management concepts, framework and the process models.
CO3 Obtain adequate knowledge about software process models and software effort estimation techniques.
CO4 Estimate the risks involved in various project activities
CO5 Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles

**TEXTBOOKS:**

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

**REFERENCES:**

1. Robert K. Wysocki —Effective Software Project Management – Wiley Publication, 2011.
2. Walker Royce: —Software Project Management- Addison-Wesley, 1998. 3. Gopalaswamy Ramesh, —Managing Global Software Projects – McGraw Hill Education (India), Fourteenth Reprint 2013.

| Course Code | HUMAN-COMPUTER INTERACTION | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2208 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**

1. To learn the foundations of Human Computer Interaction.
2. To become familiar with the design technologies for individuals and persons with disabilities.
3. To be aware of mobile HCI.
4. To learn the guidelines for user interface.
5. Learn to develop meaningful user interface.

**UNIT I FOUNDATIONS OF HCI** 6

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

**UNIT II DESIGN & SOFTWARE PROCESS** 6

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules.

**UNIT III MODELS AND THEORIES** 6

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

**UNIT IV MOBILE HCI** 6

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

**UNIT V WEB INTERFACE DESIGN** 6

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow .

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Setting up essential tools and resources for HCI design
2. Understanding the basics of user experience (UX) and user interface (UI) design.
3. Conducting user interviews and creating user personas.
4. Analyzing user behavior through usability testing and heuristic evaluation.
5. Creating paper prototypes for a given scenario.
6. Conducting usability tests on digital prototypes.
7. Analyzing usability testing results and making design refinements.
8. Applying interaction design principles to improve user interfaces.
9. Implementing responsive design for multiple devices. 10. Evaluating and improving ssibility in user interfaces.

**COURSE OUTCOMES:**

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

CO1 Design effective dialog for HCI

CO2 Design effective HCI for individuals and persons with disabilities
CO3 Assess the importance of user feedback
CO4 Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
CO5 Develop meaningful user interface.

**TEXTBOOKS:**

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, —Human Computer Interaction, 3rd Edition, Pearson Education, 2004
2. Brian Fling, —Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009
3. Bill Scott and Theresa Neil, —Designing Web Interfaces, First Edition, O'Reilly, 2009.

**Vertical 3: CYBER SECURITY**

| Course Code | CRYPTOGRAPHY & INFORMATION SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2301 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To provide a deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures.
2. To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes
3. To familiarize Digital Signature Standard and provide solutions for their issues.
4. To familiarize with cryptographic techniques for secure (confidential) communication of two parties over an insecure (public) channel; verification of the authenticity of the source of a message
5. To familiarize Authentication service, electronic mail security and web security

**UNIT - I INTRODUCTION** 6

Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.

**UNIT - II BLOCK CIPHER AND DATA ENCRYPTION STANDARDS** 6

Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles. ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4. INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem, Discrete logarithms

**UNIT - III PUBLIC KEY CRYPTOGRAPHY AND RSA** 6

Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, Elliptic Curve Arithmetic, Elliptic Curve Cryptography. MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs. HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC. DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.

**UNIT - IV AUTHENTICATION APPLICATION** 6

Kerberos, X.509 Authentication Service, Public Key Infrastructure. EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME. IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

**UNIT - V WEB SECURITY** 6

Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats. FIREWALL: Firewall Design principles, Trusted Systems.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Symmetric Key Encryption
2. Asymmetric Key Cryptography
3. Secure Communication Protocols
4. Cryptographic Applications
5. Post-quantum Cryptography

6. Cryptographic Attacks and Countermeasures
7. Cryptography in IoT
8. Quantum-Safe Cryptography

**COURSE OUTCOMES:**

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

CO1 Identify basic security attacks and services
CO2 Use symmetric and asymmetric key algorithms for cryptography
CO3 Design a security solution for a given application
CO4 Analyze Key Management techniques and importance of number Theory with Message Authentication Codes and Hash Functions work
CO5 Understanding of Authentication functions and Authentication Service and Electronic Mail Security

**TEXTBOOKS:**

1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
2. 2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

**REFERENCES:**

1. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.
2. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata Mc Grawhill, India.
3. Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata Mc Grawhill, India.

| Course Code | SECURITY AND PRIVACY IN CLOUD | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2302 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

**UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS** 6

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

**UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD** 6

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

**UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT** 6

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.

**UNIT IV CLOUD SECURITY DESIGN PATTERNS** 6

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

**UNIT V MONITORING, AUDITING AND MANAGEMENT** 6

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

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim
2. simulate resource management using cloud sim
3. simulate log forensics using cloud sim
4. simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Implement any encryption algorithm to protect the images
7. Implement any image obfuscation mechanism
8. Implement a role-based access control mechanism in a specific scenario
9. implement an attribute-based access control mechanism based on a particular scenario
10. Develop a log monitoring system with incident management in the cloud

**COURSE OUTCOMES:**

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

CO1 Understand the cloud concepts and fundamentals.
CO2 Explain the security challenges in the cloud.
CO3 Define cloud policy and Identity and Access Management.
CO4 Understand various risks and audit and monitoring mechanisms in the cloud.
CO5 Define the various architectural and design considerations for security in the cloud.

**TEXTBOOKS:**


1. Raj Kumar Buyya , James Broberg, Andrzej Goscinski, "Cloud Computing:", Wiley 2013
2. Dave shackleford, "Virtualization Security", SYBEX a wiley Brand 2013.
3. 3. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011


**REFERENCES:**


1. Mark C. Chu-Carroll —Code in the Cloud||,CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. ThamaraiSelvi

| Course Code | WEB APPLICATION SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2303 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

6. To understand the fundamentals of web application security
7. To focus on wide aspects of secure development and deployment of web applications
8. To learn how to build secure APIs
9. To learn the basics of vulnerability assessment and penetration testing
10. To get an insight about Hacking techniques and Tools

**UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY** 6

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation

**UNIT II SECURE DEVELOPMENT AND DEPLOYMENT** 6

Web Applications Security - Security Testing, Security Incident Response Planning, The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

**UNIT III SECURE API DEVELOPMENT** 6

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

**UNIT IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING** 6

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

**UNIT V HACKING TECHNIQUES AND TOOLS** 6

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS** 30

1. Install wireshark and explore the various protocols
   a. Analyze the difference between HTTP vs HTTPS
   b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
3. Create simple REST API using python for following operation
   a. GET
   b. PUSH
   c. POST
   d. DELETE
4. Install Burp Suite to do following vulnerabilities:
   b.SQL injection
   a. cross-site scripting (XSS)

5. Attack the website using Social Engineering method

**COURSE OUTCOMES**:

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

CO1 Understanding the basic concepts of web application security and the need for it

CO2 Be acquainted with the process for secure development and deployment of web applications

CO3 Acquire the skill to design and develop Secure Web Applications that use Secure APIs

CO4 Be able to get the importance of carrying out vulnerability assessment and penetration testing

CO5 Acquire the skill to think like a hacker and to use hackers tool sets

**TEXTBOOKS:**


4. Andrew Hoffman, Web Application Security: Exploitation and Counter measures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.

5. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.

6. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.


**REFERENCES:**


6. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.

7. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.

8. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.

9. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.

10. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.


| Course Code | SOCIAL NETWORK SECURITY | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2304 | | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES**:

1. To develop semantic web related simple applications
2. To explain Privacy and Security issues in Social Networking
3. To explain the data extraction and mining of social networks
4. To discuss the prediction of human behavior in social communities
5. To describe the Access Control, Privacy and Security management of social networks

**UNIT I FUNDAMENTALS OF SOCIAL NETWORKING** 6

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security, Common security threats in social networks and case studies of notable security incidents.

**UNIT II SECURITY ISSUES IN SOCIAL NETWORKS** 6

Principles of secure user authentication, Multifactor authentication, Access control mechanisms and user permissions, SSL/TLS protocols for secure data transmission, End-to-end encryption in messaging apps, The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.

**UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA** 6

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy, User education and awareness , regulatory compliance.

**UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES** 6

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties, Secure third-party integrations.

**UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT** 6

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning. Emerging trends in social network security.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Design own social media application
2. Create a Network model using Neo4j
3. Read and write Data from Graph Database

4. Find “Friend of Friends” using Neo4j
5. Implement secure search in social media
6. Create a simple Security & Privacy detector

**COURSE OUTCOMES:**

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

CO1 Develop semantic web related simple applications
CO2 Address Privacy and Security issues in Social Networking
CO3 Explain the data extraction and mining of social networks
CO4 Discuss the prediction of human behavior in social communities
CO5 Describe the applications of social networks

**TEXTBOOKS:**

1. Peter Mika, “Social Networks and the Semantic Web, First Edition, Springer 2007.
2. BorkoFurht, “Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.
3. Learning Neo4j 3.x “Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing

**REFERENCES:**

1. Easley D. Kleinberg J., “Networks, Crowds, and Markets – Reasoning about a Highly Connected World”, Cambridge University Press, 2010.
2. Jackson, Matthew O., “Social and Economic Networks”, Princeton University Press, 2008.
3. GuandongXu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011.

| Course Code | DIGITAL FORENSICS AND MALWARE ANALYSIS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2305 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. Learn preventive measures to safeguard digital systems and information against cyber threats
2. Develop policies specific to digital crime and focusing on digital investigation
3. Gain a comprehensive understanding of the methodologies, tools, and techniques used in investigating various types of cybercrimes
4. Understand scope of the malware borne cyber-attacks, various malware types, and platform-specific variations of malware
5. Explain the basic signs of malware infection and signs of intrusion from a security analyst's point of view

**UNIT I DIGITAL FORENSIC TECHNIQUE AND TRACES** 6

File System Analysis - Network Packet Analysis - Memory Forensics - Digital Evidence Collection - Mobile Device Forensics Techniques - Cloud Forensics - Big Data Analytics in Forensics - Incident Response and Timeline Analysis.

**UNIT II INTRODUCTION TO DIGITAL CRIME AND INVESTIGATION** 6

Digital Crime Overview - Legal and Ethical Frameworks - Digital Forensic Tools and Techniques - Incident Response Fundamentals - Digital Evidence Collection and Preservation - Cybersecurity Basics - Digital Investigation Methodologies - Cybercrime Trends and Emerging Threats.

**UNIT III INTERNET BASED INVESTIGATIONS** 6

Social Media Investigations - Open-Source Intelligence (OSINT) - Email and Communication Tracing - Dark Web Investigations - Online Fraud Investigations - Cyber Threat Intelligence - Digital Copyright and Intellectual Property Investigations - Online Extremism and Radicalization Investigations.

**UNIT IV INTRODUCTION TO MALWARE ANALYSIS** 6

Malware classification- types- and platform specific issues with malware- Intrusion into IT and operational network (OT) and their signs – Basics of malware detection – Intro to linux- Networks.

**UNIT V BASIC MALWARE ANALYSIS** 6

Manual Malware Infection analysis - signature-based malware detection and classification – pros and cons- and need for machine learning based techniques- Advanced Techniques Malware Analysis.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Live Case Studies Open Source Forensic Tools
2. Disk Forensics and Data Recovery
3. Steganography
4. Key loggers
5. Network monitors
6. Flowchart management
7. Upload Malware to Virustotal - Analyze the file Lab01-02.exe - [ Refer Lab 1-2 in Textbook] - Lab01-02.exe
8. This lab uses the file Lab01-04.exe. Analyze the file Lab01-04.exe. [ Refer Lab 1-4 in Textbook] - Lab01-04.exe
9. Analyze the malware found in the file Lab05-01.dll using only IDA Pro [Refer Lab 5-1 In Textbook] - Lab05-01.exe
10. Analyze the malware found in the file Lab07-02.exe [Refer Lab 07-02 in Textbook] - Lab07-02.exe

**COURSE OUTCOMES:**

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

CO1 Clarify the foundational principles of digital forensics, unraveling the core concepts essential to the field.

CO2 Evaluate and delineate strategies for managing risks associated with digital forensic investigations.

CO3 Elaborate on the basic tools and techniques utilized in the investigation of various types of cybercrimes.

CO4 Explain and introduce malware analysis efficiently.

CO5 Explain basic malware analysis and demonstrate some basic techniques.

**TEXTBOOKS:**

1. Andre Arnes, "Digital Forensics", Wiley, 2018.
2. Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.
3. Practical Malware Analysis By, Michael Siroski and Andrew Honig - Link

**REFERENCES:**

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.
2. Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, 3rd Edition Author: Eoghan Casey Publisher: Academic Press ISBN: 9780123742681.
3. Dynamic Malware Analysis in the Modern Era—A State of the Art Survey - Link

Online Reference:

4. https://www.coursera.org/specializations/computerforensics
5. https://www.youtube.com/watch?v=u2zgEFm5RHQ
6. Practical Malware analysis - Youtube

| Course Code | ETHICAL HACKING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2306 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the basics of computer based vulnerabilities.
2. To explore different foot printing, reconnaissance and scanning methods.
3. To expose the enumeration and vulnerability analysis methods.
4. To understand hacking options available in Web and wireless applications.
5. To explore the options for network protection and perform ethical hacking to expose the vulnerabilities.

**UNIT I INTRODUCTION** 6

Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security

**UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS** 6

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

**UNIT III ENUMERATION AND VULNERABILITY ANALYSIS** 6

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss

**UNIT IV SYSTEM HACKING** 6

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade .

**UNIT V NETWORK PROTECTION SYSTEMS** 6

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems – Network Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva'sMaltego.
5. Information gathering using tools like Robtex.
6. Scan the target using tools like Nessus.
7. View and capture network traffic using Wireshark.
8. Automate dig for vulnerabilities and match exploits using Armitage

FOCA :http://www.informatica64.com/foca.aspx. 134
Nessus :http://www.tenable.com/products/nessus.
Wireshark :http://www.wireshark.org.
Armitage :http://www.fastandeasyhacking.com/.
Kali or Backtrack Linux, Metasploitable, Windows XP

**COURSE OUTCOMES:**

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

CO1 To express knowledge on basics of computer based vulnerabilities
CO2 To gain understanding on different foot printing, reconnaissance and scanning methods.
CO3 To demonstrate the enumeration and vulnerability analysis methods
CO4 To gain knowledge on hacking options available in Web and wireless applications
CO5 To acquire knowledge on the options for network protection and perform ethical hacking to expose the vulnerabilities

**TEXTBOOKS:**

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3. 3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

**REFERENCES:**

1. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014

| Course Code | CRYPTOCURRENCY & BLOCKCHAIN TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2307 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Understand the basics of Blockchain
2. Learn Different protocols and consensus algorithms in Blockchain
3. Larn the Blockchain implementation frameworks
4. Experiment the Hyperledger Fabric, Ethereum networks
5. Understand the Blockchain Applications

**UNIT I INTRODUCTION TO BLOCKCHAIN** 6

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, TransactionsThe Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

**UNIT II BITCOIN AND CRYPTOCURRENCY** 6

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

**UNIT III BITCOIN CONSENSUS** 6

Bitcoin Consensus, Proof of Work (PoW)- HashcashPoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

**UNIT IV HYPERLEDGER FABRIC & ETHEREUM** 6

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

**UNIT V BLOCKCHAIN APPLICATIONS** 6

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

**COURSE OUTCOMES**:

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

CO1 Understand emerging abstract models for Blockchain Technology

CO2 Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.

CO3 It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.

CO4 Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.

CO5 To design and develop the Block chain Application.

**TEXTBOOKS:**


1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.
3. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.


**REFERENCES:**


1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.

2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015 4. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing.

| Course Code | SECURITY AUDITING & COUNTER HACKING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2308 | TECHNIQUES | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. Understand fundamentals, tools, and methodologies for security audits
2. Learn techniques to identify and mitigate network vulnerabilities
3. Explore methods to assess and secure web applications against hacking
4. Develop skills for detecting and responding to security incidents, including digital forensics
5. Acquire knowledge on advanced counter-hacking techniques and strategies for proactive security

**UNIT I FUNDAMENTALS OF SECURITY AUDITING** 6

Introduction to Cybersecurity, Principles of Security Auditing, Types of Security Audits, Security Auditing Tools, Methodologies for Security Assessments, Regulatory Compliance Standards, Security Policies and Procedures, Incident Response Planning, Security Documentation and Reporting

**UNIT II NETWORK VULNERABILITY ASSESSMENT** 6

Network Scanning Techniques, Identification and Classification of Vulnerabilities, Exploitation and Penetration Testing, Risk Assessment Methodologies, Remediation Strategies and Best Practices, Network Security Architecture, Firewalls and Intrusion Detection/Prevention Systems, Wireless Network Security, Security Assessments for IoT Devices

**UNIT III WEB APPLICATION SECURITY TESTING** 6

Overview of Web Application Architecture. Common Web Vulnerabilities (e.g., SQL Injection, XSS), Testing Methodologies (e.g., OWASP Top 10), Secure Coding Practices, Web Application Firewall (WAF) Usage, Session Management and Authentication, Content Security Policy (CSP) API Security Considerations, Mobile Application Security Testing

**UNIT IV INCIDENT RESPONSE AND DIGITAL FORENSICS** 6

Incident Detection and Classification, Incident Response Strategies and Frameworks, Basics and Principles of Digital Forensics, Forensic Tools and Analysis Techniques, Chain of Custody and Legal Considerations, Memory Forensics and Disk Analysis, Network Forensics, Malware Analysis and Reverse Engineering, Incident Documentation and Reporting

**UNIT V ADVANCED COUNTER-HACKING STRATEGIES** 6

Proactive Security Measures and Threat Hunting, Threat Intelligence and Analysis, Offensive Countermeasures and Red Teaming, Security Awareness and Training Programs, Security Automation and Orchestration, Cloud Security Considerations, Blockchain Security, Emerging Trends in Cybersecurity Defense, Ethical and Legal Aspects of Counter-Hacking

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Analyze and critique a security audit report, identifying vulnerabilities and suggesting mitigation strategies.
2. Execute a simulated network vulnerability assessment, documenting findings and proposing remediation measures.

3. Conduct a hands-on web application penetration test, addressing identified vulnerabilities and suggesting security enhancements.
4. Develop an incident response plan for a hypothetical security incident, outlining detection, response, and recovery steps.
5. Analyze a digital forensics case study, presenting findings and recommendations for legal proceedings.
6. Research and analyze threat intelligence data, creating a comprehensive report on potential risks and proactive security measures.
7. Participate in a red teaming exercise to simulate advanced cyber threats, gaining insights into offensive counter-hacking strategies.
8. Design a comprehensive security awareness training program, incorporating best practices and tailored content for end-users.
9. Assess the security of a cloud infrastructure, identifying vulnerabilities and proposing strategies for secure cloud adoption.
10. Research and write a whitepaper on blockchain security, addressing potential threats and proposing protective measures.

**COURSE OUTCOMES:**

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

CO1 Grasp cybersecurity principles and apply security auditing methodologies effectively.
CO2 Master network scanning, vulnerability identification, and risk assessment techniques.
CO3 Understand web application vulnerabilities, testing methodologies, and secure coding practices
CO4 Execute incident response strategies and perform digital forensics with precision
CO5 Implement proactive security measures, threat intelligence analysis, and offensive countermeasures

**TEXTBOOKS:**

1. "The Web Application Hacker's Handbook" by Dafydd Stuttard and Marcus Pinto (2020, 2nd
2. "Security Engineering" by Ross J. Anderson (2020, 3rd)
3. "Cybersecurity – Attack and Defense Strategies" by Yuri Diogenes and Erdal Ozkaya (2020, 1
4. "Blockchain Basics" by Daniel Drescher (2017, 1st)
5. "Network Security Essentials" by William Stallings (2017, 6th)
6. "Incident Response & Computer Forensics" by Jason T. Luttgens, Matthew Pepe, and Kevin M
(2014, 3rd)
7. "Threat Modeling: Designing for Security" by Adam Shostack (2014, 1st)

**REFERENCES:**


1. Dafydd Stuttard, Marcus Pinto. "The Web Application Hacker's Handbook" (2020, 2nd)
2. Ross J. Anderson. "Security Engineering" (2020, 3rd)
3. Yuri Diogenes, Erdal Ozkaya. "Cybersecurity – Attack and Defense Strategies" (2020, 1st)
4. Daniel Drescher. "Blockchain Basics" (2017, 1st)
5. William Stallings. "Network Security Essentials" (2017, 6th)

**Vertical 4: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

| Course Code | DATA ANALYTICS AND VISUALIZATION | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2401 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the data science fundamentals and process.
2. To learn to describe the relationship between data.
3. To utilize present and interpret data using Python libraries for Data Wrangling and data visualization.
4. To study the basic inferential statistics, sampling distribution and processes in data analytics
5. To understand the data analytics techniques and apply descriptive data analytics techniques

**UNIT I INTRODUCTION** 6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data.

**UNIT II DESCRIBING DATA** 6

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data in Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores.
DESCRIBING RELATIONSHIPS: Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

**UNIT III PYTHON LIBRARIES FOR DATA WRANGLING** 6

Indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables
DATA VISUALIZATION: Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

**UNIT IV DESCRIPTIVE ANALYTICS AND INFERENTIAL STATISTICS** 6

DESCRIPTIVE ANALYTICS - Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

**INFERENTIAL STATISTICS** - populations – samples – random sampling – Sampling distribution-standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.

**UNIT V ANALYSIS OF VARIANCE AND PREDICTIVE ANALYTICS** 6

ANALYSIS OF VARIANCE - T-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related

samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA – Introduction to chi-square tests.

**PREDICTIVE ANALYTICS** - Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 30

**SAMPLE LIST OF EXPERIMENTS**

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.
5. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:

a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.

b. Bivariate analysis: Linear and logistic regression modeling

c. Multiple Regression analysis

d. Also compare the results of the above analysis for the two data sets.

6. Apply and explore various plotting functions on UCI data sets.

a. Normal curves

6. Perform Z-test
8. Perform T-test
9. Perform ANOVA
10. Building and validating linear models
11. Building and validating logistic models
12. Time series analysis

COURSE OUTCOMES:

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

| | |
|---|---|
| CO1 | Define the data science process Understand different types of data descriptions for data science process |
| CO2 | Gain knowledge on relationships between data and use the Python Libraries for Data Wrangling |
| CO3 | Apply visualization Libraries in Python to interpret and explore data |
| CO4 | Perform various statistical analyses to make statistical inferences and explain the end-to-end data analytics pipeline |
| CO5 | Build, validate and communicate data analytical models for complex engineering problems |

**TEXTBOOKS:**


1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. Padeepz App Padeepz App 69
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.


**REFERENCES:**

| Course Code | MATHEMATICS FOR MACHINE LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2402 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. Understand fundamental linear algebra concepts, including vector spaces, matrices, eigenvalues, and eigenvectors.
2. Gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance.
3. Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic modeling.
4. Apply mathematical models through hands-on projects, implementing machine learning models.
5. Give exposure to the deep learning models and analyze their performance using mathematical tools.

**UNIT I LINEAR ALGEBRA, MATRIX, AND ANALYTICAL GEOMETRY** 6

Introduction and Motivation - Linear Algebra, Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces, Analytic Geometry, Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

**UNIT II MATRIX DECOMPOSITION AND VECTOR CALCULUS** 6

Matrix Decompositions, Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen-decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Vector Calculus, Differentiation of Univariate, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization, and Multivariate Taylor Series.

**UNIT III PROBABILITY DISTRIBUTIONS AND RISK MINIMISATION** 6

Probability and Distributions - Construction of a Probability Space-Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Independence and Gaussian Distribution - Conjugacy and the Exponential Family, Change of Variables/Inverse Transform, Continuous Optimization, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization. Machine Learning Models, Empirical Risk Minimization, Parameter Estimation, Probabilistic Modelling and Inference, Directed Graphical Models, Model Selection.

**UNIT IV MACHINE LEARNING MODELS AND APPLICATIONS** 6

Linear Regression, Parameter Estimation, Dimensionality Reduction with Principal Component Analysis, Maximum Variance Perspective, PCA in High Dimensions, Latent Variable Perspective, EM Algorithm, Latent-Variable, Classification with Support Vector Machines.

**UNIT V DEEP LEARNING MODELS** 6

Tensors from Machine Learning and Data Science, Deep Convolutional Neural Network Architectures for Image Classification, Latent Space and Generative Modelling, Autoencoders and Variational Autoencoders.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

Use python for implementing the following.

1. Systems of Linear Equations Solver: Implement a program to solve systems of linear equations using methods like Gaussian elimination or LU decomposition.
2. Vector Space Visualization: Use a computational tool like MATLAB or Python with libraries such as NumPy and Matplotlib to visualize vector spaces, linear independence, basis, and rank.
3. Matrix Decomposition Analysis: Implement algorithms for matrix decomposition techniques such as eigen-decomposition, singular value decomposition (SVD), and Cholesky decomposition. Analyze their properties and computational complexities.
4. Gradient Computation: Develop code to compute gradients for univariate and multivariate functions using analytical methods and numerical approximation techniques like finite differences.
5. Optimization Algorithms: Implement gradient descent and its variants for unconstrained optimization problems. Study their convergence properties and compare their performance on benchmark functions.
6. Constrained Optimization with Lagrange Multipliers: Solve constrained optimization problems using the Lagrange multiplier method. Explore its applications in machine learning models and analyze trade-offs between constraints and objectives.
7. Probabilistic Modeling and Inference: Develop a probabilistic model for a given dataset and perform inference using methods like maximum likelihood estimation (MLE) or Bayesian inference. Implement algorithms for parameter estimation and compare their performance.
8. Support Vector Machine (SVM) Classifier: Implement a linear SVM classifier from scratch using optimization techniques like gradient descent or quadratic programming. Evaluate its performance on benchmark datasets and compare it with other classification methods.
9. Principal Component Analysis (PCA): Implement PCA for dimensionality reduction on datasets with high dimensions. Visualize the transformed data and analyze the explained variance ratio of principal components.
10. Deep Convolutional Neural Network (CNN) for Image Classification: Implement a CNN architecture using a deep learning framework like TensorFlow or PyTorch. Train the model on image classification tasks and evaluate its performance on standard datasets like CIFAR-10 or MNIST.

**COURSE OUTCOMES**:

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

| | |
|---|---|
| CO1 | To understand fundamental linear algebra concepts, including vector spaces, matrices, eigenvalues, and eigenvectors. |
| CO2 | To gain proficiency in advanced calculus techniques, including gradient-based optimization, to train and fine-tune learning models effectively for optimal performance. |
| CO3 | Explore the role of probability and statistics in learning and understanding their significance in model training, uncertainty estimation, and probabilistic modelling. |
| CO4 | To apply mathematical models through hands-on projects, implementing machine learning models. |
| CO5 | To explore implementing deep learning models and analyse their performance using mathematical tools. |

**TEXTBOOKS:**

1.Eugene Charniak, “Introduction to Deep Learning," MIT Press, 2018.
2.Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, “Python Deep Learning," Packt Publishing Ltd, 2019.

**REFERENCES**:

1.Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “ Deep Learning," MIT Press, 2017.
2.Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach" O'Reilly Media, 2017.

3.Umberto Michelucci “Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
4.Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" The MIT Press, 2012.
5.EthemAlpaydin,"Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition 2014.
6.Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore Neural Networks with Python" Packt Publisher, 2017.
7.Antonio Gulli, Sujit Pal, "Deep Learning with Keras" Packt Publishers, 2017.
8.Francois Chollet, "Deep Learning with Python," Manning Publications, 2017

| Course Code | DEEP LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2403 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the basic ideas and principles of neural networks and concepts of deep learning.
2. To study Convolutional Neural Networks with image processing facilities like TensorFlow and Keras.
3. To study Recurrent Neural Networks with speech processing models
4. To study Deep Reinforcement Learning and the use of real-time applications.
5. To understand and implement deep learning architectures.

**UNIT I FUNDAMENTALS OF DEEP LEARNING** 6

Introduction to Neural Network – Feed Forward Neural Nets – Tensorflow - Deep Learning Fundamentals: Fundamental deep learning concepts, deep learning algorithms, and their types

**UNIT II CONVOLUTIONAL NEURAL NETWORK** 6

Convolutional Neural Networks – Filters – Strides and Padding – The structure of a convolutional network – Improving the performance of CNNs - Multilevel Convolution – Computer Vision with Convolutional Networks – Advanced Computer Vision

**UNIT III RECURRENT NEURAL NETWORK** 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks - Complete Autoencoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders – Language Modelling – Sequence to sequence learning – Speech Recognition

**UNIT IV DEEP REINFORCEMENT LEARNING** 6

Reinforcement Learning Theory – Markov Decision process – Monte Carlo methods – Temporal Difference methods – Value functions – Q learning – Deep Q-learning – Policy gradient methods – Model-based methods -Actor-Critic Methods

**UNIT V DEEP LEARNING IN AUTONOMOUS VEHICLES** 6

Autonomous Vehicles Introduction – Imitation driving policy – Driving policy with ChaufferNet – DL in Cloud

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

11. Implement a feedforward neural network using TensorFlow to classify handwritten digits from the MNIST dataset.
12. Design a convolutional neural network with appropriate filters and padding to classify images from the CIFAR-10 dataset.
13. Compare the performance of different stride values in convolutional layers on a given image recognition task.
14. Explore the impact of multilevel convolutions on improving the accuracy of a CNN for object detection in computer vision.
15. Build a recurrent neural network model to generate text sequences and analyze its performance in language modeling.
16. Develop a bidirectional RNN architecture for sentiment analysis on movie reviews dataset and compare it with a unidirectional RNN.
17. Implement a deep reinforcement learning agent using Q-learning to solve a simple grid world problem.

18. Evaluate the performance of Deep Q-learning algorithm on the CartPole environment in OpenAI Gym.
19. Design an autonomous driving policy using imitation learning and assess its performance in a simulated environment.
20. Investigate the feasibility of deploying a deep learning model for autonomous driving on cloud infrastructure, considering latency and scalability aspects.

**COURSE OUTCOMES:**

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

CO1 Understanding the basic concepts of deep learning.

CO2 Emphasizing knowledge of Convolutional Neural Networks and applying CNN to its variants for suitable applications.

CO3 Understanding Recurrent Neural Networks to apply autoencoders and generative models for suitable applications.

CO4 Understanding deep reinforcement learning

CO5 Analyzing the key computations underlying deep learning and using them to build and train deep neural networks for various tasks.

**TEXTBOOKS:**


7. Eugene Charniak, “Introduction to Deep Learning," MIT Press, 2018.
8. Ivan Vasilev, Daniel Slater, Gianmario Spacagna, Peter Roelants, Valentino Zocca, “Python Deep Learning," Packt Publishing Ltd, 2019.


**REFERENCES:**


9. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “ Deep Learning," MIT Press, 2017.
10. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach" O'Reilly Media, 2017.
11. Umberto Michelucci “Applied Deep Learning: A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.
12. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" The MIT Press, 2012.
13. EthemAlpaydin,"Introduction to Machine Learning," MIT Press, Prentice Hall of India, Third Edition 2014.
14. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore Neural Networks with Python" Packt Publisher, 2017.
15. Antonio Gulli, Sujit Pal, "Deep Learning with Keras" Packt Publishers, 2017.
16. Francois Chollet, "Deep Learning with Python," Manning Publications, 2017

| Course Code | NATURAL LANGUAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2404 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To learn the mathematical foundations and basics of Natural Language Processing.
2. To understand the text data processing technologies for processing textdata.
3. To understand the role of Information Retrieval and Information Extraction in Text Analytics.
4. To acquire knowledge of text data analytics using language models.
5. To learn about NLP Tools and real-time examples of NLP.

**UNIT I INTRODUCTION TO NATURAL LANGUAGE PROCESSING** 6

Natural Language Processing – Linguistic Background – Mathematical Foundations – Morphological Analysis – Tokenization – Stemming – Lemmatization – Boundary Determination.

**UNIT II TEXT DATA ANALYSIS**

Reading unstructured data – Representing text data – Part of speech tagging – Syntactic representation – Text similarity – WordNet-based similarity – Shallow parsing – Semantic representation.

**UNIT III INFORMATION RETRIEVAL AND EXTRACTION** 6

Information Retrieval: Design features of Information Retrieval Systems-Classical, Nonclassical, Alternative Models of Information Retrieval – Information extraction – Named Entity Recognition – RelationIdentification - Template filling.

**UNIT IV LANGUAGE MODELLING** 6

Language model – Probabilistic Models – n-gram language models- Hidden Markov Model-Topic Modelling - Graph Models -Feature Selection and classifiers -Rule-based Classifiers - Maximum entropy classifier – Clustering-Word and Phrase-based Clustering.

**UNIT V NLP TOOLS AND APPLICATIONS** 6

Tools: Natural Language Toolkit, Apache OpenNLP. Applications of Text Analytics – Applications in social media - Life science - Legal Text – Visualization - Case studies.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Implement tokenization and compare the effectiveness of stemming versus lemmatization in improving text preprocessing for sentiment analysis.
2. Develop a part-of-speech tagging system using NLTK and evaluate its accuracy on a corpus of news articles.
3. Explore various text similarity metrics, including WordNet-based similarity, for clustering news headlines into topics.
4. Build an information retrieval system using classical and nonclassical models and compare their performance on a dataset of scientific papers.
5. Implement a named entity recognition model using Apache OpenNLP and assess its accuracy on legal text documents.
6. Investigate different approaches for relation identification in biomedical texts and evaluate their precision and recall.
7. Construct a language model using n-gram models and compare its performance with a hidden Markov model on a corpus of tweets.

8. Apply topic modeling techniques to extract themes from a collection of customer reviews and visualize the results using t-SNE.
9. Develop a rule-based classifier to categorize legal documents into different types and measure its accuracy against a maximum entropy classifier.
10. Utilize word and phrase-based clustering algorithms to identify patterns in social media conversations and analyze their implications for marketing strategies.

**COURSE OUTCOMES:**

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

CO1 Understand the mathematical foundations and basics of Natural Language Processing.

CO2 Process text data at the syntactic and semantic level.

CO3 Extract key information from text data.

CO4 Analyze text content to provide predictions related to a specific domain using language processing.

CO5 Design an innovative application using NLP components.

**TEXTBOOKS:**


1. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing," MIT Press, 1999;
2. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data
3. for Business Intelligence”, Kogan Page, 2015.
4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with
5. Python”, 1st Edition, O'Reilly Media, 2009.


**REFERENCES:**


1. Matthew A. Russell, “Mining the Social Web," O'Reilly Media, 2013;
2. Daniel Jurafsky and James H. Martin “Speech and Language Processing," 3rd edition, Prentice Hall, 2009.
3. NitinIndurkhya, Fred J. Damerau “Handbook of Natural Language Processing," Second Edition, CRC Press, 2010.

| Course Code | COMPUTER VISION AND IMAGE PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2405 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the basics of image processing techniques for computer vision.
2. To learn the techniques used for image pre-processing.
3. To discuss the various object detection techniques.
4. To understand the various Object recognition mechanisms.
5. To elaborate on the video analytics techniques.

**UNIT I INTRODUCTION** 6

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

**UNIT II IMAGE PRE-PROCESSING** 6

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

**UNIT III OBJECT DETECTION USING MACHINE LEARNING** 6

Object detection– Object detection methods – Deep Learning framework for Object detection–bounding box approach-Intersection over Union(IoU)–Deep Learning
Architectures-R-CNN-FasterR-CNN- YouOnlyLookOnce(YOLO)-Salient features-Loss Functions-YOLO architectures

**UNIT IV FACE RECOGNITION AND GESTURE RECOGNITION** 6

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

**UNIT V VIDEO ANALYTICS** 6

Video Processing–use cases of video analytics- Vanishing Gradient and exploding gradient
problem-RestNet architecture- RestNet and skip connections-Inception Network- GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inceptionv3.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quadtree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms:(a)Rotation(b)
   i. Changeofscale
4. Skewing(d)Affine transform calculated from three pairs of corresponding

points(e) Bilinear transform calculated from four pairs of corresponding points.

a. Develop a program to implement Object Detection and Recognition
b. Develop a program for motion analysis using moving edges, and apply it to your image sequences.

5. Develop a program for Facial Detection and Recognition
6. Write a program for event detection in video surveillance system

**COURSE OUTCOMES:**

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

CO1 Understand the basics of image processing techniques for computer vision and Video analysis.
CO2 Explain the techniques used for image pre-processing.
CO3 Develop various object detection techniques.
CO4 Understand the various face recognition mechanisms.
CO5 Elaborate on deep learning- based video analytics.

**TEXT BOOKS:**


1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and MachineVision",4th edition,Thomson Learning,2013.
2. Vaibhav Verdhan,(2021,Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras, Apress2021(UNIT-III,IVandV)


**REFERENCES:**


1. Richard Szeliski, "Computer Vision: Algorithms and Applications",Springer Verlag London Limited,2011.
2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", Springer,2012.
3. D.A.Forsyth,J.Ponce,"Computer Vision: A Modern Approach", PearsonEducation,2003.
4. E.R.Davies,(2012),"Computer&MachineVision", Fourth Edition, Academic Press.

| Course Code | REINFORCEMENT LEARNING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2406 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Explore the historical development and interdisciplinary connections of Reinforcement Learning.
2. Gain a deep understanding of Markov Decision Processes (MDPs)
3. Focusing on iterative policy evaluation and iteration, and understanding the convergence properties.
4. Understand Monte Carlo methods for model-free prediction and control. application in reinforcement learning tasks.
5. Familiarize with function approximation methods and their applications in reinforcement learning.

**UNIT I INTRODUCTION** 6

Introduction- Origin and history of Reinforcement Learning research. Its connections with other related fields and with different branches of machine learning.

Probability Primer - Brush up of Probability concepts - Axioms of probability, concepts of random variables, PMF, PDFs, CDFs, Expectation. Concepts of joint and multiple random variables, joint, conditional and marginal distributions. Correlation and independence.

**UNIT II MARKOV DECISION PROCESS** 6

Introduction to RL terminology, Markov property, Markov chains, Markov reward process (MRP). Introduction to and proof of Bellman equations for MRPs along with proof of existence of solution to Bellman equations in MRP. Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations.

**UNIT III PREDICTION AND CONTROL BY DYNAMIC PROGRAMING** 6

Overview of dynamic programming for MDP, definition and formulation of planning in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, Banach fixed point theorem, proof of contraction mapping property of Bellman expectation and optimality operators, proof of convergence of policy evaluation and value iteration algorithms, DP extensions.

**UNIT IV MONTE CARLO METHODS FOR MODEL FREE PREDICTION AND CONTROL** 6

Overview of Monte Carlo methods for model-free RL, First visit and every visit Monte Carlo, Monte Carlo control, On-policy and off-policy learning, Importance sampling. TD Methods Incremental Monte Carlo Methods for Model Free Prediction, Overview TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC, and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.

**UNIT V FUNCTION APPROXIMATION METHODS** 6

Getting started with the function approximation methods, Revisiting risk minimization, gradient descent from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, Eligibility trace for function approximation, Afterstates, Control with function approximation, Least squares, Experience replay in deep Q-Networks.

Policy Gradients - Getting started with policy gradient methods, Log-derivative trick, Naive REINFORCE algorithm, bias and variance in Reinforcement Learning, Reducing variance in policy

gradient estimates, baselines, advantage function, actor-critic methods.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60
30

**SAMPLE LIST OF EXPERIMENTS**

1. Simulation of a Markov Chain: Simulate a simple Markov chain to demonstrate its properties and transitions between states.
2. Bellman Equation Implementation: Implement the Bellman equation for a Markov reward process in a simple environment to understand its application in reinforcement learning.
3. Policy Evaluation with Dynamic Programming: Implement policy evaluation using iterative methods like policy iteration or value iteration for a simple Markov decision process.
4. Monte Carlo Prediction: Implement first-visit Monte Carlo prediction to estimate state values in a grid world environment without a model.
5. Q-Learning Implementation: Implement the Q-learning algorithm for solving a simple grid world problem, demonstrating the exploration-exploitation trade-off.
6. Function Approximation with Linear Regression: Implement linear regression as a function approximation method in reinforcement learning to approximate state-action values.
7. Actor-Critic Method Implementation: Implement an actor-critic algorithm to learn policies and value functions concurrently, demonstrating the advantage of bootstrapping.
8. Gradient Descent in Function Approximation: Implement gradient descent for updating parameters in a function approximation method like neural networks for Q-value estimation.
9. Experience Replay in Deep Q-Networks: Implement experience replay in a deep Q-network (DQN) to improve learning efficiency and stability.
10. Policy Gradient Method Implementation: Implement a policy gradient method like REINFORCE to learn a policy in a simple environment, analyzing bias and variance in the estimates.

**COURSE OUTCOMES:**

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

CO1 Attain a comprehensive understanding of RL's historical evolution and interdisciplinary connections, alongside fundamental Probability concepts.

CO2 Achieve deep comprehension of MDPs, emphasizing terminology, properties, and Bellman equations for optimal decision-making.

CO3 Master Dynamic Programming techniques for MDP prediction and control tasks, understanding convergence properties.

CO4 Gain a thorough understanding of Monte Carlo methods for model-free RL, proficiently implementing First visit and every-visit techniques.

CO5 Familiarize with function approximation methods, gradient descent, eligibility traces, experience replay, policy gradient methods, and actor-critic architectures in RL applications.

**TEXT BOOKS:**


1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", , 2nd Edition.
2. Sutton, R. S., & Barto, A. G. (2018). Reinforcement learning: An introduction (2nd ed.). MIT Press.


**REFERENCES:**


1. Leon-Garcia, A. (2008). Probability, statistics, and random processes for electrical engineering. Prentice Hall.

2. Murphy, K. P. (2012). Machine learning: A probabilistic perspective. MIT Press.

| Course Code | BIG DATA ANALYTICS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2407 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand big data
2. To learn and use NoSQL big data management.
3. To learn MapReduce analytics using Hadoop and related tools.
4. To work with map-reduce applications
5. To understand the usage of Hadoop-related tools for Big Data Analytics

**UNIT I UNDERSTANDING BIG DATA** 6

Introduction to big data–convergence of key trends–unstructured data–industry examples of big data–web analytics–big data applications–big data technologies–introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence –Crowd sourcing analytics – inter and trans firewall analytics.

**UNIT II NOSQL DATAMANAGEMENT** 6

Introduction to NoSQL –aggregate data models –key-value and document data models – relationships – graph databases – schemaless databases – materialized views –distribution models–master-slave replication – consistency -Cassandra– Cassandra data model– Cassandra examples–Cassandra clients

**UNIT III MAPREDUCE APPLICATIONS** 6

MapReduce workflows–unit tests with MRUnit–test data and local tests–anatomy of MapReduce jobrun–classicMap-reduce–YARN–failures in classic Map-reduce and YARN – job scheduling –shuffle and sort –task execution –MapReduce types– input formats– output formats.

**UNIT IV BASICS OF HADOOP** 6

Data format–analyzing data with Hadoop–scaling out–Hadoop streaming–Hadooppipes –design of Hadoop distributed file system(HDFS)–HDFS concepts–Java interface–data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration.

**UNIT V HADOOP RELATED TOOLS** 6

Hbase–data model and implementations –Hbase clients–Hbase examples–praxis.Pig– Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts.
Hive –data types and file formats–HiveQL data definition–HiveQL data manipulation– HiveQL queries.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Downloading and installing Hadoop;Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories,retrieving files and Deleting files
3. Implement ofMatrix Multiplication with Hadoop MapReduce
4. Run a basic Word Count MapReduce program to understand MapReduce Paradigm
5. Installation of Hive along with practice examples.
6. Installation of HBase,Installing thrift along with Practice examples.
7. Practice importing and exporting data from various databases.

**COURSE OUTCOMES:**

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

CO1 Describe big data and use cases from selected business domains.
CO2 Explain NoSQL big datamanagement.
CO3 Install,configure,and run Hadoop and HDFS.
CO4 Perform map-reduce analytics using Hadoop.
CO5 Use Hadoop-related tools such as HBase,Cassandra,Pig,and Hive for big data analytics.

**TEXTBOOKS:**


1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. EricSammer,"Hadoop Operations",O'Reilley,2012.
3. Sadalage,PramodJ."NoSQL distilled",2013


**REFERENCES:**


1. E.Capriolo,D.Wampler,andJ.Rutherglen,"Programming Hive", O'Reilley, 2012.
2. LarsGeorge,"HBase: The Definitive Guide",O'Reilley,2011.
3. EbenHewitt,"Cassandra:The Definitive Guide",O'Reilley,2010.
4. AlanGates,"Programming Pig",O'Reilley,2011.

| Course Code | GENERATIVE ARTIFICIAL INTELLIGENCE | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2408 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Understand the principles and theory behind generative AI.
2. Gain practical experience in developing generative AI models.
3. Analyse and evaluate the ethical and societal implications of generative AI.
4. Apply generative AI techniques to real-world problems and domains.
5. Keep up-to-date with the latest developments and trends in the field of generative AI.

**UNIT I INTRODUCTION TO GENERATIVE AI** 6

Probability distributions and their role in generative models – Maximum Likelihood Estimation (MLE) – Bayesian Inference and Maximum a Posteriori (MAP) estimation – Generative models as probabilistic models.

**UNIT II PROBABILITY AND STATISTICS FOR GENERATIVE AI** 6

Probability distributions and their role in generative models – Maximum Likelihood Estimation (MLE) – Bayesian Inference and Maximum a Posteriori (MAP) estimation – Generative models as probabilistic models.

**UNIT III GENERATIVE MODEL** 6

Introduction to Autoencoders – Variational Autoencoders (VAE) – Generative Adversarial Networks (GAN) – Flow-based models – Practical implementation and hands-on exercises (using TensorFlow, PyTorch, Jupyter Notebook, Keras, etc).

**UNIT IV APPLICATIONS OF GENERATIVE AI** 6

Image generation and manipulation – Text generation and natural language processing – Anomaly detection and data augmentation – Style transfer and artistic applications – Real-world use cases (Art & Design, Medical Imaging, Content creation, Chatbots, Virtual Assistants, Cybersecurity, etc.) and industry examples. Guest Lectures by Industry Experts, and Researchers,

**UNIT V EVALUATION AND ETHICAL CONSIDERATIONS** 6

Metrics for evaluating generative models (e.g., Inception Score, FID) – Ethical concerns in generative AI, including bias and fairness – Privacy and security considerations – Future trends and emerging technologies in Generative AI.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Image Generation with Generative Adversarial Networks (GANs)
   - Implement a basic GAN architecture using TensorFlow or PyTorch.
   - Train the GAN on a dataset of images (e.g., CIFAR-10, CelebA).
   - Experiment with different architectures (e.g., DCGAN, WGAN) and hyperparameters to observe their effects on image quality and convergence speed.
2. Text Generation with Recurrent Neural Networks (RNNs)
   - Implement a character-level or word-level RNN using a framework like TensorFlow or PyTorch.
   - Train the RNN on a large corpus of text data (e.g., Shakespearean texts, Wikipedia articles).
   - Explore different RNN architectures (e.g., vanilla RNN, LSTM, GRU) and training techniques. (e.g., teacher forcing, beam search) for text generation.

3. Music Generation with Variational Autoencoders (VAEs)
   - Implement a VAE architecture using TensorFlow or PyTorch.
   - Train the VAE on a dataset of MIDI files or audio samples.
   - Investigate techniques for generating novel music sequences by sampling from the learned latent space of the VAE.

4. Style Transfer with Neural Style Transfer Algorithms:
   - Implement neural style transfer algorithms such as Gatys et al.'s method or Johnson et al.'s method using TensorFlow or PyTorch.

- Experiment with different content and style images to observe the transfer of artistic styles.

5. Data Augmentation with Generative Models
   - Utilize generative models (e.g., GANs, VAEs) to augment training data for classification tasks.
   - Train a classifier (e.g., CNN) on a dataset augmented with generated samples and compare its performance with a classifier trained on the original dataset.
6. Video Generation with Generative Adversarial Networks (GANs)
   - Extend GAN architectures to generate video sequences.
   - Train the GAN on a dataset of video clips (e.g., action recognition datasets, video game recordings).
   - Evaluate the generated video sequences in terms of realism and diversity.
7. Anomaly Detection with Generative Models
   - Train a generative model (e.g., VAE) on a dataset containing only normal instances.
   - Use the trained generative model to reconstruct instances from both normal and anomalous data.
   - Devise anomaly detection techniques based on reconstruction errors or latent space distances.
8. Domain Adaptation with Generative Adversarial Networks (GANs)
   - Implement domain adaptation techniques using GANs to transfer knowledge from a labelled source domain to an unlabelled target domain.
   - Train the GAN to generate target domain samples that are indistinguishable from source domain samples.
   - Evaluate the effectiveness of the adapted model on the target domain tasks.

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1 | Understand the fundamental principles and applications of Generative Artificial Intelligence and distinguish between generative and discriminative models. |
| CO2 | Apply probability and statistics concepts to analyze and model data, with a focus on their role in generative models. |
| CO3 | Implement and evaluate various generative models, including Autoencoders, Variational Autoencoders (VAE), and Generative Adversarial Networks (GANs). |
| CO4 | Apply generative AI techniques to solve real-world problems, including image generation, text generation, and artistic applications. |
| CO5 | Evaluate generative models using appropriate metrics and critically analyse the ethical implications, privacy concerns, and societal impact of generative AI technologies. |

**TEXT BOOKS:**


1. Babcock, J., & Bali, R. (2021). Generative AI with Python and TensorFlow 2: Create images, text, and music with vaes, gans, lstms, transformer models. Packt Publishing.
2. David Foster, "Generative Deep Learning", Second Edition, O'Reilly Media, 2023.
3. Jakub Langr and Vladimir Bok, "GANs in Action: Deep learning with Generative Adversarial Networks" Manning, 2019.
4. Jacob Emerson, "Ripples of Generative AI", IngramSpark, 2023.


**REFERENCES:**


1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2016.
2. Hannes Hapke, Cole Howard, Hobson Lane "Natural Language Processing in Action", Manning, 2019.
3. Alberto Chierici, "The Ethics of AI", New Degree Press, 2021.
4. Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2017.
5. Eric Matthes, "Python Crash Course", Third Edition, No Starch Press, 2023.


**YouTube Resources:**

1. 3Blue1Brown - While not specific to generative AI, this channel provides fantastic visual explanations of mathematics and concepts that are fundamental to AI and machine learning.
2. sentdex - This channel focuses on machine learning and AI using Python. It includes tutorials on various topics, including generative models.
3. Two Minute Papers - This channel offers concise summaries of research papers and breakthroughs in computer graphics, machine learning, and AI, including generative AI.DeepLizard - This channel provides tutorials on machine learning and deep learning topics, which can be useful for understanding the technical aspects of generative AI.
4. Andrew Ng's Deeplearning.ai - The deeplearning.ai courses on Coursera, created by Andrew Ng, are also available on YouTube. These videos cover deep learning and neural networks, which are foundational to generative AI.
5. Stanford University's Machine Learning - You can find recordings of Stanford University's machine learning course on YouTube, which includes lectures on relevant topics. (Stanford Online)
6. PyTorch - The official PyTorch YouTube channel provides tutorials and resources for learning PyTorch, a popular framework for deep learning and generative AI.
7. TensorFlow - The official TensorFlow YouTube channel offers tutorials and resources for learning TensorFlow, another widely used deep learning framework.

**Vertical 5: CLOUD COMPUTING**

| Course Code | CLOUD TECHNOLOGIES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2501 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To understand the principles of cloud architecture, models and infrastructure.
2. To understand the concepts of virtualization and virtual machines.
3. To gain knowledge about virtualization Infrastructure.
4. To explore and experiment with various Cloud deployment environments.
5. To learn about the security issues in the cloud environment.

**UNIT I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE** 6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

**UNIT II VIRTUALIZATION BASICS** 6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

**UNIT III VIRTUALIZATION INFRASTRUCTURE AND DOCKER** 6

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

**UNIT IV CLOUD DEPLOYMENT ENVIRONMENT** 6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

**UNIT V CLOUD SECURITY** 6

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub

**COURSE OUTCOMES:**

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

CO1 Understand the design challenges in the cloud.

CO2 Apply the concept of virtualization and its types.

CO3 Experiment with virtualization of hardware resources and Docker.
CO4 Develop and deploy services on the cloud and set up a cloud environment.
CO5 Explain security challenges in the cloud environment.

**TEXTBOOKS:**


1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.


**REFERENCES:**


1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

| Course Code | VIRTUALIZATION | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2502 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To Learn the basics and types of Virtualization
2. To understand the Hypervisors and its types
3. To Explore the Virtualization Solutions
4. To Experiment the virtualization platforms

**UNIT I INTRODUCTION TO VIRTUALIZATION** 6

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors

**UNIT II SERVER AND DESKTOP VIRTUALIZATION** 6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

**UNIT III NETWORK VIRTUALIZATION** 6

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization- VLAN-WAN Architecture-WAN Virtualization

**UNIT IV STORAGE VIRTUALIZATION** 6

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID

**UNIT V VIRTUALIZATION TOOLS** 6

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1.Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.

2. a.Shrink and extend virtual disk
   b.Create, Manage, Configure and schedule snapshots
   c.Create Spanned, Mirrored and Striped volume
   d.Create RAID 5 volume
3. a.Desktop Virtualization using VNC
   b.Desktop Virtualization using Chrome Remote Desktop

4.Create type 2 virtualization on ESXI 6.5 server
5.Create a VLAN in CISCO packet tracer
6.Install KVM in Linux
7.Create Nested Virtual Machine(VM under another VM)

**COURSE OUTCOMES:**

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

CO1 Analyse the virtualization concepts and Hypervisor
CO2 Apply the Virtualization for real-world applications
CO3 Install &Configure the different VM platforms
CO4 Experiment with the VM with various software

**TEXT CUM REFERENCE BOOKS:**

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010

2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
5. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
6. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

| Course Code | CLOUD ARCHITECTURES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2503 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Understand the Fundamentals of Cloud Computing
2. Explore Key Concepts in Cloud Architectures
3. Evaluate Cloud Service Providers and Deployment Models
4. Apply Design Principles for Building Cloud Architectures
5. Analyze Architectural Patterns and Networking Strategies in the Cloud

**UNIT I FOUNDATIONS OF CLOUD COMPUTING AND ARCHITECTURAL CONCEPTS** 6

Introduction to Cloud Computing – Definition and Characteristics, Evolution of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Deployment Models (Public Cloud, Private Cloud, Hybrid Cloud). Key Concepts in Cloud Architectures – Virtualization, Scalability and Elasticity, Reliability and Availability, Security in the Cloud, Compliance and Governance.

**UNIT II CLOUD SERVICE PROVIDERS AND ARCHITECTURAL DESIGN PRINCIPLES** 6

Cloud Service Providers – Overview of Major Cloud Providers (AWS, Azure, Google Cloud, etc.), Comparative Analysis of Cloud Providers, Choosing the Right Cloud Service Provider. Design Principles for Cloud Architectures – Microservices Architecture, Serverless Computing, Containerization (Docker, Kubernetes), Decoupling and Asynchronous Communication.

**UNIT III CLOUD ARCHITECTURE PATTERNS AND NETWORKING** 6

Architectural Patterns in the Cloud – Multi-Tier Applications, Event-Driven Architectures, Big Data Architectures, IoT (Internet of Things) Architectures. Cloud Networking and Connectivity - Virtual Private Clouds, Content Delivery Networks (CDN), Hybrid Networking, Network Security in the Cloud.

**UNIT IV CLOUD DATA MANAGEMENT AND PERFORMANCE OPTIMIZATION** 6

Data Management in the Cloud – Cloud Databases (SQL and NoSQL), Data Storage Services, Data Backup and Recovery, Data Transfer and Migration Strategies. Performance Optimization and Monitoring – Resource Scaling and Auto-Scaling, Performance Monitoring and Logging, Cost Optimization Strategies, Troubleshooting and Debugging in the Cloud.

**UNIT V REAL-WORLD APPLICATIONS AND FUTURE TRENDS** 6

Case Studies and Real-world Implementations – Successful Cloud Migrations, Cloud-Native Applications, Challenges and Lessons Learned. Future Trends in Cloud Architectures - Edge Computing, Quantum Computing and Cloud, Emerging Technologies.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Deploy a virtual machine on AWS. Install a web server and share the public IP address for verification.
2. Set up auto-scaling for an Azure web app. Show how it responds to a simulated increase in user traffic.

3. Create an AWS VPC with security groups. Launch an EC2 instance with a secure connection. Share access details.
4. Dockerize three microservices (e.g., Node.js, Python, Java). Show how they communicate using Docker Compose.
5. Write an AWS Lambda function in Python. Configure an S3 bucket to trigger the function on object creation.
6. Build an AWS-based big data pipeline using S3, Lambda, and Athena. Show data ingestion and query results.
7. Set up an Azure VNet with front-end and back-end subnets. Implement Azure CDN for a web application.
8. Use Google Cloud Monitoring to track the performance of a Compute Engine instance. Implement auto-scaling based on metrics.
9. Analyze Netflix's cloud architecture. Identify key decisions, challenges, and benefits of their migration to the cloud.

**COURSE OUTCOMES:**

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

CO1 Master the Core Concepts of Cloud Computing
CO2 Demonstrate Proficiency in Designing Secure and Scalable Cloud Architectures
CO3 Evaluate and Select Appropriate Cloud Service Providers
CO4 Apply Architectural Patterns to Real-world Cloud Solutions
CO5 Implement Efficient Networking and Data Management Strategies in Cloud Environments
CO6 Critically Analyze and Troubleshoot Cloud-based Systems

**TEXT BOOKS:**

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, Zaigham Mahmood
2. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models" by Michael J. Kavis
3. "Cloud Native Patterns: Designing Change-tolerant Software" by Cornelia Davis

**REFERENCES:**

1. "The Art of Cloud Computing: Building Cloud-Based Applications and Infrastructure" by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
2. "Cloud Computing: From Beginning to End" by Ray J. Rafaels
3. "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" by George Reese

| Course Code | CLOUD PLATFORM PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2504 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. Ability to Develop Proficiency in Cloud Service Providers
2. Master Cloud Programming Languages and Tools
3. Implement Cloud-native Applications
4. Ensure Cloud Application Security
5. Apply DevOps Practices for Cloud Development

**UNIT I INTRODUCTION TO CLOUD COMPUTING AND CLOUD PLATFORMS** 6

Overview of Cloud Computing; Evolution of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Cloud Deployment Models (Public, Private, Hybrid), Major Cloud Service Providers (AWS, Azure, Google Cloud), Setting up Cloud Accounts and Environments, Cloud Platform Services (Compute, Storage, Networking), Identity and Access Management (IAM), Overview of Pricing and Billing in the Cloud.

**UNIT II PROGRAMMING LANGUAGES AND TOOLS FOR CLOUD** 6

Overview of Programming Languages for Cloud Development, Cloud SDKs and CLIs, Infrastructure as Code (IaC) Concepts and Tools (e.g., Terraform), Containerization and Orchestration (Docker, Kubernetes).

**UNIT III CLOUD APPLICATION DEVELOPMENT** 6

Serverless Computing and Functions as a Service (FaaS), Microservices Architecture in the Cloud, Cloud-native Development Best Practices, Data Storage and Databases in the Cloud, Testing and Debugging Cloud Applications

**UNIT IV CLOUD SECURITY AND COMPLIANCE** 6

Security Challenges in the Cloud, Encryption and Key Management, Compliance and Governance in the Cloud, Best Practices for Securing Cloud Applications, Incident Response and Recovery in the Cloud.

**UNIT V ADVANCED TOPICS IN CLOUD PROGRAMMING** 6

DevOps and Continuous Integration/Continuous Deployment (CI/CD), Monitoring and Logging in the Cloud, Advanced Cloud Services (e.g., AI/ML, IoT), Performance Optimization and Scalability.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**LIST OF EXPERIMENTS**

1. Setting Up a Cloud Account:
2. Virtual Machines and Containers:
3. Serverless Computing:
4. Cloud Storage:
5. Database Services:
6. Networking and Security:
7. Monitoring and Logging:
8. Continuous Integration/Continuous Deployment (CI/CD):
9. Scaling and Load Balancing:
10. Identity and Access Management (IAM):

**COURSE OUTCOMES:**

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

CO1 Able to explain the fundamental concepts of cloud computing, including service models deployment models, and the evolution of cloud technologies.

CO2 Will gain practical experience in setting up and using a cloud platform

CO3 Will acquire proficiency in programming for the cloud, using relevant programming languages, SDKs, and tools.
CO4 Will demonstrate an Understanding of cloud security challenges and solutions, including encryption, identity and access management, compliance.
CO5 Able to design and implement cloud-native applications, incorporating advanced concepts such as serverless computing.

**TEXTBOOKS & REFERENCES**


1. "Cloud Computing: From Beginning to End" by Ray J. Rafaels, Publisher: Apress, Edition: 1st edition (2016)
2. "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" by George Reese, Publisher: O'Reilly Media, Edition: 1st edition (2009)
3. "Programming Amazon EC2" by Jurg van Vliet and Flavia Paganelli, Publisher: O'Reilly Media, Edition: 1st edition (2011)
4. "Kubernetes: Up and Running" by Kelsey Hightower, Brendan Burns, and Joe Beda, Publisher: O'Reilly Media, Edition: 1st edition (2017)


| Course Code | CLOUD SERVICES MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2505 | | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. Introduce Cloud Service Management terminology, definition & concepts.
2. Compare and contrast cloud service management with traditional IT service management.
3. Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
4. Select appropriate structures for designing, deploying and running cloud-based services in a business environment.
5. Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems.

**UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS** 6

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models

**UNIT II CLOUD SERVICES STRATEGY** 6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture

**UNIT III CLOUD SERVICE MANAGEMENT** 6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management

**UNIT IV CLOUD SERVICE ECONOMICS** 6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models

**UNIT V CLOUD SERVICE GOVERNANCE & VALUE** 6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one

**COURSE OUTCOMES**:

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

CO1 Exhibit cloud-design skills to build and automate business solutions using cloud technologies.

CO2 Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.

CO3 Solve the real world problems using Cloud services and technologies.

**TEXTBOOKS:**

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

**REFERENCES:**

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

| Course Code | | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2506 | STREAM PROCESSING | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. Introduce Data Processing terminology, definition & concepts
2. Define different types of Data Processing
3. Explain the concepts of Real-time Data processing
4. Select appropriate structures for designing and running real-time data services in a business environment
5. Illustrate the benefits and drive the adoption of real-time data services to solve real world problems

**UNIT I FOUNDATIONS OF DATA SYSTEMS** 6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

**UNIT II REAL-TIME DATA PROCESSING** 6

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing,Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

**UNIT III DATA MODELS AND QUERY LANGUAGES** 6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

**UNIT IV EVENT PROCESSING WITH APACHE KAFKA** 6

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

**UNIT V REAL-TIME PROCESSING USING SPARK STREAMING** 6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault-tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Install MongoDB
2. Design and Implement Simple application using MongoDB
3. Query the designed system using MongoDB
4. Create a Event Stream with Apache Kafka
5. Create a Real-time Stream processing application using Spark Streaming
6. Build a Micro-batch application
7. Real-time Fraud and Anomaly Detection,
8. Real-time personalization, Marketing, Advertising

**COURSE OUTCOMES:**

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

CO1 Understand the applicability and utility of different streaming algorithms.
CO2 Describe and apply current research trends in data-stream processing.
CO3 Analyze the suitability of stream mining algorithms for data stream systems.
CO4 Program and build stream processing systems, services and applications.
CO5 Solve problems in real-world applications that process data streams.

**TEXTBOOKS:**


1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media
3. Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing


**REFERENCES:**


1. https://spark.apache.org/docs/latest/streaming-programming-guide.html
2. Kafka.apache.org

| Course Code | FOG AND EDGE COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2507 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. To enhance real-time data processing and analytics at the network edge.
2. To optimize resource utilization and reduce latency in fog computing environments.
3. To improve scalability and flexibility for edge devices and applications.
4. To Enhance security and privacy for data processing at the edge.
5. To Facilitate seamless integration of fog and edge computing with cloud services.

**UNIT I INTRODUCTION TO FOG AND EDGE COMPUTING** 6

Definition and Fundamentals:Overview of Fog and Edge Computing, Key concepts and characteristics, Motivations and Advantages: Reasons for adopting Fog and Edge Computing, Comparative advantages over traditional Cloud Computing, Use Cases and Applications: Challenges and Limitations: Security concerns, privacy issues, and compliance, Comparison with Cloud Computing: Contrasting characteristics and use cases, Complementary roles in a hybrid computing environment.

**UNIT II ARCHITECTURES AND COMPONENTS** 6

Edge Computing Architecture Models: Design principles and characteristics, Hierarchical vs. flat architectures. Fog Nodes and Infrastructure: Role and capabilities of Fog nodes, Infrastructure components supporting Edge Computing. Edge Device Types and Capabilities: Categorization of Edge devices (e.g., gateways, sensors, actuators), Capabilities and limitations of different device types. Edge-to-Cloud Communication Models; Middleware and Software Frameworks: Middleware solutions for Edge Computing.

**UNIT III SECURITY AND PRIVACY IN EDGE COMPUTING** 6

Security Challenges in Edge Computing: Identifying security threats in Edge Computing, Risks associated with decentralized architectures. Methods for secure access control: Role of authentication in ensuring device integrity, Data Encryption in Edge Environments: Encryption strategies for data at rest and in transit. Privacy Concerns and Regulatory Compliance; Risk Management and Incident Response.

**UNIT IV EDGE APPLICATION DEVELOPMENT** 6

Programming Models and Frameworks: Overview of programming models for Edge Computing, Exploration of popular frameworks for Edge application development, Integration with IoT Devices:

Techniques for integrating Edge Computing with Internet of Things (IoT) devices. Edge Application Deployment Strategies; Edge-to-Cloud Communication Patterns; Optimizing Edge Application Performance: Performance considerations in Edge Computing, Strategies for optimizing resource usage and responsiveness.

**UNIT V PERFORMANCE OPTIMIZATION AND FUTURE TRENDS** 6

Performance Metrics and Optimization: Metrics for evaluating performance in Edge Computing Strategies for optimizing Edge applications; Energy-Efficient Edge Architectures: Techniques for optimizing energy consumption, Green computing practices in Edge environments, Real-time Processing and Analytics: Approaches for real-time data processing at the Edge, Analytics capabilities in decentralized architectures. Scalability and Flexibility in Edge Architectures; Emerging Trends in Fog and Edge Computing.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Design and deploy a fog computing architecture for a smart city application.
2. Optimize data processing algorithms for edge devices in a real-time monitoring system.
3. Evaluate resource utilization in a fog computing environment using simulation tools.
4. Implement security protocols for edge devices to protect sensitive data.
5. Develop a scalable edge computing solution for IoT devices in a manufacturing setting.
6. Integrate fog computing with cloud services to enhance overall system efficiency.

7. Perform a hands-on deployment of edge computing nodes in a network infrastructure.
8. Design and implement a fault-tolerant edge computing solution for critical applications.
9. Conduct performance testing to assess the latency reduction achieved through edge computing.
10. Create a comprehensive case study on the successful integration of fog and edge computing in a specific industry.

**COURSE OUTCOMES:**

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

CO1 Proficiently deploy and manage fog and edge computing solutions in diverse environments.
CO2 Demonstrate expertise in optimizing data processing and analytics at the network edge.
CO3 Evaluate and enhance resource efficiency for fog computing deployments.
CO4 Implement robust security measures for safeguarding edge computing data.
CO5 Successfully integrate fog and edge computing technologies to address real-world challenges.

**TEXT& REFERENCE BOOKS**


1. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya and Amir Vahid Dastjerdi (Wiley, 1st Edition, 2018),
2. "Edge Computing: A Primer" by Shiwen Mao and Ying-Chang Liang (Wiley, 1st Edition, 2019),
3. "Fog Computing in the Internet of Things: Intelligence at the Edge" by Yogesh Simmhan, Nalini Venkatasubramanian, and Viktor K. Prasanna (Springer, 1st Edition, 2018),
4. "Fog Computing: Concepts, Frameworks and Technologies" by Flavio Bonomi, Rodolfo Milito, Jiang Zhu, and Sateesh Addepalli (Springer, 1st Edition, 2018),
5. "Edge Computing – The Dawn of Industry 4.0 Revolution" by Satya Prakash Ghrera (CRC Press, 1st Edition, 2020)
6. "Fog Computing: Towards Minimizing Latency and Improving QoE in the Internet of Things" by Mohammad Mehedi Hassan, Saad B. Qaisar, and Abdelgadir Mohammed Ahmed (Springer, 1st Edition, 2018).


| Course Code | BLOCK CHAIN TECHNOLOGY AND CLOUD COMPUTING | L | T | P | C |
|---|---|---|---|---|---|

| CZPE 2508 | | 2 | 0 | 2 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. Introduce students to the core principles, mechanisms,and applications of Blockchain Technology and Cloud Computing.
2. Foster a solid theoretical foundation in Blockchain mechanisms, cryptographic principles, cloud architectures, and enabling technologies.
3. Provide hands-on experience through lab sessions, experiments,and projects to apply theoretical concepts into practical scenarios.
4. Enable students to integrate the principles and practices of Blockchain and Cloud Computing to develop innovative and efficient solutions.
5. Empower students to analyse real-world use cases and explore the potential of utilizing Blockchain and Cloud Computing in various applications.

**UNIT I INTRODUCTION TO BLOCKCHAIN AND CLOUD COMPUTING** 6

Blockchain Technology Mechanisms & Networks: Overview, Blockchain Networks, Decentralization. Transactions,Blocks,P2PSystems:Structure of Transactions,Concept of Blocks,Peer-to-Peer(P2P) Systems. Keys, Digital Signatures, Hashing:Cryptographic Keys, Digital Signatures in Blockchain Transactions,Hash Functions and Applications. Cloud Computing-Definition, Evolution, Characteristics:Introduction to Cloud Computing,Characteristics, Evolution of Cloud. Principles of Parallel Computing, Elasticity: Principles of Parallel Computing in Cloud,Elasticity and Scalability in Cloud Environments, Techniques for Parallelism.On-demand Provisioning:Understanding On-demand Provisioning in Cloud, Resource Allocation and De-allocation, Implementing Scalable Resources on Demand.

**UNIT II CYPTOCURRENCY AND CLOUD ENABLING TECHNOLOGY** 6

Bitcoin Overview: Introduction to Bitcoin, Bitcoin Mining Process, Bitcoin Wallets: Types and Functions, EthereumVirtual Machine (EVM). Blockchain & Cryptocurrency: Consensus Mechanisms in Blockchain, Smart Contracts and Applications, Decentralization and its Significance,Impact of Blockchain Technology on Cryptocurrency. Understanding Cloud Basics: Service-Oriented Architecture (SOA), Fundamentals of Virtualization, Types and Levelsof Virtualization, Cloud Characteristics and Attributes, Elasticity and Scalability in Cloud Computing. Principles and Implementation:CloudServices and Deployment Models, Cloud Virtualization Tools and Mechanisms. CPU,Memory,and I/O Devices Virtualization, Disaster Recovery in Cloud Environments.

**UNIT III ETHEREUM & CLOUD ARCHITECTURE** 6

Overview of Ethereum:Ethereum Origins and Core Principles, Smart Contracts, Decentralization. Ethereum Operations & Transactions: Ethereum Accounts: Types and Functions, Transaction Process in Ethereum Network, Ethereum Smart Contracts: Structure and Execution. Understanding Hyperledger:Introduction to Hyperledger Fabric,Hyperledger Composer:Overview and Functions,Consensus Mechanisms in Hyperledger. Layered Cloud Architecture Design: Components of Cloud Architecture, Exploring Layers in Cloud Environments, Architectural Design Challenges.Cloud Services & Service Models: Overview of Cloud Services (IaaS, PaaS, SaaS), Characteristics and Applications ofEach Service Model, Challenges and Solutions in Service Deployment. Cloud Storage Solutions: Cloud Storage Basics and Principles,Storage-as-a-Service(STaaS)Concept,Analysis of Cloud Storage Providers(e.g.,S3).

**UNIT IV SOLIDITY PROGRAMMING AND CLOUD SECURITY** 6

Solidity Programming Language: Syntax, Types, Variables, Functions, Data Structures in Solidity. Ethereum Wallet &Smart Contracts: Overview of Ethereum Wallet, Structure & Working of Smart Contracts. Basics of Solidity &Smart Contract Structure: Understanding Basic Solidity Concepts, Components and Structure of Smart Contracts. Resource Provisioning & Cloud Overview: Cloud Resource Allocation & Management, Cloud Service Models (IaaS, PaaS, SaaS).Security Overview in Cloud Environment: Cloud Security Challenges, Security Governance in Cloud. IAM, Virtual Machine Security,Security Standards:Identity & Access Management in

Cloud, Ensuring Security in Virtual Machines, Compliance with Security Standards in Cloud Environments.

**UNIT V BLOCKCHAIN APPLICATIONS AND ADVANCEMENT OF CLOUD TECHNOLGIES** 6

IoT Integration with Blockchain: Introduction to IoT (Internet of Things), Blockchain's Role in IoT Security, IoT DataManagement using Blockchain. Blockchain in Medical Record Management: Healthcare Data Challenges & Security, Blockchain's Impacton Medical Records, Privacy,Integrity, and Accessibility in Medical Records, Applications. Domain Name Service (DNS) using Blockchain: DNS Issues in Centralized Systems, Blockchain-Based Decentralized DNS. AltCoins and Their Significance: Introduction to Alt Coins (Alternative Cryptocurrencies), Role and Market Impact of AltCoins, Differentiating Factors and Advantages, Future Trends and Adoption of Alt Coins. Future Trends in BlockchainTechnology: Emerging Trends, Impact on Industries and Potential Evolution.Hadoop and Big Data Processing inCloud: Introduction to Hadoop and MapReduce, Cloud-Based Big Data Analytics, Hadoop's Role in Cloud Computing, Use Cases and Industry Applications. Google App Engine (GAE) for Cloud Development: Overview of GAE, Buildingand Deploying Applications on GAE, Scalability and Maintenance Aspects, GAE's Contribution to Cloud Development.OpenStack and Cloud Federation: OpenStack in Cloud Environments, Federation in Cloud Computing, Multi-Cloud Managementusing OpenStack, Benefitsand Challenges of Cloud Federation.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Simulate a basic blockchain network to understand transactions, blocks, and the structure of peer-to-peer systems, alongside implementing on-demand resource provisioning in cloud computing.
2. Analyze the Bitcoin mining process, types of wallets, and Ethereum Virtual Machine (EVM) while exploring consensus mechanisms and smart contracts' impact on cryptocurrency, and understanding cloud basics such as service-oriented architecture (SOA) and virtualization.
3. Develop smart contracts in Solidity programming language for Ethereum, comprehend Hyperledger Fabric and Hyperledger Composer, and design layered cloud architecture considering cloud services and service models.
4. Implement Solidity programming language features like variables, functions, and data structures, alongside understanding Ethereum wallet and smart contracts structure, and ensuring cloud security through identity & access management (IAM) and compliance with security standards.
5. Explore blockchain applications like IoT integration and medical record management, analyze alternative cryptocurrencies (Alt Coins) and their significance, and investigate advancements in cloud technologies such as Hadoop for big data processing and Google App Engine (GAE) for cloud development.

**COURSE OUTCOMES:**

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

CO1 Demonstrate a comprehensive understanding of the fundamental principles and mechanisms of Blockchain Technology and Cloud Computing.

CO2 Apply theoretical knowledge to solve problems related to Blockchain and Cloud Computing through hands-on experiments and practical sessions.

CO3 Integrate Blockchain Technology and Cloud Computing for the development of innovative solutions, leveraging the combined strengths of both domains.

CO4 Exhibit problem-solving skills by analyzing and proposing solutions using Blockchain and Cloud Computing principles in diverse scenarios.

CO5 Analyse and evaluate real-world use cases to determine the suitability and potential impact of Blockchain and Cloud Computing technologies.

Develop practical proficiency in executing projects that utilize Blockchain and Cloud Computing for addressing contemporary challenges.

**TEXTBOOKS:**

1. DanielDrescher,"Blockchain Basics: ANon-Technical Introduction in 25Steps",1st Edition,2017
2. AndreasM. Antonopoulos,"Mastering Bitcoin: Unlocking Digital Cryptocurrencies", 2ndEdition,2017
3. Stephen Grider,"Ethereum Programming", 1stEdition,2020.
4. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood,"Cloud Computing: Concepts, Technology & Architecture", 2nd edition,2013.
5. Michael J.Kavis, "Architecting the Cloud: Design Decisions for Cloud ComputingServiceModels", 1stedition,2014.

**REFERENCES:**

1. DonTapscott and Alex Tapscott,"Blockchain Revolution:How the Technology Behind Bitcoin and Other Cryptocurrenciesis Changing theWorld",2nd edition,2018.
2. Arvind Narayanan, Joseph Bonneau,Edward Felten, Andrew Miller,and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies:A Comprehensive Introduction",1st edition, 2016.
3. Judith Hurwitz,Robin Bloor, MarciaKaufman,andFernHalper, "Cloud Computing for Dummies", 1st edition,2009.
4. Tim Mather, SubraKumaraswamy, and ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance",1stedition,2009.

**Vertical 6: IOT SYSTEMS**

| Course Code | FOUNDATIONS OF EMBEDDED IOT SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2601 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To provide students with a good depth of knowledge of Designing Embedded and IOT Systems for various applications.
2. Knowledge of the design and analysis of Embedded and IoT Systems for Electronics Engineering students.

**UNIT I INTRODUCTION TO EMBEDDED AND IOT SYSTEMS** 6

Introduction Embedded and IoT systems, Definition, Examples and components of embedded and IoT Systems, Embedded and IoT Systems Design Process, Various Embedded and IoT cores controllers.

**UNIT II HARDWARE/SOFTWARE CO-DESIGN FOR EMBEDDED AND IOT SYSTEMS** 6

Microcontrollers for embedded systems, Arduino embedded platform, Peripheral interfacing and programming with Arduino platform, Sensors and Actuator interfacing, Cloud support with Arduino platform.

**UNIT III PROTOCOLS FOR EMBEDDED AND IOT SYSTEMS** 6

Serial protocols, UART, I2C, and SPI. NFC, Wireless protocols like, RFID, Zig-bee, IEEE 802.15.4e, Thread, 6LoWPAN, Constrained Application Protocol (CoAP), Extensible Messaging Protocol (XMPP) , WebSocket , Advanced Message Queueing Protocol (AMQP) , Message Queue Telemetry Transport (MQTT), Web Real Time Communications (WebRTC), LoRa, SIGFOX, Z Wave.

**UNIT IV IOT BASED EMBEDDED SYSTEMS** 6

Open source OS for IoT such as Contiki OS, TinyOS, Basic architecture of an IoT based Embedded Systems., Embedded Hardware for IoT applications, like Raspberry Pi, Arduino, and Raspberry Pi based development board, IoT Cloud Platform and IoT client applications on mobile phones.

**UNIT V CASE STUDIES OF EMBEDDED AND IOT SYSTEMS** 6

Embedded application development through Arduino and Raspberry Pi based development boards, Development of mini-Project on new version of Operating systems and development board. That project should also address to the current societal needs.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Study of Open source operating system used in Embedded Design.
2. Introduction to Arduino based Embedded System Programming.
3. LED Interfacing program for Arduino based Embedded System
4. Interfacing Push button Switch interfacing with Arduino based Embedded System
5. External Peripheral Interfacing with Arduino based Embedded System.
6. On Chip peripheral programming with Arduino/Raspberry Pi based Embedded System
7. Serial Communication Protocol programming with Arduino/Raspberry Pi based Embedded Systems.
8. Wireless communications with Arduino/Raspberry Pi Embedded IOT Platform.
9. Bluetooth communication interfacing with Arduino/Raspberry PiEmbedded IOT Board.
10. WiFi module interfacing with Arduino/Raspberry Pi Embedded IOT Board.
11. Embedded Systems design with IOT capability.
12. IOT based Temperature monitoring embedded system with open source cloud tools.
13. Introduction to RTOS
14. RTOS based task performances

**COURSE OUTCOMES:**

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

| | |
|---|---|
| CO1 | Knowledge of theory and practice related to Embedded and IOT System. |
| CO2 | Ability to identify, formulate and solve engineering problems by using Embedded Systems with IoT. |
| CO3 | Ability to implement real field problem by gained knowledge of Embedded Systems with IoT capability. |

**TEXT CUM REFERENCE BOOKS:**


1. Muhammad Ali MazidiShujen Chen, Sepehr Naimi Sarmad Naimi "Embedded Programming
2. Using C Language", 1st Edition, Freescale ARM Cortex-M.
3. Steve Ferbur, "ARM System on Chip".
4. Rajkamal, "Embedded System: Architecture, Programming and Design", TMH3.
5. Dr.OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for
6. Smart Environments and Integrated Ecosystems", River Publisher

| Course Code | IOT NETWORKS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2602 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To give an understanding about the choice and application of IoT & M2M communication protocols.
2. To describe Cloud computing and design principles of IoT.
3. To relate to MQTT clients, MQTT server and its programming.
4. To describe the architectures and communication protocols of WSNs.
5. To identify the uplink and downlink communication protocols associated with specific application of IOT /WSNs.

**UNIT I OVERVIEW OF INTERNET OF THINGS** 6

IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices. -Refer Chapter 1,2 and 3 of Text 1.

**UNIT II ARCHITECTURE AND DESIGN PRINCIPLES FOR IOT** 6

Internet connectivity, Internet based communication, IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS,FTP, TELNET and ports.

**UNIT III PROTOTYPING AND DESIGNING SOFTWARE FOR IOT APPLICATIONS** 6

Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server. Introduction to IoT privacy and security. Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model. -Refer Chapter 9 and 10 of Text 1.

**UNIT IV OVERVIEW OF WIRELESS SENSOR NETWORKS** 6

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. -Refer Chapter 1,2, 3 of Text 2.

**UNIT V COMMUNICATION PROTOCOLS** 6

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wrreless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA, PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. Refer Chapter 4, 5, 7 and 11 of Text 2. Lt, L2, L3

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Implement an IoT conceptual framework and analyze M2M communication using CoAP-SMS and CoAP-MQ protocols, focusing on data enrichment and consolidation at the IoT/M2M gateway.
2. Design a prototype for Internet connectivity in IoT, exploring IPv4, IPv6, and 6LoWPAN protocol, alongside understanding application layer protocols like HTTP, HTTPS, and FTP.

3. Develop embedded device software using Arduino IDE, read data from sensors, and program MQTT clients and servers while addressing IoT privacy and security concerns through threat analysis and IoT Security Tomography.
4. Explore enabling technologies and architectures for wireless sensor networks (WSNs), understand single-node architecture components, and optimize energy consumption using operating systems and execution environments.
5. Analyze physical layer and transceiver design considerations for WSNs, implement MAC protocols like S-MAC and contention-based protocols like CSMA, and design energy-efficient routing protocols for hierarchical networks by clustering.

**COURSE OUTCOMES:**

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

CO1 Understand choice and application of IoT & M2M communication protocols.
CO2 Describe Cloud computing and design principles of IoT.
CO3 Relate to MQTT clients, MQTT server and its programming.
CO4 Describe the architectures and communication protocols of WSNs.
CO5 Identify the uplink and downlink communication protocols associated with specific application of IOT /WSNs.

**TEXTBOOKS:**

1. Raj Kamal, "Internet of Things-Architecture and Design Principles", McGraw Hill Education.
2 Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

**REFERENCES:**

1. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 007.
2. Kazem Sohraby, Daniel Minoli, &TaiebZnati, '' Wireless Sensor Networks- Technology, Protocols and Applications", John Wiley, 2007.
3. Anna Hac, 'Wireless Sensor Network Designs", John Wiley, 2003.

| Course Code | SECURE HARDWARE AND EMBEDDED DEVICES | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2603 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To Understand the Concepts of Computer and Network Security
2. To Study and Understand Encryption Techniques.
3. To Explore the different aspects of Embedded System Security.
4. To Understand the role of Security Aspects during Data Transfer and Communication.
5. To apply the Security Algorithms for Real-time Applications.

**UNIT I BACKGROUND AND INTRODUCTION** 6

Computer and Network Security Concepts: Computer Security Concepts - The OSI SecurityArchitecture - Security Attacks - Security Services - Security Mechanisms - Fundamentals ofSecurity Design Principles - Attack Surfaces and Attack Trees - A Model for Network Security.Introduction to Number Theory: Divisibility and the Division Algorithm - The Euclidean Algorithm -ModularArithmetic-PrimeNumbers-Fermat'sandEuler'sTheorems-TestingforPrimality-TheChineseRemainderTheorem-DiscreteLogarithms.

**UNIT II SYMMETRIC CIPHERS** 6

Classical Encryption Techniques: Symmetric Cipher Model-Substitution Techniques-Transposition Techniques. Block Ciphers and the Data Encryption Standard (DES): TraditionalBlock Cipher Structure - The Data Encryption Standard - A DES Example - Strength of DES.Advanced Encryption Standard: Finite Field Arithmetic - AES Structure - AES Transformation Functions-AES Key Expansion- An AESExample- AES Implementation.

**UNIT III EMBEDDED SYSTEMS SECURITY** 6

Embedded Security Trends-Security Policies-Security Threats. System Software Considerations: The Role of Operating System - Microkernel versus Monolithic - Core Embedded OS Security Requirements-Access Control and Capabilities-Hypervisors and System Virtualization- I/O Virtualization-Remote Management-Assuring Integrity of the TCB.

**UNIT IV EMBEDDED CRYPTOGRAPHY AND DATA PROTECTION PROTOCOLS** 6

The One-time Pad-Cryptographic Modes- BlockCiphers- Authenticated Encryption-PublicKey Cryptography-KeyAgreement-Public Key Authentication-Elliptic Curve Cryptography-Cryptographic Hashes - Message Authentication Codes - Random Number Generation – Key Management for Embedded Systems-Cryptographic Certifications. Data Protection Protocols for Embedded Systems: Data-in-Motion Protocols - Data-at-Rest Protocols. Emerging Applications: Embedded Network Transactions- Automotive Security-Secured Android.

**UNIT V PRACTICAL EMBEDDED SYSTEM SECURITY** 6

NetworkCommunicationsProtocolsandBuilt-inSecurity-SecurityProtocolsandAlgorithms-TheSecured Socket Layer - Embedded Security - Wireless - Application-Layer and Client/Server Protocols- Choosing and Optimizing Cryptographic Algorithms for Resource-Constrained Systems –Hardware-Based Security.

**TOTAL NUMBER OF PERIODS INCLUDING LAB**: 60

**SAMPLE LIST OF EXPERIMENTS**

1. Write a program, to Analyses OSI Security Architecture and its role in computer security.
2. Write a program to Implement classical encryption techniques such as substitution and transposition.

3. Write a program to implement the structure and strength of the Data Encryption Standard (DES).
4. Write a program to Explore the Advanced Encryption Standard (AES) and implement AES encryption.
5. Write a program to Investigate embedded security trends, policies, and threats.
6. Examine system software considerations for embedded systems, including access control and hypervisors.
7. Write a program to Implement cryptographic primitives such as the one-time pad and cryptographic modes.
8. Write a program to implement public key cryptography and its applications in embedded systems.
9. Write a program to Compare and contrast data protection protocols for embedded systems.
10. Write a program to implement a secure communication protocol for resource-constrained embedded systems.

**COURSE OUTCOMES:**

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

CO1 Understand the significance of Security.
CO2 Understand the major concepts and techniques related to Cryptography.
CO3 Demonstrate thorough knowledge about the aspects of Embedded System Security.
CO4 Delivers insight onto role of Security Aspects during Data Transfer and Communication.
CO5 Applying the Security Algorithms for Real-time Applications.

**TEXT CUM REFERENCE BOOKS:**


1. "Cryptography and Network Security Principles and Practice", 7th Edition - Global Edition, William Stallings, Pearson Education Limited, 2017.
2. "Embedded Systems Security - Practical Methods for Safe and Secure Software and Systems Development", David Kleidermacher and Mike Kleidermacher, Newnes (an imprint of Elsevier), 2012.
3. "Practical Embedded Security - Building Secure Resource-Constrained Systems", Timothy Stapko, Newnes (an imprint of Elsevier), 2008.

| Course Code | IOT PROCESSORS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2604 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. Learn the architecture and features of ARM.
2. Study the exception handling and interrupts in CORTEX M3
3. Program the CORTEX M3
4. Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
5. Understand the concepts of System – On – Chip (SoC)

**UNIT I OVERVIEW OF ARM AND CORTEX-M3** 6

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I –Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.

**UNIT II CORTEX EXCEPTION HANDLING AND INTERRUPTS** 6

Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

**UNIT III CORTEX M3/M4 PROGRAMMING** 6

Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS UsingAssembly, Excepiton Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.

**UNIT IV STM32L15XXX ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS** 6

STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assemblerm Compiler, Debugger, Simulator, In – Circuit Emulator (ICE), Logic Analyser.

**UNIT V INTRODUCTION TO SYSTEM – ON – CHIP** 6

System Architecture: An Overview, Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection –An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

ARM Assembly Programming

1. Write a program to add two 32-bit numbers stored in r0 and r1 registers and write the result to r2. The result is stored to a memory location. a) Run the program with breakpoint and verify the result b) Run the program with stepping and verify the content of registers at each stage.
2. Write ARM assembly to perform the function of division. Registers r1 and r2 contain the dividend and divisor, r3 contains the quotient, and r5 contains the remainder.

Embedded C Programming on ARM Cortex M3/M4 Microcontroller

1. Write a program to turn on green LED (Port B.6) and Blue LED (Port B.7) on STM32L-

Discovery by configuring GPIO.

2. Transmit a string "Programming with ARM Cortex" to PC by configuring the registers of USART2. Use polling method.

ARM Cortex M3/M4 Programming with CMSIS

1. Write a program to toggle the LEDs at the rate of 1 sec using standard peripheral library. Use Timer3 for Delay.

2. Transmit a string "Programming with ARM Cortex" to PC by using standard peripheral library with the help of USART3. Use polling method.

**COURSE OUTCOMES:**

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

CO1 Explain the architecture and features of ARM.
CO2 List the concepts of exception handling.
CO3 Write a program using ARM CORTEX M3/M4.
CO4 Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.
CO5 Design an SoC for any application.

**TEXT CUM REFERENCE BOOKS**

1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010.(Unit – I, II)

2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV)

3. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011.(Unit – V)

| Course Code | MOBILE APPLICATION DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2605 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES:**

1. To facilitate students to understand android SDK
2. To help students to gain basic understanding of Android application development
3. To understand how to work with various mobile application development frameworks
4. To inculcate working knowledge of Android Studio development tool
5. To learn the basic and important design concepts and issues of development of mobile applications

**UNIT I MOBILE PLATFORM AND APPLICATIONS** 6

Mobile Device Operating Systems — Special Constraints & Requirements — Commercial Mobile Operating Systems — Software Development Kit: iOS, Android, BlackBerry, Windows Phone —MCommerce — Structure — Pros & Cons — Mobile Payment System — Security Issues

**UNIT II INTRODUCTION TO ANDROID** 6

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

**UNIT III ANDROID APPLICATION DESIGN ESSENTIALS** 6

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

**UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA** 6

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

**UNIT V ANDROID APIs** 6

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed.
6. Create an application using Sensor Manager
7. Create an android application that converts the user input text to voice.
8. Develop a Mobile application for simple and day to day needs (Mini Project)

**COURSE OUTCOMES:**

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

CO1 Identify various concepts of mobile programming that make it unique from programming for other platforms.

CO2 Create, test and debug Android application by setting up Android development.

CO3 Demonstrate methods in storing, sharing and retrieving data in Android applications

CO4 Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces

CO5 Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

**TEXT CUM REFERENCE BOOKS:**


1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
2. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.
3. Prasanth Kumar Pattnaik, RajibMall,”Fundamentals of Mobile Computing”,PHI Learning Pvt.Ltd,New Delhi-2012
4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009
6. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O‟Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
7. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.
8. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming: The Big Nerd
9. Ranch Guide”, 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054

| Course Code | INDUSTRIAL IOT & HEALTHCARE SYSTEMS | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2606 | | 2 | 0 | 0 | 2 |

**COURSE OBJECTIVES:**

1. To teach key skills employed in the IIoT&IoRT space building applications.
2. To give knowledge on Design suitable network architecture and use appropriate learning algorithm.
3. To Comprehend IOT protocols
4. To implement digital Twin
5. To implement IOT systems for robotics

**UNIT I INTRODUCTION TO INDUSTRIAL IOT** 6

Technical requirements, IoT Background-History and definition, IoT enabling factors, IoT applications, IoT key technologies, I-IoT, IoT and I-IoT – similarities and differences, Industry environments and scenarios covered by I-IoT.

**UNIT II UNDERSTANDING THE INDUSTRIAL PROCESS AND DEVICES TECHNICAL REQUIREMENTS** 6

The industrial process-Automation in the industrial process, Control and measurement systems, Types of industrial processes.

**UNIT III INDUSTRIAL DATA FLOW AND DEVICES** 6

Technical requirements, The I-IoT data flow in the factory, Measurements and the actuator chain Sensors, The converters - Digital to analogical, Analog to digital, Actuators, Controllers - Microcontrollers, Embedded microcontrollers, Microcontrollers with external memory, DSP's. Industrial protocols -Automation networks, the fieldbus, Developing Industrial IoT and Architecture Introduction to the I-IoT platform and architectures, OSGi, micro service, containers, and server less computing, The standard IoT flow.

**UNIT IV INTRODUCTION TO IOT BASED HEALTH CARE** 6

Introduction to IoT applications in smart healthcare& their distinctive advantages - Patient Health Monitoring System (PHMS), Tele-Health, Tele-medicine, Tele-Monitoring, Mobile Health Things (m-health).

**UNIT V IOT SMART SENSING HEATH CARE AND POWER CHALLENGE** 6

Concept of Generic Biomedical sensors, Smart Sensors: Monitor health parameters, Wearable ECG sensors, IoT Data Acquisition System, Energy harvesting, Battery based systems, Power management.

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Analyze the technical requirements and key technologies of Industrial IoT (I-IoT), comparing its similarities and differences with traditional IoT, while exploring its applications and enabling factors.
2. Explore automation, control, and measurement systems in industrial processes, categorizing different types of industrial processes.
3. Investigate the industrial data flow in factories, focusing on sensors, converters, actuators, controllers, and industrial protocols, and introduce I-IoT platform architectures like OSGi and microservices.
4. Examine IoT applications in healthcare, including Patient Health Monitoring System (PHMS), Tele-Health, Tele-medicine, and Mobile Health Things (m-health), highlighting their advantages.
5. Implement smart sensing healthcare solutions using generic biomedical sensors, wearable ECG sensors, and IoT Data Acquisition Systems, while addressing power challenges through energy harvesting, battery-based systems, and power management techniques.

**COURSE OUTCOMES**:

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

CO1 Understand key skills employed in the IIoT&IoRT space building applications.

CO2 Design suitable network architecture and use appropriate learning algorithm.

CO3 Comprehend IOT protocols

CO4 Implement digital Twin
CO5 Implement IOT systems for robotics

**TEXT CUM REFERENCE BOOKS:**

1. “Industry 4.0: The Industrial Internet of Things”, Alasdair Gilchrist, Apress,2016
2. “Introduction to Industrial Internet of Things and Industry 4.0”, Sudip Misra, Chandana Roy, Anadarup Mukherjee, CRC Press,2021
3. “Hands on Industrial Internet of Things”, Giacomo Veneri, Antonio Capasso, Packt Press, 2018
4. “Emerging Technologies for Health and Medicine: Virtual Reality, Augmented Reality, Artificial Intelligence, Internet of Things, Robotics, Industry 4.0”, Dac- Nhuong Le Wiley, 2019
5. “Introduction to IoT”. S. Misra, A. Mukherjee, and A. Roy Cambridge University Press, 2017
6. “The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black”, Donald Norris, 2014..

| **Course Code** | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|

| CZPE 2607 | SMART CITIES | 3 | 0 | 0 | 3 |
|---|---|---|---|---|---|

**COURSE OBJECTIVES:**

1. To understand the concept of a smart city and associated challenges.
2. To understand the latest technologies used in intelligent building.
3. To understand the process of planning and drafting a plan for a smart city.
4. To understand the importance of different smart systems.
5. To understand technologies, infrastructure, and the concept of planning and the latest methodology.

**UNIT I INTRODUCTION TO SMART CITIES** 6

Introduction to city planning: Concept, Principle stakeholders, key trends in smart cities developments.

**UNIT II SMART CITIES PLANNING AND DEVELOPMENT** 6

Understanding smart cities, Dimension of smart cities, Global Standards and performance benchmarks, Practice codes, Smart city planning and development, Financing smart cities development, Governance of smart cities.

**UNIT III PROJECT MANAGEMENT IN SMART CITIES** 6

Phases, Stages of project and work break down Structure, Project organization structure, Planning, Scheduling and CPM, Project cost analysis, resource allocation & leveling, Line of balancing technique, Project monitoring and control, Project risk management.

**UNIT IV GREEN BUILDING IN SMART CITIES** 6

Introduction to green buildings, Rating system, Energy saving system

**UNIT V CASE STUDY** 6

Smart environment, smart streetlight and smart water & waste management, Smart Road & Traffic (Live & Connected roads), Smart Parking (Connected Parking)

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

Prepare a comprehensive project report by analysing the following aspects of a smart city.

1. Analyze key stakeholders and trends in smart city development.
2. Investigate global standards and benchmarks in smart city planning.
3. Implement project management phases and work breakdown structures for smart city projects.
4. Explore green building concepts and energy-saving systems in smart cities.
5. Conduct a case study on smart environment initiatives in urban areas.
6. Evaluate the implementation of smart streetlight and water/waste management systems.
7. Study live and connected road systems for smart traffic management.
8. Implement smart parking solutions using connected technologies.
9. Analyze the financing and governance structures of smart city projects.
10. Develop a comprehensive smart city plan integrating various aspects of planning, development, and management.

COURSE OUTCOMES:

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

CO1 Understand the concept of a smart city and associated challenges.
CO2 Understand the latest technologies used in intelligent building.
CO3 Understand the process of planning and drafting a plan for a smart city.
CO4 Understand the importance of different smart systems.
CO5 Understand technologies, infrastructure, and the concept of planning and the latest methodology.

**TEXTBOOKS:**

1. "Designing, Developing, and Facilitating Smart Cities Urban Design to IoT Solutions", Vangelis Angelakis Springer, 2019

2. “Introduction to IoT”, S. Misra, A. Mukherjee, and A. Roy, Cambridge University Press, 2018

**REFERENCES:**


1. Jo Beall (1997); “A city for all: valuing differences and working with diversity”; Zed books limited, London (ISBN: 1-85649-477-2)
2. UN-Habitat; “Inclusive and sustainable urban planning: a guide for municipalities”; Volume3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4)
3. Arup Mitra; “Insights into inclusive growth, employment and wellbeing in India”; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2)
4. William J. V. Neill (2004); “Urban Planning and cultural identity”; Routledge, London (ISBN:0- 415-19747-3)
5. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); “Remaking the city: Social science perspective on urban design”; State University of New York Press, Albany (ISBN:0-87395-678-8)
6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic;Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities.Vienna: Centre of Regional Science
7. "Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development

| Course Code | ADVANCED INTELLIGENT SYSTEM | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2608 | | 2 | 0 | 2 | 3 |

**COURSE OBJECTIVES**:

1. Introduce students to the concepts of machine learning and deep learning and their significance in developing intelligent systems.
2. Provide hands-on experience with Python programming for implementing machine learning algorithms such as linear regression, polynomial regression, clustering, and classification.
3. Explore emerging trends in hardware architectures for deep learning, including quantization, precision reduction, and hardware-software co-design.
4. Enable students to develop Python applications specifically for deep learning tasks, focusing on CNN and YOLO algorithms.
5. Engage students in case studies to apply their knowledge and skills in developing intelligent systems for various domains, including power systems, smart energy, motor control, and Industry 4.0 and Industry 5.0 applications.

**UNIT I INTELLIGENT SYSTEMS AND PYTHON PROGRAMMING** 6

Introduction to Machine Learning and Deep Learning - Performance Improvement with Machine Learning-Building Intelligent Systems-Introduction to Python-Python Programming

**UNIT II PYTHON FOR ML** 6

Python Application of Linear Regression and Polynomial Regression using SciPy - Interpolation,Overfitting and Underfitting concepts & examples using SciPy-Clustering and Classification using Python.

**UNIT III EMERGING TRENDS IN HARDWARE ARCHITECTURES FOR DEEP LEARNING** 6

Quantization and Precision Reduction Techniques-Hardware aware neural Architecture. Hardware-software co-design for deep learning systems Memory hierarchy and cache optimization for deep learning Parallelization and distributed training of deep learning models Energy-efficient deep learning hardware architectures Hardware acceleration for specific deep learning applications (e.g.,natural language processing, computer vision)

**UNIT IV PYTHON FOR DL** 6

Python Applications for DL-Python for CNN and YOLO

**UNIT V CASE STUDIES** 6

Development of Intelligent System for Power system protection - Smart Energy - IOE-Motorcontrol-BMS-Intelligent systems for Industry4.0 and Industry5.0

**TOTAL NUMBER OF PERIODS INCLUDING LAB:** 60

**SAMPLE LIST OF EXPERIMENTS**

1. Implement linear regression and polynomial regression in Python using SciPy, analyze concepts like interpolation, overfitting, and underfitting, then explore clustering and classification algorithms.
2. Investigate quantization and precision reduction techniques in hardware architectures for deep learning, focusing on hardware-software co-design and memory hierarchy optimization.
3. Develop Python applications for deep learning, specifically for Convolutional Neural Networks (CNN) and You Only Look Once (YOLO) algorithms.
4. Create intelligent systems for various applications such as power system protection, smart energy management, motor control, and building management systems (BMS), exploring Industry 4.0 and Industry 5.0 scenarios.

**COURSE OUTCOMES:**

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

CO1 Able to gain proficiency in the Python programming language and learn how to apply it in the context of intelligent system

CO2 Able to learn Python libraries such as NumPy, Pandas, and scikit-learn to

preprocess data,build and train Machine Learning models,and evaluate their performance

CO3 Able to learn Deep Learning libraries such as TensorFlow or PyTorch to build, train, and evaluate Deep Learning models for tasks such as image classification, natural language processing, and computer vision.

CO4 Able to learn hardware components, such as processors, memory, and accelerators, and how they are integrated.

CO5 Able to learn intelligent systems implementations, examine their design choices, evaluate their performance, and understand the challenges.

**TEXT CUM REFERENCE BOOKS:**


1. "Intelligent Systems: Principles,Paradigms,and Pragmatics"by Rajendra P.Srivastava(Publishedin2013)
2. "Intelligent Systems: A Modern Approach"by Thomas Bäck,David B.Fogel,and Zbigniew Michalewicz(Publishedin2000)
3. "Intelligent Systems: Modeling,Optimization,and Control"by Grzegorz Bocewicz and Konrad Jackowski(Publishedin2016)
4. "Intelligent Systems: Architecture, Design,and Control" by Janos Sztipanovits and GaborKarsai(Publishedin2018)
5. "Intelligent Systems: Concepts and Applications" by Veera M.Boddu(Published in 2017)

**Vertical 7: HIGH END COMPUTING**

| Course Code | PARALLEL PROCESSING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2701 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To study the scalability and clustering issues and the technology necessary for them.
2. To understand the technologies enabling parallel computing.
3. To study the different types of interconnection networks.
4. To study the different parallel programming models.
5. To study the software support needed for shared memory programming

**UNITI I INTRODUCTION** 9

Introduction, Parallel Processing–Shared Memory Multiprocessing–Distributed Shared Memory – Message Passing Parallel Computers.

**UNIT II PROCESSES & SHARED MEMORY PROGRAMMING** 9

Processes - Shared Memory Programming – General Model Of Shared Memory Programming – Forking-Creating Processes – Joining Processes - Process Model Under UNIX.

**UNIT III BASIC PARALLEL PROGRAMMING TECHNIQUES:** 9

Loop Splitting–Ideal Speedup–Spin-Locks, Contention and Self-Scheduling. Scheduling : Loop Scheduling–Variations On Loop Scheduling–Self-Scheduling–Variations On Self-Scheduling – Indirect Scheduling – Block Scheduling.

**UNIT IV THREAD-BASED IMPLEMENTATION** 9

Thread Management – The POSIX Thread Application Programmer Interface- Synchronization Primitives in POSIX-Example with Threads–Attributes of Threads– Mutual Exclusion with Threads – Mutex Usage of Threads – Thread Implementation – Events and Condition Variables–Deviation Computation with Threads –Java Threads.

**UNIT V ALGORITHMS FOR PARALLEL MACHINES** 9

Models Of Computation–Analysis Of Parallel Algorithms–Prefix Computation–Histogram Computation – Parallel Reduction – Sorting Networks - Matrix Multiplication

**TOTAL PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 Understand the basics concepts of Parallel Processing.
CO2 Apply the concepts of processes and shared memory programming.
CO3 Use basic parallel programming techniques.
CO4 Implementations of thread based methods.
CO5 Understand parallel algorithms for tightly coupled and loosely coupled parallel systems for various applications

**TEXT BOOKS:**


1 Introduction To Parallel Programming-By Steven Brawer.
2 Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, By Pearson Publication.
3 Introduction To Parallel Processing–By M. Sasikumar, Dinesh Shikhare And P.Ravi Prakash.
4 M.Sasikumar, D.Shikhare and P. RaviPrakash, "Introduction to Parallel processing".PHI2006

**REFERENCES:**


1 Hwang. K, "Advanced computer Architecture", Parallelism, Scalability, Programmability, Tata McGrawHill, 3rdEdition, 1993.

2 TanenbaumA.S, "Distributed Operating Systems", Pearson Education Asia, 2002.

3 DezsoSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architectures", Pearson Education,2007.

4 V.Rajaraman and C.Siva Ram Murthy," Parallel Computers Architecture and Programming", PHI,2000.

5 Quinn, M.J., "Designing Efficient Algorithms for Parallel Computers", McGraw–Hill, 2003.

6 Culler,D.E., "Parallel Computer Architecture, A Hardware – Software approach", Morgan Kaufmann Publisher, 1998.

| Course Code | HIGH-PERFORMANCE COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2702 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To Study various computing technology architectures.
2. To know Emerging trends in computing technology.
3. To highlight the advantage of deploying computing technology

**UNIT I CLUSTER COMPUTING AND ITS ARCHITECTURE:** 9

Ease of Computing, Scalable Parallel Computer Architecture, Towards Low Cost Parallel Computing & Motivation, Windows opportunity, A Cluster Computer and Its Architecture, Cluster Classification, Commodity Components for Clusters Network
Services/Communication SW, Cluster Middleware and Single Systems Image, Resource management & Scheduling (RMS).

**UNIT II CLUSTER SETUP AND ADMINISTRATION:** 9

Introduction, Setting up the cluster, Security, System Monitoring, and System Tuning. Introduction to Grid and its Evolution:, Introduction to Grid and its Evolution, Beginning of the Grid, Building blocks of Grid, Grid Application and Grid Middleware, Evolution of
The Grid: First, Second & Third Generation.

**UNIT III CLOUD DEFINITION AND MANAGEMENT:** **9**

Introduction to Cloud Computing, Defining Clouds, Cloud Providers, Consuming Cloud Services, Cloud Models, Iaas, Paas, SaaS, Inside the cloud, Administering cloud services, technical interface, and Cloud resources.

**UNIT IV NATURE OF CLOUD** **9**

Tradition Data Center, Cost of Cloud Data Center, Scaling computer systems, Cloud workload, Managing data on clouds, Public, private, and hybrid clouds

**UNIT V CLOUD ELEMENTS** 9

Infrastructure as a service, Platform as a service, Software as a service.

**TOTAL PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 On successful completion of the course, the student will be having the basic knowledge of computingtechnology.
CO2 Student will be able to understand architecture of computing technology.
CO3 Student will be able to know cloud computing service models.
CO4 Know about emerging trends in computing technology
CO5 Student will be able to know big data and had oop architecture.

**TEXT CUM REFERENCE BOOKS:**


1 Ronald Krutz, Cloud Security, WileyIndia.
2 Cloud Computing, A Practical Approach, Anthony Velte, To by Velte, Robert Elsenpeter, McGrawHill.

| Course Code | PERVASIVE COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2703 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To understand the characteristics and principles of Pervasive computing and the solutions that are in use
2. To realize the role of wireless protocols in shaping the future Internet
3. To design and implement pervasive applications
4. To give an introduction to the enabling technologies of pervasive computing

**UNIT I INTRODUCTION** 9

Pervasive Computing- Principles, Characteristics- interaction transparency, context aware, automated experience capture. Architecture for pervasive computing-Pervasive devices-Embedded controls.-smart sensors and actuators-Context communication and access services.

**UNIT II PROTOCOLS** 9

Open protocols- Service discovery technologies- SDP, Jini, SLP, UpnP protocols–data synchronization- SyncML framework - Context aware mobile services - Context aware sensor networks, addressing and communications- Context aware security.

**UNIT III TECHNOLOGIES** 9

Past, Present and Future-Device Technology-Device Connectivity-Web application Concepts-WAP and Beyond-Voice Technologies-Personal Digital Assistants.

**UNIT IV ARCHITECTURE** 9

Serverside programming in Java-Pervasive Webapplication Architecture-Example Application-Access via PCs-Access via WAP-Access via PDA and Voice.

**UNIT V EXAMPLES** 9

Smart Tokens, Heating Ventilation and Air Conditioning, Set Top Boxes, Appliances and Home Networking, Residential Gateway, Automotive Computing, On Board Computing Systems, In Vehicle networks, Entertainment Systems

**TOTAL PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 Outline the basic problems, performance requirements of pervasive computing applications, and the trends of pervasive computing and its impacts on future computing applications and society

CO2 Analyze and compare the performance of different data dissemination techniques and algorithms for mobile real-time applications

CO3 Analyze the performance of different sensor data management and routing algorithms For sensor networks

CO4 Develop an attitude to propose solutions with comparisons for problems related to pervasive computing system through investigation

**REFERENCES:**


1 SengLoke, Context-Aware Computing Pervasive Systems, Auerbach Pub., NewYork, 2007.

2 Uwe Hansmannetl, Pervasive Computing, Springer ,NewYork, 2001.

**3** Jochen Burkhardt, Stefan Hepper, Klaus Rindtorff, Thomas Schaeck" Pervasive
Computing-Technology and Architecture of Mobile Internet Application", Pearson
Education, sixth Edition 2009.

| Course Code | PICO COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2704 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. Understanding PICO Computing Principles
2. Exploring PICO Architecture
3. Mastering PICO Programming Skills
4. Examining PICO Operating Systems
5. Investigating Advanced Topics in PICO Computing

**UNIT 1: INTRODUCTION TO PICO COMPUTING:** 9

Overview of PICO Computing – Definition and characteristics, Distinction from traditional computing. Historical perspective and evolution – Milestones in PICO Computing development, Key contributors and innovations. Importance and applications in modern computing – Use cases and real-world examples, Advantages and limitations of PICO Computing. Characteristics of PICO Computing systems – Scalability and flexibility, Energy efficiency and power consumption, Reliability and fault tolerance.

**UNIT II PICO ARCHITECTURE** 9

Basic principles of PICO architecture – Instruction set architecture (ISA), Data and control flow in PICO systems. Components and building blocks – Processors, memory, and interconnects, Custom hardware accelerators. PICO processors and memory – Types of PICO processors (e.g., PICO CPUs, GPUs), Memory hierarchy and organization. Parallelism and concurrency in PICO Computing – Parallel processing models, Synchronization and communication mechanisms, Task parallelism vs. data parallelism

**UNIT III PROGRAMMING FOR PICO COMPUTING** 9

PICO programming languages – High-level languages for PICO systems, Low-level languages and assembly for PICO architectures. PICO-specific programming paradigms – Data parallel programming, Task-based programming models. Code optimization techniques for PICO systems – Compiler optimizations, Manual optimization strategies. Case studies and examples – Practical applications of PICO programming, Challenges and solutions in PICO software development.

**UNIT IV PICO OPERATING SYSTEMS** 9

Role of operating systems in PICO Computing – Resource management and abstraction, PICO OS vs. traditional OS. PICO OS design principles – Minimalist kernel design, Security considerations in PICO OS. Kernel architecture for PICO systems – System calls and kernel services, Device drivers for PICO peripherals. Resource management and scheduling in PICO OS - Memory allocation and deallocation, Scheduling algorithms for PICO processors.

**UNIT V ADVANCED TOPICS IN PICO COMPUTING** 9

Emerging trends in PICO Computing - Edge computing and PICO devices, Quantum-inspired PICO architectures. Quantum aspects of PICO systems – Quantum computing principles in PICO, Quantum algorithms and their implications. PICO Computing in specific domains – Healthcare applications, financial modeling and PICO, AI and machine learning on PICO systems. Ethical considerations and challenges in PICO Computing – Privacy concerns in PICO applications, social implications of PICO technology.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES**:

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

CO1 Demonstration of Comprehensive PICO Computing Knowledge
CO2 Application of PICO Architecture Concepts
CO3 Proficient PICO Programming Skills Development
CO4 Design and Analysis of PICO Operating Systems
CO5 Critical Evaluation of Advanced PICO Computing Concepts

**TEXTBOOKS:**


1. “Parallel Computer Architecture: A Hardware/Software Approach” by David Culler, Jaswinder Pal Singh, and Anoop Gupta
2. "Quantum Computing: A Gentle Introduction" by Eleanor G. Rieffel and Wolfgang H. Polak - Although focused on quantum computing.
3. "Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy.
4. “Programming Massively Parallel Processors: A Hands-on Approach" by David B. Kirk and Wen-mei W. Hwu -
5. “Operating System Concepts" by Abraham Silberschatz, Greg Gagne, and Peter B.
6. “Edge Computing: Models, Technologies, and Applications" by Danda B. Rawat, Joel J.P.C. Rodrigues, and Ivan Stojmenovic.

| Course Code | NANO COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2705 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To understand the fundamental principles of Dielectrics and Electronic Structures.
2. To know the construction and working of Logic Devices.
3. To know the construction and working of mass storage devices.
4. To study sensor arrays and Imaging systems
5. To know about various types of Display.

**UNIT I INTRODUCTION** 9

Dielectrics – Ferroelectrics - Electronic Properties and Quantum Effects – Magneto electronics – Magnetism and Magneto transport in Layered Structures - Organic Molecules –Electronic Structures, Properties, and Reactions -Neurons–The Molecular Basis of their Electrical Excitability - Circuit and System Design.

**UNIT II LOGIC DEVICES** 9

Silicon MOSFETs–Novel Materials and Alternative–Concepts-Ferro electric Field Effect Transistors- Quantum Transport devices Based on Resonant Tunnelling - Single-Electron Devices for Logic Applications-Super conductor Digital Electronics-Quantum Computing Using Super conductors - Carbon Nano tubes for Data Processing - High-Permittivity Materials for DRAMs - Ferroelectric Random Access Memories Magneto resistive RAM.

**UNIT III MASS STORAGE DEVICES** 9

Hard Disk Drives-Magneto-Optical Discs-Rewriteable DVDs Based on Phase Change Materials - Holographic Data Storage - AFM-Based Mass Storage – The Millipede Concept - Transmission on Chip and Board Level - Photonic Networks - Microwave Communication Systems–Novel Approaches for Passive Devices–Neuro electronic Interfacing: Semiconductor Chips with Ion Channels, Nerve Cells and Brain.

**UNIT IV SENSOR ARRAYS AND IMAGING SYSTEMS** 9

Optical3-DTime-of-Flight Imaging System–Pyroelectric Detector Arrays for IR Imaging - Electronic Noses. 2-D Tactile Sensors and Tactile Sensor Arrays.

**UNIT V DISPLAYS** 9

Liquid Crystal Displays-Organic Light Emitting Devices-Field-Emission and Plasma Displays - Electronic Paper.

**TOTAL PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 To design the basic components in Nano Computing.
CO2 To construct the Logic Devices
CO3 To design the storage devices
CO4 To analyze different types of imaging systems.
CO5 To analyze the principles of Various Displays LCD, LED and Plasma Displays.

**REFERENCES:**


1 Rainer Waser, Nano electronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley VCH, April 2003.
2 Nano computing: Computational Physics for Nano science and Nanotechnology, Jang-YuHsu, CRCPress, 2009.

**3** Nano computing: The Future of Computing, Vishal Sahni Tata McGraw Hill, 2008.
**4** Nano, Quantum and Molecular Computing: Implications to High level design and Validation
**5** ,Shukla, SandeepKumar, 2004, Springer
**6** Bio Inspired Nano scale Integrated computing, Mary mehrnoo she shaghian – wilner, 2009, Johnwiley publications.
**7** N.K.Jha and D. Chen, Editors, Nano electronic Circuit Design, Springer, 2011.

| Course Code | FOG AND EDGE COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2706 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To enhance real-time data processing and analytics at the networkedge.
2. To optimize resource utilization and reduce latency in fog computing environments.
3. To improves calability and flexibility for edge devices and applications.
4. To Enhance security and privacy for data processing at the edge.
5. To Facilitate seamless integration of fog and edge computing with cloud services.

**UNIT1: INTRODUCTION TO FOG AND EDGE COMPUTING** 9

Definition and Fundamentals: Overview of Fog and Edge Computing, Key concepts and characteristics, Motivations and Advantages: Reasons for adopting Fog and Edge Computing, Comparative advantages over traditional Cloud Computing, Use Cases and Applications: Challenges and Limitations: Security concerns, privacy issues, and
compliance, Comparison with Cloud Computing: Contrasting characteristics and use cases, Complementary roles in a hybrid computing environment

**UNIT II: ARCHITECTURES AND COMPONENTS** 9

Edge Computing Architecture Models: Design principles and characteristics, Hierarchicalvs. Flat architectures. Fog Nodes and Infrastructure: Role and capabilities of Fog nodes, Infrastructure components supporting Edge Computing. Edge Device Types and Capabilities: Categorization of Edge devices (e.g., gateways, sensors, actuators), Capabilities and limitations of different device types. Edge-to-Cloud Communication Models; Middle ware and Software Frameworks: Middle ware solutions for Edge Computing.

**UNIT III: SECURITY AND PRIVACY IN EDGE COMPUTING** 9

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.

**UNIT IV :EDGE APPLICATION DEVELOPMENT** 9

Programming Models and Frameworks: Overview of programming models for Edge Computing, Exploration of popular frameworks for Edge application development, Integration with IoT Devices:
Techniques for integrating Edge Computing with Internet of Things (IoT) devices. Edge Application Deployment Strategies; Edge-to-Cloud Communication Patterns; Optimizing Edge Application Performance: Performance considerations in Edge Computing, Strategies for optimizing resource usage and responsiveness.

**UNIT V: PERFORMANCE OPTIMIZATION AND FUTURE TRENDS** 9

Performance Metrics and Optimization: Metrics for evaluating performance in Edge Computing Strategies for optimizing Edge applications; Energy-Efficient Edge Architectures:
Techniques for optimizing energy consumption, Green computing practices in Edge

environments, Real-time Processing and Analytics: Approaches for real-time data processing at the Edge, Analytics capabilities in decentralized architectures. Scalability and Flexibility in Edge Architectures; Emerging Trends in Fog and Edge Computing.

**NUMBER OF THEORY PERIODS:** 45

**SAMPLE LIST OF EXPERIMENTS**

1. Design and deploy a fog computing architecture for a smart city application.
2. Optimize data processing algorithms for edge devices in a real-time monitoring system.
3. Evaluate resource utilization in a fog computing environment using simulation tools.
4. Implement security protocols for edge devices to protect sensitive data.
5. Develop a scalable edge computing solution for IoT devices in a manufacturing setting.
6. Integrate fog computing with cloud services to enhance overall system efficiency.
7. Perform a hands-on deployment of edge computing nodes in a network infrastructure.
8. Design and implement a fault-tolerant edge computing solution for critical applications.
9. Conduct performance testing to assess the latency reduction achieved through edge computing.
10. Create a comprehensive case study on the successful integration of fog and edge Computing in a specific industry.

**COURSE OUTCOMES:**

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

CO1 Proficiently deploy and manage fog and edge computing solutions indiverse environments.

CO2 Demonstrate expertise in optimizing data processing and analytics at the network edge.

CO3 Evaluate and enhance resource efficiency for fog computing deployments.

CO4 Implement robust security measures for safeguarding edge computing data.

CO5 Successfully integrate fog and edge computing technologies to address real-world challenges.

**REFERENCES:**


1. "Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyy a and Amir Vahid Dastjerdi (Wiley, 1st Edition, 2018),
2. "Edge Computing: A Primer" by Shiwen Mao and Ying-Chang Liang (Wiley, 1st Edition, 2019),
3. "Fog Computing in the Internet of Things: Intelligence at the Edge" by Yogesh Simmhan, Nalini Venkata subramanian, and Viktor K. Prasanna (Springer, 1st Edition, 2018),
4. "Fog Computing: Concepts, Frameworks and Technologies" by Flavio Bonomi, Rodolfo Milito,
5. JiangZhu, and Sateesh Addepalli (Springer, 1st Edition, 2018),
6. "Edge Computing – The Dawn of Industry 4.0 Revolution" by Satya Prakash Ghrera (CRC Press, 1st Edition, 2020)
7. 6. "Fog Computing: Towards Minimizing Latency and Improving QoE in the Internet of Things" by Mohammad Mehedi Hassan, Saad B. Qaisar, and Abdelgadir Mohammed Ahmed (Springer, 1st Edition, 2018).

| Course Code | AI AND CLOUD COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2707 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. Understand the fundamentals of basic AI approaches.
2. Learn techniques to identify problem-solving agents
3. To understand the concept of cloud computing.
4. To appreciate the evolution of the cloud from the existing technologies.
5. To have knowledge on the various issues in cloud computing.

**UNIT I INTELLIGENT AGENTS** 9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies. Constraint satisfaction problems.

**UNIT II PROBLEM SOLVING & LOGICAL REASONING** 9

Heuristic search strategies – heuristic functions. Knowledge-based agents – propositional logic– propositional theorem proving–agents based on proposition allogic. First-order logic – syntax and semantics –inferences in first-order logic – forward chaining – backward chaining–resolution.

**UNIT III CLOUD COMPUTING INTRODUCTION** 9

Introduction to Cloud Computing– Definition of Cloud–Evolution of Cloud Computing–
Underlying Principles of Parallel and Distributed Computing–Cloud Characteristics– Elasticity in Cloud – On-demand Provisioning.

**UNIT IV CLOUD ENABLING TECHNOLOGIES** 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization–Virtualization Structures–Tools and Mechanisms–Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

**UNIT V CLOUD ARCHITECTURE, SERVICES AND STORAGE** 9

Layered Cloud Architecture Design–NIST Cloud Computing Reference Architecture– Public, Private and Hybrid Clouds-laaS–PaaS–SaaS–Architectural Design Challenges– Cloud Storage–Storage-as-a-Service–Advantages of Cloud Storage–Cloud Storage Providers–S3.

**NUMBER OF THEORY PERIODS:** 45

**COURSE OUTCOMES**:

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

CO1 :Learn the intelligent agent frameworks
CO2 Apply problem solving techniques and CSP techniques

CO3 Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO4 Learn the key and enabling technologies that help in the development of cloud.

CO5 Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

**TEXT BOOKS:**


1. Stuart Russell and Peter Norvig, "Artificial Intelligence– AModern Approach", Fourth Edition, Pearson Education, 2021.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome,—Cloud Computing: Implementation, Management and Security||, CRC Press,2017.


**REFERENCES:**


1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education,2013.
5. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, —Mastering Cloud Computing||, Tata Mcgraw Hill, 2013.
6. To by Velte, Anthony Velte, Robert Elsenpeter," Cloud Computing –A Practical Approach||, Tata Mcgraw Hill, 2009.
7. GeorgeReese,"Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)||, O'Reilly, 2009.
8. http://nptel.ac.in/

| Course Code | QUANTUM COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| CZPE 2708 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To introduce the building blocks of Quantum computers and highlight the paradigm change between conventional computing and quantum computing
2. To understand the Quantum state transformations and the algorithms
3. To understand entangled quantum sub systems and properties of entangled states
4. To explore the applications of quantum computing

**UNIT I QUANTUM BUILDING BLOCKS** **9**

The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere

**UNIT II QUANTUMS TATETRANS FORMATIONS** 9

Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations.

**UNIT III QUANTUM ALGORITHMS** 9

Computing with Super positions, Quantum Subroutines, Quantum Fourier Transformations, Shor's Algorithm and Generalizations, Grover's Algorithm and Generalizations

**UNIT IV ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION** 9

Quantum Subsystems, Properties of Entangled States, Quantum Error Correction, Graph States and codes, CSS Codes, Stabilizer Codes, Fault Tolerance and Robust Quantum Computing

**UNIT V QUANTUM INFORMATION PROCESSING** 9

Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems,Bellstates.Quantumteleportation.QuantumCryptography,nocloningtheorem

**TOTAL PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 Understand the basic principles of quantum computing.

CO2 Gain knowledge of the fundamental differences between conventional computing and quantum computing.

CO3 Understand several basic quantum computing algorithms.

CO4 Understand the classes of problems that can be expected to be solved well by quantum computers.

Simulate and analyze the characteristics of Quantum Computing Systems.

**TEXT BOOKS:**


1 ParagK Lala, Mc Graw Hill Education, Quantum Computing, A Beginners Introduction, First edition(1November2020).

2 Michael A. Nielsen, Issac L. Chuang, Quantum Computation and Quantum Information, Tenth Edition, Cambridge University Press,2010.

3 Chris Bernhardt, The MIT Press; Reprint edition(8 September 2020), Quantum Computing for Everyone.

**REFERENCES:**


1 John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
2 William(Chuck)Easttom, Quantum Computing Fundamentals, 2021
3 ParagLala, Quantum Computing, 2019
4 Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011
5 Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press. 2002
6 Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I:Basic Concepts, VolII: Basic Tools and Special Topics, World Scientific. 2004
7 Pittenger A.O., An Introduction to Quantum Computing Algorithms 2000

## APPENDIX B: OPEN ELECTIVES

**Open Elective– I:**

| Course Code | INTRODUCTION TO R PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| OE2001 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. Develop proficiency in programming using the R language.
2. Acquire skills for data manipulation, visualization, and statistical analysis.
3. Understand advanced programming concepts and techniques in R.
4. Apply R programming skills to solve real-world data science problems.
5. Foster critical thinking and problem-solving abilities through hands-on projects and assignments.

**UNIT I INTRODUCTION TO R** 9

Introduction To The R Language, Understand R syntax, data types, and data structures., Learn how to install and set up R and RStudio. Explore basic operations and functions in R.

**UNIT II DATA MANIPULATION AND VISUALIZATION** 9

Teach students how to manipulate and visualize data using R., Use the dplyr and tidyr packages for data manipulation., Create basic and advanced plots using ggplot2.
Understand principles of effective data visualization.

**UNIT III STATISTICAL ANALYSIS WITH R** 9

Enable students to perform statistical analysis and hypothesis testing in R. - Conduct descriptive statistics and exploratory data analysis, Perform inferential statistics and hypothesis tests., Implement linear regression and other statistical models.

**UNIT IV ADVANCED R PROGRAMMING TECHNIQUES** 9

Introduce students to advanced programming techniques in R., Learn how to write custom functions and control structures., Understand object-oriented programming in R.
Explore techniques for debugging and error handling.

**UNIT V DATA SCIENCE APPLICATIONS WITH R** 9

Apply R programming skills to solve real-world data science problems. Work on data analysis projects using publicly available datasets. Apply machine learning algorithms for predictive modeling. Learn best practices for reproducible research and project management in R.

**NUMBER OF THEORY PERIODS: 45**

**COURSE OUTCOMES**:

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

CO1 Demonstrate proficiency in writing R code for data manipulation, visualization, and statistical analysis.

CO2 Apply statistical techniques and hypothesis testing methods to analyze data and draw conclusions.

CO3 Implement advanced programming concepts such as custom function writing and object-oriented programming in R.

CO4 Successfully complete R analysis projects, including data cleaning, exploration, modeling, and visualization.

CO5 Develop critical thinking and problem-solving skills by tackling real-world data science challenges and effectively communicating results.

**TEXTBOOKS:**

1. Roger D. Pengm, "R Programming for Data Science", O'Reilly Media, 2016.

**REFERENCES:**

1. "The Art of R Programming: A Tour of Statistical Software Design" by Norman Matloff
2. "R Cookbook: Proven Recipes for Data Analysis, Statistics, and Graphics" by Winston Chang
3. "Advanced R" by Hadley Wickham
4. "Introductory Statistics with R" by Peter Dalgaard
5. "Hands-On Programming with R" by Garrett Grolemund

| Course Code | USER INTERFACE DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| OE2002 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. To understand the characteristics and principles of human-computer interaction (HCI), including graphical user interfaces and web interfaces.
2. To explore the user interface design process, focusing on usability and incorporating human characteristics into design considerations.
3. To examine the components and characteristics of windows in graphical user interfaces, including presentation styles, types, and management.
4. To learn about multimedia elements in user interfaces, such as text, images, icons, and multimedia content, and their effective utilization.
5. To gain knowledge of window layout design, including the creation of prototypes, testing methods, information search techniques, and visualization in HCI.

**UNIT I INTRODUCTION** 9

Human–Computer Interface – Characteristics Of Graphics Interface –Direct Manipulation Graphical System – Web User Interface –Popularity –Characteristic & Principles.

**UNIT II HUMAN COMPUTER INTERACTION** 9

User Interface Design Process – Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed –Business Functions –Requirement Analysis – Direct – Indirect Methods – Basic Business Functions – Design Standards – System Timings – Human Consideration In Screen Design – Structures Of Menus – Functions Of Menus– Contents Of Menu– Formatting – Phrasing The Menu – Selecting Menu Choice– Navigating Menus– Graphical Menus.

**UNIT III WINDOWS** 9

Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– Device– Based Controls Characteristics– Screen – Based Controls – Operate Control – Text Boxes– Selection Control– Combination Control– Custom Control– Presentation Control.

**UNIT IV MULTIMEDIA** 9

Text For Web Pages – Effective Feedback– Guidance & Assistance– Internationalization– Accessibility– Icons– Image– Multimedia – Colouring.

**UNIT V WINDOWS LAYOUT** 9

Prototypes – Kinds Of Tests – Retest – Information Search – Visualization – Hypermedia – WWW– Software Tools.

**NUMBER OF THEORY PERIODS**:

45

**COURSE OUTCOMES:**

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

CO1 Students will be able to analyze and apply the characteristics and principles of HCI to design effective graphical and web interfaces.

CO2 Students will demonstrate proficiency in the user interface design process, including requirement analysis, design standards, and consideration of human factors.

CO3 Students will be able to identify and utilize various components of windows in graphical user interfaces, adapting presentation styles and controls based on user needs.

CO4 Students will develop skills in incorporating multimedia elements, such as text, images, and multimedia content, into user interfaces to enhance user experience.

CO5 Students will be able to design effective window layouts, including creating prototypes, conducting tests, and utilizing visualization techniques to improve HCI outcomes.

**TEXTBOOKS:**

1. Wilbent. O. Galitz ,"The Essential Guide To User Interface Design", John Wiley & Sons, 2001.
2. Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.

**REFERENCES:**

1. Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd., 2002.

| Course Code | INTERNET MARKETING AND E-COMMERCE | L | T | P | C |
|---|---|---|---|---|---|
| OE2003 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To comprehend the historical development of e-commerce and its significance in the Indian business context.
2. To explore the various aspects of e-marketing and its integration with traditional marketing principles.
3. To examine the critical aspects of e-security and legal issues surrounding e-commerce.
4. To comprehend the different types of digital payment systems and their functionalities.
5. To understand the concepts and technologies underlying mobile commerce and human resource portals.

**UNIT I INTRODUCTION** 9

History of E-commerce and Indian Business Context: E-Commerce –Emergence of the Internet – Emergence of the WWW – Advantages of E-Commerce – Transition to E-Commerce in India – The Internet and India – E-transition Challenges for Indian Corporate. Business Models for E-commerce: Business Model – E-business Models Based on the Relationship of Transaction Parties - E-business Models Based on the Relationship of Transaction Types.

**UNIT II WWW AND E-MARKETING** 9

Enabling Technologies of the World Wide Web: World Wide Web – Internet Client-Server Applications –Networks and Internets – Software Agents – Internet Standards and Specifications – ISP. e-Marketing: Traditional Marketing – Identifying Web Presence Goals – Online Marketing – E-advertising – E-branding.

**UNIT III E-SECURITY** 9

E-Security: Information system Security – Security on the Internet – E-business Risk Management Issues – Information Security Environment in India. Legal and Ethical Issues : Cyberstalking – Privacy is at Risk in the Internet Age – Phishing – Application Fraud – Skimming – Copyright – Internet Gambling – Threats to Children.

**UNIT IV DIGITAL PAYMENTS** 9

e-Payment Systems: Main Concerns in Internet Banking – Digital Payment Requirements – Digital Token-based e-payment Systems – Classification of New Payment Systems – Properties of Electronic Cash – Cheque Payment Systems on the Internet – Risk and e-Payment Systems – Designing e-payment Systems – Digital Signature – Online Financial Services in India - Online Stock Trading.

**UNIT V MOBILE COMMERCE** 9

Information systems for Mobile Commerce: What is Mobile Commerce? – Wireless Applications –Cellular Network – Wireless Spectrum – Technologies for Mobile Commerce – Wireless Technologies –Different Generations in Wireless Communication – Security Issues Pertaining to Cellular Technology. Portals for E-Business: Portals – Human Resource Management – Various HRIS Modules.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 To trace the emergence of the Internet, the World Wide Web, and analyze the advantages of e-commerce.

CO2 To understand web presence goals, online marketing techniques, e-advertising, and e-branding strategies.

CO3 To learn about information system security, e-business risk management, and legal and ethical concerns such as cyberstalking, privacy infringement, phishing, and copyright issues.

CO4 To classify and evaluate digital payment systems, understand the properties of electronic cash, assess the risks associated with e-payment systems, and analyze the design considerations for implementing secure e-payment systems.

CO5 To gain knowledge about mobile commerce, wireless technologies, cellular networks, and security issues related to cellular technology

**TEXTBOOKS:**

1. P.T. Joseph, S.J., "E-Commerce - An Indian Perspective", PHI 2012, 4th Edition.

**REFERENCES:**

1. David Whiteley , "E-Commerce Strategy, Technologies and Applications", Tata McGraw Hill, 2001.
2. 2. Ravi Kalakota, Andrew B Whinston, "Frontiers of Electronic Commerce", Pearson 2006, 12th Impression.

**WEB REFERENCES**:

1. https://www.docsity.com/en/e-commerce-notes-pdf-lecture-notes-universitylevel/2484734/
2. https://magnetoitsolutions.com/blog/advantages-and-disadvantages-of-ecommerce
3. https://www.researchgate.net/publication/320547139ECommerce_Merits_and_Demerits_A_Review_Paper

| Course Code | COGNITIVE SCIENCE | L | T | P | C |
|---|---|---|---|---|---|
| OE2004 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

**UNIT I PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE** 9

Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.

**UNIT II COMPUTATIONAL INTELLIGENCE** 9

Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.

**UNIT III PROBABILISTIC PROGRAMMING LANGUAGE** 9

WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration

**UNIT IV INFERENCE MODELS OF COGNITION** 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

**UNIT V LEARNING MODELS OF COGNITION** 9

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Understand the underlying theory behind cognition.
CO2 Connect to the cognition elements computationally.
CO3 Implement mathematical functions through WebPPL.
CO4 Develop applications using cognitive inference model.
CO5 Develop applications using cognitive learning model.

**TEXTBOOKS:**


1. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing:
2. Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
3. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
4. Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences", The MIT Press, 1999.
5. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

**REFERENCES:**

1. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/

3. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016, https://probmods.org/.

| Course Code | EMOTIONAL INTELLIGENCE | L | T | P | C |
|---|---|---|---|---|---|
| OE2005 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

6. To know the theoretical background of cognition.
7. To understand the link between cognition and computational intelligence.
8. To explore probabilistic programming language.
9. To study the computational inference models of cognition.
10. To study the computational learning models of cognition.

**UNIT I INTRODUCTION TO EMOTIONAL INTELLIGENCE** 9

Meaning of Emotions, Emotional Intelligence- Importance- Models of Emotional Intelligence- Social Intelligence- IQ and EQ- Self Awareness- Social Skills – Relationship Management- EI and Motivation.

**UNIT II UNDERSTANDING EMOTIONS** 9

The Brain and Emotion - The Relationship of Mood and Emotion - The Role of Emotion in Organizational Health and the Bottom Line - Types of Emotions- Control of Emotions Gender Differences in Emotion - Impulse Control- Marshmallow Experiment- Negative and Positive Emotions – Emotion and Health

**UNIT III MANAGING EMOTIONS** 9

Learning EI – Emotional Self Awareness – EI Assessment Tools - Emotional Intelligence and Psychological Adjustment - Issues in Anxiety, Stress, Depression, Anger, Self Esteem and Self Management Empathy

**UNIT IV EI PRACTICE IN ORGANIZATIONS** 9

Emotional Intelligence and Decision Making - EI and Personality- Work Frustrations- EI and Work Performance- EI and Leadership - EI and Job Stress – EI and Information Processing - EI and Communication – Goal Conflict – EI and Conflict Resolution – EI and Work Place Diversity – Group EI – Star Performers

**UNIT V EMOTIONAL COMPETENCE** 9

Developing EI in Organization – Transformation and Change – Training, Transfer, Maintenance and Evaluating Change - Emotional Quality Management.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Understand the underlying theory behind cognition.
CO2 Connect to the cognition elements computationally.
CO3 Implement mathematical functions through WebPPL.
CO4 Develop applications using cognitive inference model.
CO5 Develop applications using cognitive learning model.

**TEXT CUM REFERENCE BOOKS:**


1. Ciarruchi, J., Forgas, J. and Mayer, John. (2001) Emotional Intelligence in Everyday Life: A Scientific Inquiry. Psychology Press: Philadelphia, PA.
2. Daliph Singh (2001) Emotional Intelligence At Work: A Professional Guide. Response Books: New Delhi
3. Daniel Goleman, (1996) Emotional Intelligence: Why It can Matter More Than IQ. Bantam Books: NewYork.
4. Doty, G. (2001). Fostering Emotional Intelligence in K-8 Students. Corwin Press: Thousand Oaks, CA.

5. Oatley, K and Jenkins, J (2000) Understanding Emotions. Malden MA: Blackwell

| Course Code | DESIGN THINKING | L | T | P | C |
|---|---|---|---|---|---|
| OE2006 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. Learn design thinking concepts and principles
2. Use design thinking methods in every stage of the problem
3. Learn the different phases of design thinking
4. Apply various methods in design thinking to different problems

**UNIT I INTRODUCTION** 9

Why Design? - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.

**UNIT II: UNDERSTAND, OBSERVE, AND DEFINE THE PROBLEM** 9

Search field determination - Problem clarification - Understanding of the problem - Problem analysis - Reformulation of the problem - Observation Phase - Empathetic design - Tips for observing - Methods for Empathetic Design - Point-of-View Phase - Characterization of the target group - Description of customer needs.

**UNIT III IDEATION AND PROTOTYPING** 9

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization and presentation techniques.

**UNIT IV TESTING AND IMPLEMENTATION** 9

Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.

**UNIT V FUTURE** 9

Design Thinking meets the corporation – The New Social Contract – Design Activism – Designing
tomorrow.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Grasp the fundamentals of design thinking, including its principles, tools, and project planning.

CO2 Develop skills in problem understanding, observation, analysis, and empathetic design for effective problem-solving.

CO3 Cultivate creativity, ideation, and prototyping capabilities using various techniques and methodologies.

CO4 Acquire proficiency in user testing, workshop facilitation, and agile implementation for successful design execution.

CO5 Explore the future implications of design thinking, including its intersection with corporate innovation, societal responsibilities, and proactive design activism.

**TEXTBOOKS:**

1. 1. Christian Mueller-Roterberg, Handbook of Design Thinking - Tips & Tools for how to design thinking. [ Unit 1, 2, 3, 4]

2. Designing for Growth: a design thinking tool kit for managers By Jeanne Liedtka and Tim Ogilvie. [Unit 1]
3. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown. [Unit 5]

**REFERENCES:**


1. Johnny Schneider, “Understanding Design Thinking, Lean and Agile”, O'Reilly Media, 2017.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage”, Harvard Business Press, 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
4. http://ajjuliani.com/design-thinking-activities/
5. 5. https://venturewell.org/class-exercises

| Course Code | ELECTRONIC WASTE MANAGEMENT - ISSUES AND CHALLENGES | L | T | P | C |
|---|---|---|---|---|---|
| OE2007 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To define e-waste, assess its prevalence domestically and internationally, and understand its implications for the environment and public health.
2. To comprehend the legal framework governing e-waste management in India and the responsibilities assigned to different stakeholders.
3. To examine historical and contemporary e-waste disposal, recycling, and recovery methods, including their ecological impact and life cycle assessment.
4. To explore innovative technologies and guidelines to promote environmentally sustainable e-waste management practices.
5. To apply theoretical knowledge through case studies and field exposure, fostering practical skills in devising effective e-waste management strategies.

**UNIT I INTRODUCTION** 9

What is E-Waste, Indian and global scenario of e-Waste, Growth of Electrical and Electronics industry in India, E-waste generation in India, Composition of e-waste, Possible hazardous substances present in ewaste, Environmental and Health implications

**UNIT II E-WASTE LEGISLATION** 9

Regulatory regime for e-waste in India, The hazardous waste (Management and Handling) rules 2003, E-waste management rules 2015, Regulatory compliance including roles and responsibility of different stakeholders – producer, manufacturer, consumer etc., Proposed reduction in the use of hazardous substances(RoHS), Extended producer responsibility (EPR).

**UNIT III END OF LIFE MANAGEMENT OF E-WASTE** 9

Historic methods of waste disposal – dumping, burning, landfill; Recycling and recovery technologies – sorting, crushing, separation; Life cycle assessment of a product – introduction; Case study – optimal planning for computer waste.

**UNIT IV ENVIRONMENTALLY SOUND E-WASTE MANAGEMENT** 9

Emerging recycling and recovery technologies, Guidelines for environmentally sound management of e-waste, environmentally sound treatment technology for e-waste.

**UNIT V APPLICATION CASE STUDY** 9

Guidelines for establishment of integrated e-waste recycling and treatment facility, Case studies and unique initiatives from around the world., Case Study and Field Exposure.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Understand the origins, composition, and environmental impact of e-waste on both local and global scales.

CO2 Analyze the legislative framework governing e-waste management in India and assess the responsibilities of various stakeholders.

CO3 Evaluate historical and modern methods of e-waste disposal, recycling, and recovery, while considering their ecological footprint.

CO4 Explore emerging technologies and guidelines for environmentally friendly e-waste management, including case studies and global initiatives.

CO5 Apply theoretical knowledge to practical scenarios through case studies and field exposure, developing optimal strategies for managing e-waste.

**TEXTBOOKS:**

1. Johri R., "E-waste: implications, regulations, and management in India and current global best practices", TERI Press, New Delhi.
2. Choudhary, C. K., Waste management and bioremediation, Oxford Book Company, 2012.

**REFERENCES:**

1. Wong, J. W. C, Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., Selvan, A., Sustainable Solid Waste Management, American Society of Civil Engineers, 2016.
2. Ojovan, M. I., Handbook of Advanced Radioactive Waste Conditioning Technologies, Woodhead Publishing, 2011.

**ONLINE REFERENCES:**

1. Dubey, B. K., Electronic Waste Management - Issues and Challenges, Division of Environmental Engineering and Management at Indian Institute of Technology, Kharagpur, NPTEL, https://onlinecourses.nptel.ac.in/noc18_ce07/preview
2. Dubey, B. K., Integrated Waste Management for a Smart City, Division of Environmental Engineering and Management at Indian Institute of Technology, Kharagpur, NPTEL, https://onlinecourses.nptel.ac.in/noc17_ce20/preview
3. Ramachandra, T. V., Municipal Solid Waste Management, Centre for Ecological Sciences, Indian Institute of Science, NPTEL, http://nptel.ac.in/courses/120108005/2#

| Course Code | FUNDAMENTALS OF GIS | L | T | P | C |
|---|---|---|---|---|---|
| OE2008 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To define e-waste, assess its prevalence domestically and internationally, and understand its implications for the environment and public health.
2. To comprehend the legal framework governing e-waste management in India and the responsibilities assigned to different stakeholders.
3. To examine historical and contemporary e-waste disposal, recycling, and recovery methods, including their ecological impact and life cycle assessment.
4. To explore innovative technologies and guidelines to promote environmentally sustainable e-waste management practices.
5. To apply theoretical knowledge through case studies and field exposure, fostering practical skills in devising effective e-waste management strategies.

**UNIT I FUNDAMENTALS OF GIS** 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

**UNIT II SPATIAL DATA MODELS** 9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

**UNIT III DATA INPUT AND TOPOLOGY** 9

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

**UNIT IV DATA ANALYSIS** 9

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

**UNIT V APPLICATIONS** 9

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology.
CO4 Gain knowledge on data quality and standards.
CO5 Understand data management functions and data output

**TEXTBOOKS:**

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

**REFERENCES:**

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

| Course Code | BIO INFORMATICS | L | T | P | C |
|---|---|---|---|---|---|
| OE2009 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. Understand the fundamental concepts of bioinformatics and computational biology, including biological sequences and the classification of biological databases.
2. Master various sequence analysis techniques such as sequence alignment, substitution matrices, and database similarity searching tools for interpreting biological data effectively.
3. Explore molecular phylogeny principles and methods, including distance matrix methods and character-based approaches, for constructing evolutionary relationships among biological sequences.
4. Develop proficiency in analyzing macromolecular structures, including gene prediction, conserved domain analysis, and protein structure prediction techniques, along with validating predicted structures.
5. Apply bioinformatics approaches to diverse biological applications such as systems biology, microarray data analysis, DNA computing, and drug discovery, showcasing their significance in advancing biological research and technology.

**UNIT I BIOLOGICAL DATABASES** 9

Introduction to Bioinformatics and Computational Biology, Biological sequences, Classification of biological databases - Sequence Databases, Structure Databases, Genome specific databases, Special Databases and applications- Microarray, Metabolic pathway, motif, and domain databases, Data file formats.

**UNIT II SEQUENCE ANALYSIS** 9

Sequence Alignment- Homology vs Similarity, Similarity vs Identity. Types of Sequence alignment - Pairwise and Multiple sequence alignment, Global alignment, Local alignment, Dotplot, Alignment algorithms- Needleman wunsch and Smith and waterman algorithm, Substitution matrices- PAM, BLOSUM. Multiple Sequence Alignment- Application of multiple alignments, Viewing and editing of MSA and Scoring function. Database Similarity Searching- Basic Local Alignment Search Tool (BLAST), FASTA, PHI BLAST, PSI BLAST, BLAST algorithm.

**UNIT III MOLECULAR PHYLOGENY** **9**

Phylogenetics Basics, Molecular clock theory, Ultrametric trees, Distance matrix methods UPGMA,NJ, Character based methods-Maximum Parsimony. Methods of evaluating phylogenetic methods- boot strapping, jackknifing.

**UNIT IV MACROMOLECULAR STRUCTURE ANALYSIS** 9

Gene prediction, Conserved domain analysis, Protein structure visualization, Prediction of protein secondary structure, Tertiary structure prediction- Homology modeling, Threading, Ab-initio prediction. Validation of the predicted structure using Ramachandran plot, steriochemical properties, Structure- structure alignment..

**UNIT V APPLICATIONS** 9

Introduction to Systems Biology and Synthetic Biology, Microarray data analysis, DNA computing, Bioinformatics approaches for drug discovery, Applications of Bioinformatics in genomics and proteomics- Assembling the genome, STS content mapping for clone contigs, Functional annotation, Peptide mass fingerprinting.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Apply computational based solutions for biological perspectives

CO2 Analyze the evolutionary relationship between the organisms

CO3 Understand the macromolecules structure prediction methods

CO4 Relate how bioinformatics methods can be used in sequence to structure and function analysis.

CO5 Learn the applications of bioinformatics approach for drug discovery, genomics and proteomics.

**TEXT CUM REFERENCE BOOKS:**

1. Arthur K. Lesk- Introduction to Bioinformatics, Oxford University Press.

2. Baxivanis and FouletteD- Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition, 2001.

3. Attwood TK, parry DJ-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.

4. David W. Mount-Bioinformatics Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press. 1st edition 2001.

**Open Elective– II:**

| Course Code | BUSINESS STRATEGY | L | T | P | C |
|---|---|---|---|---|---|
| OE2010 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. To introduce the concepts of strategic management and understand its nature in competitive and institutional landscape.
2. To develop a holistic approach to see business issues comprehensively and using other core and functional subject knowledge for decision-making.
3. To identify and interpret the critical challenges and opportunities before an organization.

**UNIT I INTRODUCTION TO STRATEGIC MANAGEMENT** 9

Importance of Strategic Management, Vision and Objectives, Schools of thought in Strategic Management, strategy Content, Process, and Practice, Fit Concept and Configuration Perspective in Strategic Management

**UNIT II INTERNAL ENVIRONMENT OF FIRM- RECOGNIZING A FIRM'S INTELLECTUAL ASSETS** 9

Core Competence as the Root of Competitive Advantage, Sources of Sustained Competitive Advantage, Business Processes and Capabilities-based Approach to Strategy

**UNIT III EXTERNAL ENVIRONMENTS OF FIRM- COMPETITIVE STRATEGY** 9

Five Forces of Industry Attractiveness that Shape Strategy, The concept of Strategic Groups, and Industry Life Cycle, Generic Strategies, Generic Strategies and the Value Chain.

**UNIT IV CORPORATE STRATEGY, AND GROWTH STRATEGIES** 9

The Motive for Diversification, Related and Unrelated Diversification, Business Portfolio Analysis, Expansion, Integration and Diversification, Strategic Alliances, Joint Ventures, and Mergers & Acquisitions.

**UNIT V STRATEGY IMPLEMENTATION: STRUCTURE AND SYSTEMS** 9

The 7S Framework, Strategic Control and Corporate Governance.

**NUMBER OF THEORY PERIODS: 45**

**COURSE OUTCOMES**:

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

CO1 Learn the fundamental concepts of strategic management to analyze business situations and apply these concepts to solve business problems.

CO2 Understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, HR and information technology

CO3 Understand the inter-relationships of business to individuals, other organizations, government and society.

CO4 Describe the tools of strategic analysis thoroughly, how they are used, and where they fit in the managerial process to frame and implement strategies.

**TEXTBOOKS:**

1. Strategic management of technological innovation (2019), Schilling, M. A., & Shankar, R,McGraw-Hill Education.
2. The business of platforms: Strategy in the age of digital competition, innovation, and power (2019), Cusumano, M. A., Gawer, A., & Yoffie, D. B.,New York: Harper Business.

**REFERENCES:**

1. Dislodging multinationals: India's strategy in comparative perspective (2019), Encarnation, D.Cornell, University Press.

2. Dynamics of knowledge intensive entrepreneurship: Business strategy and public policy (2018),
3. Malerba, F., Caloghirou, Y., McKelvey, M., &Radoševic, S. (Eds.), Routledge.

| Course Code | INTRODUCTION TO CYBER SECURITY | L | T | P | C |
|---|---|---|---|---|---|
| OE2011 | | 3 | 0 | 2 | 4 |

**COURSE OBJECTIVES:**

1. To develop a comprehensive understanding of fundamental cybersecurity concepts, including cyber threats, preventive measures, and cyber security principles.
2. To explore networking basics, focusing on concepts, protocols, and architectures crucial to understanding cyber security measures.
3. To acquire knowledge on core security principles, including risk management practices, to build a solid foundation for implementing effective security measures.
4. To understand the principles of cryptography and encryption, exploring the irrole in securing data and communication channels in cybersecurity.
5. To develop the skills to create, implement, and enforce security policies and procedures, fostering a security-aware culture and mitigating cyber threats through the effective governance.

**UNIT I INTRODUCTION TO CYBER SECURITY CONCEPTS** 9

Introduction to Cybersecurity Fundamentals-Cyber Threat Landscape-Cybersecurity Frameworks and Standards - Security Architecture and Models - Incident Response and Cybersecurity Incident Handling - Security Awareness and Training - Legal and Ethical Aspects of Cybersecurity-Emerging Trends in Cybersecurity.

**UNIT II FUNDAMENTALS OF NETWORKING** 9

Introduction to Networking Concepts-OSI Model Overview-TCP/IP Protocol Suite-Network Devices and Components-IP Addressing and Subnetting-Routing and Switching Basics-Wireless Networking Fundamentals -Network Security Principles.

**UNIT III SECURITY FUNDAMENTALS** 9

Introduction to Security Principles - Access Control and Authentication - Security Risk Management - Security Policies and Procedures - Security Incident Response – Security Awareness Training-Vulnerability Assessment and Management-Physical Security Considerations.

**UNIT IV CRYPTOGRAPHY AND ENCRYPTION** 9

Introduction to cryptography-symmetric encryption algorithms-asymmetric encryption and publickey infrastructure (PKI)-hash functions and message digests –digital signatures -cryptographic key management- transport layer security(TLS) and secure sockets layer(SSL)-cryptography in block chain technology.

**UNIT V SECURITY POLICIES AND PROCEDURES** 9

Introduction to security policies and procedures - policy development and implementation - access control policies - data classification and handling policies - incident response plans – security awareness training programs-compliance and regulatory policies-security auditing and monitoring procedures.

**NUMBER OF THEORY PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 Gain a clear understanding of fundamental cyber security principles, exploring the core concepts that form the basis of cyber defense

CO2 Understand the application of cybersecurity policies and riskmanagement practices, emphasizing their importance in maintaining secure digital environment

CO3 Learn about the basic tools and techniques for investigating various cybercrimes, providing a foundational knowledge base for cyber crime detection and resolution

CO4 Apply security fundamentals to digital environments, incorporating knowledge of Risk management, access control, and other core principles to enhance overall security

CO5 Demonstrate proficiency in cyber forensics techniques and methodologies, integrating knowledge from security policies and procedures to enhance investigative capabilities

**TEXT BOOKS LINKS:**

**Unit 1:** Introduction to Cybersecurity by jeetendrapandehttps://uou.ac.in/sites/default/files/slm/Introduction-cyber-security.pdf**Unit2:Fundamentals of Networking:** https://www.cisco.com/c/dam/global/fi_fi/assets/docs/SMB_University_120307_Networking_Fundamentals.pdf

**Unit3: Security Fundamentals:** https://training.apnic.net/wp-content/uploads/sites/2/2016/11/eSEC01_NetSec.pdfUnit4:**Cryptography and Encryption:** https://www.cs.umd.edu/~waa/414-F11/IntroToCrypto.pdfUnit5:**SecurityPolicies and Procedures:** https://oklahoma.gov/content/dam/ok/en/omes/documents/InfoSecPPG.pdf

**REFERENCES:**


1. Diogenes, Y., & Ozkaya, E.(2018). Cybersecurity-Attack and defense strategies: Infrastructure security with red team and blue team tactics. Packt Publishing.
2. Schneier, B. (2017). Applied cryptography: Protocols, algorithms and sourcecode in C. John Wiley& Sons.
3. Erickson,J.(2008).Hacking: The art of exploitation (2nded.). No Starch Press.

| Course Code | GREEN COMPUTING | L | T | P | C |
|---|---|---|---|---|---|
| OE2012 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. Understand the fundamentals, significance, and regulations shaping the field of green computing.
2. Implement techniques to enhance energy efficiency in computing systems and embrace sustainable practices.
3. Develop eco-friendly software solutions, incorporating energy-efficient coding practices and sustainable software design.
4. Design and manage data centers with a focus on energy efficiency and environmentally responsible practices.
5. Equip students with knowledge to manage electronic waste responsibly, emphasizing reuse, recycling, and regulatory compliance.

**UNIT I FOUNDATIONS OF GREEN COMPUTING** 9

Introduction to Green Computing, Significance and Global Relevance, Environmental Challenges in Computing, Energy Consumption in Computing, Electronic Waste and Resource Depletion, Green Policies and Regulations, Compliance with Environmental Standards, Case Studies in Sustainable Computing

**UNIT II OPTIMIZING ENERGY CONSUMPTION** 9

Techniques for Reducing Energy Consumption, Power Management Strategies, Energy-efficient Hardware Design, Sustainable Software Development, Virtualization and Server Consolidation, Energy-aware Algorithms, Renewable Energy Integration, Best Practices in Energy Optimization.

**UNIT III GREEN SOFTWARE PRACTICES** 9

Principles of Green Software, Code Optimization for Energy Efficiency, Sustainable Software Design Patterns, Energy-efficient Algorithms, Software Development Lifecycle and Green Computing, Case Studies in Green Software Development, Hands-on Coding Exercise, Collaboration Between Developers and Environmental Experts

**UNIT IV BUILDING ECO-FRIENDLY DATA CENTERS** 9

Green Data Center Concepts, Cooling and Climate Control Innovations, Server Virtualization and Consolidation, Sustainable Server and Storage Solutions, Energy-efficient Hardware Selection, Monitoring and Optimization Tools, Data Center Certification Standards, Group Workshop: Designing a Green Data Center.

**UNIT V RESPONSIBLE E-WASTE PRACTICES** 9

Understanding Electronic Waste (E-waste), E-waste Collection and Recycling Programs, Reuse and Upcycling of Computing Equipment, Eco-friendly Disposal Practices, Regulatory Compliance in E-waste Management, Community Engagement for E-waste Awareness, Student-led E-waste Collection Drive, Final Project Presentations and Reflections

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES:**

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

CO1 Understand environmental impact, regulations, and ethical considerations influencing sustainable computing practices globally.

CO2 Apply strategies for energy efficiency and renewable energy integration in computing systems effectively.

CO3 Develop eco-friendly software, employing energy-efficient coding, sustainable design patterns, and lifecycle assessment principles.

CO4 Design and manage data centers with a focus on energy efficiency, eco-friendly hardware, and certifications.

CO5 Lead e-waste initiatives, ensuring ethical disposal, regulatory compliance, and community engagement for sustainability.

**TEXTBOOKS:**

1. "Green IT for Dummies" by Carol Baroudi (2022)
2. "Energy Efficient Servers: Blueprints for Data Center Optimization" by Corey Gough (2021)
3. "Sustainable Software Development: An Agile Perspective" by Kevin Carlson (2023)
4. "Designing Green Data Centers" by Bill Kleyman (2022)
5. "E-Waste in Transition: From Pollution to Resource" by Flor Avelino (2021)

**REFERENCES:**

1. "Green Computing: Tools and Techniques for Saving Energy, Money, and Resources" by Bud E. Smith (2023)
2. "Energy-Efficient Distributed Computing Systems" by Albert Y. Zomaya (2022)
3. "Sustainable Software Architecture: A Framework for Modern Enterprise Applications" by Carola Lilienthal (2023)
4. "Data Center Handbook" by Hwaiyu Geng (2021)
5. "Electronic Waste Management and Treatment Technology" by Majeti Narasimha Vara Prasad (2022)

| Course Code | E – BUSINESS MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| OE2013 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. Define the concepts of e-business and e-commerce, analyze economic factors and advantages, and debunk myths surrounding e-business models.
2. Explore the technology infrastructure supporting e-business, including internet protocols, intranets, extranets, and web server hardware/software.
3. Evaluate consumer-oriented and business-oriented e-business applications such as e-tailing, e-CRM, and e-governance, along with strategies for marketing and delivery management.
4. Examine e-business payment systems and security measures, including characteristics, protocols, and internet security techniques like cryptography and network security.
5. Analyze legal, ethical, and privacy issues related to e-business, including consumer protection, cyber laws, taxation policies, and encryption regulations.

**UNIT I INTRODUCTION TO e-BUSINESS** 9

e-business, e-business vs e-commerce, Economic forces – advantages – myths – e-business models, design, develop and manage e-business, Web 2.0 and Social Networking, Mobile Commerce, S-commerce.

**UNIT II TECHNOLOGY INFRASTRUCTURE** 9

Internet and World Wide Web, internet protocols - FTP, intranet and extranet, information publishing technology- basics of web server hardware and software.

**UNIT III BUSINESS APPLICATIONS** 9

Consumer oriented e-business – e-tailing and models - Marketing on web – advertising, e-mail marketing, affiliated programs - e-CRM; online services, Business oriented e-business, e-governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals – social media marketing

**UNIT IV e-BUSINESS PAYMENTS AND SECURITY** 9

E-payments - Characteristics of payment of systems, protocols, e-cash, e-cheque and Micro payment systems- internet security – cryptography – security protocols – network security.

**UNIT V LEGAL AND PRIVACY ISSUES** 9

Legal, Ethics and privacy issues – Protection needs and methodology – consumer protection, cyber laws, contracts and warranties, Taxation and encryption policies.

NUMBER OF THEORY PERIODS : 45

**COURSE OUTCOMES:**

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

CO1 Ability to build and manage an e-business.
CO2 Knowledge about Technology Infrastructure
CO3 Understanding of customer-oriented business applications
CO4 Knowledge of e business payment protocols and security
CO5 Understanding of ethical, legal , privacy issues and encryption policies

**TEXTBOOKS:**

1. Harvey M.Deitel, Paul J.Deitel, Kate Steinbuhler, e-business and e-commerce for managers, Pearson, 2011.
2. Efraim Turban, Jae K. Lee, David King, Ting Peng Liang, Deborrah Turban, Electronic Commerce –A managerial perspective, Pearson Education Asia, 2010.

**REFERENCES:**

1. Parag Kulkarni, SunitaJahirabadkao, Pradeep Chande, e business, Oxford University Press, 2012.
2. Hentry Chan &el , E-Commerce – fundamentals and Applications, Wiley India Pvt Ltd, 2007.

3. Gary P. Schneider, Electronic commerce, Thomson course technology, Fourth annual edition, 2007
4. Bharat Bhasker, Electronic Commerce – Frame work technologies and Applications, 3rd Edition. Tata McGrawHill Publications, 2009
5. KamleshK.Bajaj and Debjani Nag, Ecommerce- the cutting edge of Business, Tata McGraw Hill Publications, 7th reprint, 2009.
6. Kalakota et al, Frontiers of Electronic Commerce, Addison Wesley, 2004
7. MichealPapaloelon and Peter Robert, e-business, Wiley India, 2006.

| Course Code | MULTICORE ARCHITECTURE AND PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| OE2014 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To understand the need for multi-core processors, and their architecture.
2. To understand the challenges in parallel and multithreaded programming.
3. To learn about the various parallel programming paradigms,

4. To develop multicore programs and design parallel solutions.

**UNIT I INTRODUCTION TO e-BUSINESS** 9

e-business, e-business vs e-commerce, Economic forces – advantages – myths – e-business models, design, develop and manage e-business, Web 2.0 and Social Networking, Mobile Commerce, S-commerce.

**UNIT II TECHNOLOGY INFRASTRUCTURE** 9

Internet and World Wide Web, internet protocols - FTP, intranet and extranet, information publishing technology- basics of web server hardware and software.

**UNIT III BUSINESS APPLICATIONS** 9

Consumer oriented e-business – e-tailing and models - Marketing on web – advertising, e-mail marketing, affiliated programs - e-CRM; online services, Business oriented e-business, e-governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals – social media marketing

**UNIT IV e-BUSINESS PAYMENTS AND SECURITY** 9

E-payments - Characteristics of payment of systems, protocols, e-cash, e-cheque and Micro payment systems- internet security – cryptography – security protocols – network security.

**UNIT V LEGAL AND PRIVACY ISSUES** 9

Legal, Ethics and privacy issues – Protection needs and methodology – consumer protection, cyber laws, contracts and warranties, Taxation and encryption policies.

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES**:

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

CO1 Describe multicore architectures and identify their characteristics and challenges.
CO2 Identify the issues in programming Parallel Processors.
CO3 Write programs using OpenMP and MPI.
CO4 Design parallel programming solutions to common problems.
CO5 Compare and contrast programming for serial processors and programming for parallel processors.

**TEXT CUM REFERENCE BOOKS:**


1. Peter S. Pacheco, "An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2021.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011 (unit 2)
3. Michael J Quinn, "Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003. Tentative
4. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.


| Course Code | AUGMENTED REALITY AND VIRTUAL REALITY | L | T | P | C |
|---|---|---|---|---|---|
| E2015 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. Define AR and VR, explore historical evolution, and understand their significance and applications.
2. Master AR and VR technologies, utilizing development tools and frameworks effectively.

3. Apply UI/UX design principles, creating immersive narratives and interactive experiences in AR and VR.
4. Evaluate AR/VR applications in healthcare, education, and industries, understanding practical use cases.
5. Anticipate emerging technologies, propose solutions to challenges, and assess the future impact of AR and VR.

**UNIT I INTRODUCTION TO AR AND VR TECHNOLOGIES** 9

Definitions and Fundamentals of AR and VR, Historical Evolution of AR and VR, Significance and Real-world Applications, Social Impact and Ethical Considerations, Key Technological Components, Overview of AR and VR Devices, Comparison of AR and VR Experiences, Future Trends in AR and VR.

**UNIT II CORE TECHNOLOGIES AND DEVELOPMENT TOOLS** 9

Augmented Reality (AR) Technologies: Marker-based and Markerless, Virtual Reality (VR) Technologies: Headsets and Controllers, AR and VR Development Tools and Frameworks, Cross-cutting Technologies: AI and Machine Learning in AR/VR, Advances in Spatial Computing, 3D Modeling and Content Creation, Building AR and VR Environments, Hands-on Development Exercise

**UNIT III DESIGN PRINCIPLES FOR AR AND VR EXPERIENCES** 9

User Interface (UI) Design Principles, User Experience (UX) Design Principles, Interaction Design in AR and VR, Gestures, Voice, and Haptic Feedback, Storytelling in Immersive Environments, Content Creation for AR and VR, Prototyping AR and VR Experiences, Evaluation of AR and VR Designs

**UNIT IV APPLICATIONS IN INDUSTRY AND EDUCATION** 9

AR/VR in Healthcare: Training and Patient Care, AR/VR in Education and Training, Virtual Conferencing and Collaboration, Industrial Applications of AR and VR, Retail and Marketing in AR and VR, Architectural Visualization, Gaming and Entertainment, Industry-specific Use Cases and Case Studies

**UNIT V FUTURE TRENDS AND CHALLENGES IN AR AND VR** 9

Emerging Technologies: AR Glasses, Smart Contact Lenses, Challenges and Solutions in AR and VR Development, Scalability Issues and Solutions, Ethical Considerations in AR and VR, Societal Impact of Widespread Adoption, The Integration of AR and VR with Other Technologies, Future of Work and Education in AR and VR, Student-led Discussion and Project Exploration

**NUMBER OF THEORY PERIODS : 45**

**SAMPLE LIST OF EXPERIMENTS:**

Assignment 1: Fundamentals Review (3 hours)
Review foundational concepts in AR and VR through quizzes and short answer questions.
Hands-on Project 1: AR Basics (6 hours)
Develop a basic AR application using marker-based technology with guidance and feedback.
Assignment 2: VR Development Principles (3 hours)
Analyze VR development principles and submit a reflective assignment on key concepts.
Hands-on Project 2: VR Environment Creation (6 hours)
Design and build a virtual environment, integrating UI/UX principles and interactive elements.
Assignment 3: Design Critique (3 hours)
Critique a given AR/VR design, highlighting strengths, weaknesses, and potential improvements.
Hands-on Project 3: Industry-specific Application (6 hours)
Develop a practical AR or VR application targeting a specific industry, emphasizing real-world relevance.
Assignment 4: Future Trends Paper (3 hours)

Research and write a paper on emerging trends in AR and VR, addressing their future impact.

**COURSE OUTCOMES:**

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

CO1 Establish a foundational knowledge of AR and VR, including key terms, historical context, and ethical considerations.

CO2 Demonstrate proficiency in using AR and VR technologies, development tools, and frameworks in practical applications

CO3 Apply advanced UI/UX design principles, developing compelling narratives and interactive elements for immersive AR and VR experiences

CO4 Analyze and compare industry-specific applications of AR and VR, presenting insights into their impact and potential improvements.

CO5 Evaluate evolving technologies, propose innovative solutions to challenges, and predict societal implications of advancing AR and VR.

**TEXTBOOKS:**

1. "Augmented Reality: Principles and Practice" - Dieter Schmalstieg and Tobias Hollerer (2021)
2. "Virtual Reality: Concepts and Technologies" - William R. Sherman and Alan B. Craig (2022)
3. "Designing Virtual Worlds" - Richard Bartle (2018)
4. "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything" - Robert Scoble and Shel Israel (2016)
5. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" - Daniel Drescher (2020)

**REFERENCES:**

1. "Understanding Augmented Reality: Concepts and Applications" - Alan B. Craig (2013)
2. "Unity Virtual Reality Projects" - Jonathan Linowes (2015)
3. "Virtual Reality Designer: Leveraging VR for Ongoing Design Innovation" - Todd Richmond (2018)
4. "Augmented Reality in Education: Cases, Places, and Lessons" - Charles Wankel and Ryan Crowley (2014)
5. "The Age of Em: Work, Love, and Life when Robots Rule the Earth" - Robin Hanson (2016)

| Course Code | INTERNET OF THINGS (IOT) | L | T | P | C |
|---|---|---|---|---|---|
| OE2016 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. To give an understanding about the choice and application of IoT & M2M communication protocols.
2. To describe Cloud computing and design principles of IoT.
3. To relate to MQTT clients, MQTT server and its programming.
4. To describe the architectures and communication protocols of WSNs.
5. To identify the uplink and downlink communication protocols associated with specific application of IOT /WSNs.

**UNIT I OVERVIEW OF INTERNET OF THINGS** 9

IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT, XMPP) for IoT/M2M devices. -Refer Chapter 1,2 and 3 of Text 1.

**UNIT II ARCHITECTURE AND DESIGN PRINCIPLES FOR IOT** 9

Internet connectivity, Internet based communication, IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS,FTP, TELNET and ports.

**UNIT III PROTOTYPING AND DESIGNING SOFTWARE FOR IOT APPLICATIONS** 9

Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server. Introduction to IoT privacy and security. Vulnerabilities, security requirements and threat analysis, IoT Security Tomography and layered attacker model. -Refer Chapter 9 and 10 of Text 1.

**UNIT IV OVERVIEW OF WIRELESS SENSOR NETWORKS** 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. -Refer Chapter 1,2, 3 of Text 2.

**UNIT V COMMUNICATION PROTOCOLS** 9

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA, PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. Refer Chapter 4, 5, 7 and 11 of Text 2. Lt, L2, L3

**NUMBER OF THEORY PERIODS : 45**

**SAMPLE LIST OF EXPERIMENTS:**

1. Implement an IoT conceptual framework and analyze M2M communication using CoAP-SMS and CoAP-MQ protocols, focusing on data enrichment and consolidation at the IoT/M2M gateway.
2. Design a prototype for Internet connectivity in IoT, exploring IPv4, IPv6, and 6LoWPAN protocol, alongside understanding application layer protocols like HTTP, HTTPS, and FTP.
3. Develop embedded device software using Arduino IDE, read data from sensors, and program MQTT clients and servers while addressing IoT privacy and security concerns through threat analysis and IoT Security Tomography.
4. Explore enabling technologies and architectures for wireless sensor networks (WSNs), understand single-node architecture components, and optimize energy consumption using operating systems and execution environments.
5. Analyze physical layer and transceiver design considerations for WSNs, implement MAC protocols like S-MAC and contention-based protocols like CSMA, and design energy-efficient routing protocols for hierarchical networks by clustering.

**COURSE OUTCOMES**:

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

CO1 Understand choice and application of IoT & M2M communication protocols.
CO2 Describe Cloud computing and design principles of IoT.
CO3 Relate to MQTT clients, MQTT server and its programming.

CO4 Describe the architectures and communication protocols of WSNs.
CO5 Identify the uplink and downlink communication protocols associated with specific application of IOT /WSNs.

**TEXTBOOKS**:

1. Raj Kamal, "Internet of Things-Architecture and Design Principles", McGraw Hill Education.
2 Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

**REFERENCES:**

1. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 007.
2 Kazem Sohraby, Daniel Minoli, &TaiebZnati, '' Wireless Sensor Networks- Technology, Protocols and Applications", John Wiley, 2007.
3. Anna Hac, 'Wireless Sensor Network Designs", John Wiley, 2003.

| Course Code | CYBER LAW | L | T | P | C |
|---|---|---|---|---|---|
| OE2017 | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES**:

1. To gain through knowledge on the basic concepts which lead to the formation and execution of electronic contracts
2. To Study the Technical aspects of Cyber Security and Evidence Aspects
3. To acquire knowledge on Information Technology Act and EDI

**UNIT I INTRODUCTION**

Cyber Law: Introduction- Concept of Cyberspace-E-Commerce in India-Privacy factors in E - Commerce-cyber law in E-Commerce-Contract Aspects.

**UNIT II SECURITY ASPECTS** 9

Security Aspects: Introduction-Technical aspects of Encryption-Digital Signature-Data Security.
Intellectual Property Aspects: WIPO-GII-ECMS-Indian Copy rights act on soft propriety works Indian Patents act on soft propriety works.

**UNIT III EVIDENCE ASPECTS** 9

Evidence Aspects: Evidence as part of the law of procedures –Applicability of the law of Evidence on Electronic Records-The Indian Evidence Act1872.Criminal aspect: Computer Crime-Factors influencing Computer Crime- Strategy for prevention of computer crime Amendments to Indian Penal code 1860.

**UNIT IV GLOBAL TRENDS** 9

Global Trends- Legal frame work for Electronic Data Interchange: EDI Mechanism-Electronic Data Interchange Scenario in India

**UNIT V THE INFORMATION TECHNOLOGY ACT 2000** 9

The Information Technology Act 2000-Definitions-Authentication of Electronic Records
Electronic Governance-Digital Signature Certificates. Expert lectures, online seminars – webinars

**NUMBER OF THEORY PERIODS : 45**

**COURSE OUTCOMES**:

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

| | |
|---|---|
| CO1 | Discuss the concepts of Cyber law and Cyber Space |
| CO2 | Describe Cyber Security technical aspects. |
| CO3 | Explain the Evidence Aspects. |
| CO4 | Understand the Electronic Data Interchange Scenario in India. |
| CO5 | To gain knowledge on Information Technology Act. |

**TEXTBOOKS:**

1. The Indian Cyber Law : Suresh T.Viswanathan, Bharat Law House, New Delhi.

REFERENCES:

1. https://www.youtube.com/watch?v=KtuCsBlJXk8
2. https://www.youtube.com/watch?v=6srnawS4PLQ&list=PLX0Im12KwTwlmjOWfFqejg8go7JBj72J
3. 3 https://www.youtube.com/watch?v=SCgc55vtd6M

## APPENDIX C: MANDATORY COURSES

### Mandatory Course – I (MC)

| S. No. | Course Title | Semester | L | T | P | C |
|---|---|---|---|---|---|---|
| 1. | Introduction to Women and Gender Studies | III | 2 | 0 | 0 | 0 |
| 2. | Elements of Literature | III | 2 | 0 | 0 | 0 |
| 3. | Film Appreciation | III | 2 | 0 | 0 | 0 |
| 4. | Disaster Risk Reduction and Management | III | 2 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5. | Environmental Sciences and Sustainability | III | 2 | 0 | 0 | 0 |
| **Total Credits** | | | **0** | | | |

**Mandatory Course – II (MC)**

| S. No. | Course Title | Semester | L | T | P | C |
|---|---|---|---|---|---|---|
| 1. | Well Being with Traditional Practices Yoga Ayurveda and Sidda | IV | 2 | 0 | 0 | 0 |
| 2. | History of Science and Technology in India | IV | 2 | 0 | 0 | 0 |
| 3. | Political and Economic Thought for a Human Society | IV | 2 | 0 | 0 | 0 |
| 4. | State, Nation Building and Politics in India | IV | 2 | 0 | 0 | 0 |
| 5. | Industrial Safety | IV | 2 | 0 | 0 | 0 |
| **Total Credits** | | | **0** | | | |

**MANDATORY COURSE I**

| Course Code | INTRODUCTION TO WOMEN AND GENDER STUDIES | L | T | P | C |
|---|---|---|---|---|---|
| MC2301 | | 3 | 0 | 0 | 0 |

9

**UNIT I CONCEPTS**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

**UNIT II FEMINIST THEORY** 9

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

**UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL** 9

Rise of Feminism in Europe and America.
Women's Movement in India.

**UNIT IV GENDER AND LANGUAGE** 9

Linguistic Forms and Gender.
Gender and narratives.

**UNIT V GENDER AND REPRESENTATION** 9

Advertising and popular visual media.
Gender and Representation in Alternative Media.
Gender and social media.

**TOTAL NUMBER OF PERIODS: 45**

| Course Code | ELEMENTS OF LITERATURE | L | T | P | C |
|---|---|---|---|---|---|
| MC2302 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES**:

1. To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

**UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE** 9

Relevance of literature a) Enhances Reading, thinking, discussing and writing skills. b) Develops finer sensibility for better human relationship. c) Increases understanding of the problem of humanity without bias. d) Providing space to reconcile and get a cathartic effect.

**UNIT II ELEMENTS OF FICTION** 9

a) Fiction, fact and literary truth.
b) Fictional modes and patterns.
c) Plot character and perspective.

**UNIT III ELEMENTS OF POETRY** 9

a) Emotions and imaginations. b) Figurative language. c) (Simile, metaphor, conceit, symbol, pun and irony). d) Personification and animation. e) Rhetoric and trend.

**UNIT IV ELEMENTS OF DRAMA** 9

a) Drama as representational art. b) Content mode and elements. c) Theatrical performance. d) Drama as narration, mediation and persuasion. e) Features of tragedy, comedy and satire.

**UNIT V OTHER SESSION** 9

Tutorials:
Laboratory:
Project: The students will write a term paper to show their understanding of a particular piece of literature
ASSESSMENT:
HA:
Quizzes-HA:
Periodical Examination: one
Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
Final Exam:

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.

**READINGS**

1. An Introduction to the Study of English Literature, W.H. Hudson, Atlantic, 2007.
2. An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.
3. The Experience of Poetry, Graham Mode, Open college of Arts with Open Unv Press,1991.
4. The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.
5. The Elements of Drama, J.L.Styan, Literary Licensing, 2011.

**REFERENCES:**

1. To be decided by the teacher and student, on the basis of individual student so as to enable him or her to write the term paper.

| Course Code | FILM APPRECIATION | L | T | P | C |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **MC2303** | | **3** | **0** | **0** | **0** |

**COURSE OBJECTIVES**:

1. In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully

**UNIT I THEME - A: THE COMPONENT OF FILMS** 9

A-1: The material and equipment A-2: The story, screenplay and script A-3: The actors, crew members, and the director A-4: The process of film making… structure of a film

**UNIT II THEME - B: EVOLUTION OF FILM LANGUAGE** 9

B-1: Film language, form, movement etc. B-2: Early cinema… silent film (Particularly French) B-3: The emergence of feature films: Birth of a Nation B-4: Talkies

**UNIT III THEME - C: FILM THEORIES AND CRITICISM/APPRECIATION** 9

C-1: Realist theory; Auteurists C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films? C-4: Film Criticism / Appreciation

**UNIT IV THEME – D: DEVELOPMENT OF FILMS** 9

D-1: Representative Soviet films, D-2: Representative Japanese films, D-3: Representative Italian films, D-4: Representative Hollywood film and the studio system

**UNIT V THEME - E: INDIAN FILMS** 9

E-1: The early era, E-2: The important films made by the directors, E-3: The regional films, E-4: The documentaries in India

**TOTAL NUMBER OF PERIODS: 45**

READINGS

1. A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

| Course Code | DISASTER RISK REDUCTION AND MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| MC2304 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES**:

1. To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
2. To acquaint with the skills for planning and organizing disaster response.

**UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS** 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - Inter relations between Disasters and Sustainable development Goals

**UNIT II DISASTER RISK REDUCTION (DRR)** 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies. - Relevance of indigenous Knowledge, appropriate technology and Local resources.

**UNIT III DISASTER MANAGEMENT** 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

**UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT** 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

**UNIT V DISASTER MANAGEMENT: CASE STUDIES** 9

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOME:**

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

CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3: To develop disaster response skills by adopting relevant tools and technology

CO4: Enhance awareness of institutional processes for Disaster response in the country and

CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

**TEXT BOOKS**


1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India
5. Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]


**REFERENCE BOOKS**


1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

| Course Code | ENVIRONMENTAL SCIENCES AND SUSTAINABILITY | L | T | P | C |
|---|---|---|---|---|---|
| MC2406 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES:**

1. To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
2. To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
3. To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
4. To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyse climate changes, concept of carbon credit and the challenges of environmental management.
5. To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

**UNIT I ENVIRONMENT AND BIODIVERSITY** 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

**UNIT II ENVIRONMENTAL POLLUTION** 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

**UNIT III RENEWABLE SOURCES OF ENERGY** 6

Energy management and energy conservation, New Energy Sources: Need of new energy sources. Different types of new energy sources. Applications of–Hydrogen energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

**UNIT IV SUSTAINABILITY AND MANAGEMENT** 6

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

**UNIT V SUSTAINABILITY PRACTICES** 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials,

Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio- economical and technological change.

**TOTAL NUMBER OF PERIODS:** 30

**COURSE OUTCOMES:**

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

CO1 To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.

CO2 To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

**TEXTBOOKS:**


1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.


**REFERENCES:**


1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
   Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient BlackswanPvt. Ltd. 2013.

**MANDATORY COURSES II**

| Course Code | WELL-BEING WITH TRADITIONAL PRACTICES, AYURVEDA AND SIDDHA | L | T | P | C |
|---|---|---|---|---|---|
| MC2401 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES:**

1. To enjoy life happily with fun-filled new style activities that help to maintain health also
2. To adapt a few lifestyle changes that will prevent many health disorders
3. To be cool and handbill every emotion very smoothly in every walk of life
4. To learn to eat cost-effective but healthy foods that are rich in essential nutrients
5. To develop immunity naturally that will improve resistance against many health disorders

**UNIT I HEALTH AND ITS IMPORTANCE** 9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases/disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increases satisfaction - Saves time.

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining importance and actions to be taken

**UNIT II DIET** 9

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients
one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet
Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method.

**UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH** 9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - UyirThathukkal (Tri-Dosha Theory) - Udal Thathukkal

Prevention of illness with our traditional system of medicine Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

**UNIT IV MENTAL WELLNESS** 9

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long-term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion.

Immunity - Types and importance - Ways to develop immunity

**UNIT V YOGA** 9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals
according to their age - The Eight Limbs of Yoga - Simple yogasan as for cure and prevention of
health disorders - What yoga can bring to our life.

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOMES**:

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

CO1 Learn the importance of different components of health
CO2 Gain confidence to lead a healthy life
CO3 Learn new techniques to prevent lifestyle health disorders
CO4 Understand the importance of diet and workouts in maintaining health

**TEXTBOOKS:**

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body,

**REFERENCES:**

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts
2. A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.

Web Reference:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health
https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-

health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html
4. https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926
5. Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefits-ofhealthy-eating.html
6. Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditives
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---whorecommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
https://yogamedicine.com/guide-types-yoga-styles/
Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
9. Siddha : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. CAM : https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409

| Course Code | HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA | L | T | P | C |
|---|---|---|---|---|---|
| MC2402 | | 3 | 0 | 0 | 0 |

9

**UNIT I CONCEPTS AND PERSPECTIVES**

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history

Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, the concept of historical inevitability, and Historical Positivism.

Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India

**UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA** 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

**UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA** 9

Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times
Science and technology from 1st century AD to C-1200

**UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA** 9

Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

**UNIT V SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA** 9

Science, Technology and Development discourse
Shaping of the Science and Technology Policy
Developments in the field of Science and Technology
Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology .

**TOTAL NUMBER OF PERIODS: 45**

**REFERENCES:**

1.Acharya , P. K ., Dictionary o f Hindu Architecture. London, 1927.
2 Bose , D. M ., Sen , S. N., and Subba rayappa , B. V. (Eds.), A Concise History of Science in India. Indian National Science Academy, New Delhi, 1971.
3.. Chatterji, Sunm Kumar (E d.), The Cultural Heritage of India. Vol. V. The Ramakrishna Mission Institute of Culture, Calcutta, 1978.
4. Chattopadhyaya, Debiprasad (Ed.), Studies in the History of Science in India (2 Vols.). Editorial Enterprises, New Delhi, 1982.
5. Dampier, W. C., History of Science and its Relations with Philosophy and Religion. 4th Edn. Cam bridge, 1961.
6. Forbes, George , History of Astronomy. Watts & Co., London, 1909.
7.Forbes, R. J., Metallurgy in Antiquity. Leyden, 1950.
8.Haldane, J. B. S., Science and Indian Culture. New Age Publishers Pvt. L td., Calcutta, 1965.
9. Frawley, D., Planets in the Vedic literature, Indian Journal of History of Science. 29.495-506, 1994. 10 B Datta and A N Singh, History of Hindu Mathematics: A source book, Parts 1 and 2 (single volume), Asia Publishing House, Bombay, 1962.
11. George G Joseph, Crest of the Peacock, Non-European roots of mathematics, Third edition, Princeton University Press, Princeton, NJ, 2011.

| Course Code | POLITICAL AND ECONOMIC THOUGHT FOR A HUMANE SOCIETY | L | T | P | C |
|---|---|---|---|---|---|
| MC2403 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES:**

1. This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfil them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

**UNIT I INTRODUCTION** 9

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems.

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

**UNIT II CAPATALISM AND MONOPOLIES** 9

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (Refs: Adam smith, J S Mill) Fascism and totalitarianism. World War I and II. Cold war.

**UNIT III COMMUNISM** 9

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models. (Refs: Marx, Lenin, Mao, M N Roy)

**UNIT IV HUMAN EMPOWERMENT** 9

Welfare state. Relation with human desires. Empowered human beings, satisfaction. Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. (Refs: M K Gandhi, Schumacher, Kumarappa)

**UNIT V EDUCATION AND TECHNOLOGY** 9

Essential elements of Indian civilization. (Refs: Pt Sundarlal, R C Mazumdar, Dharampal) Technology as a driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

**REFERENCES:**

Authors mentioned along with topics above. Detailed reading list will be provided

| Course Code | STATE, NATION BUILDING AND POLITICS IN INDIA | L | T | P | C |
|---|---|---|---|---|---|
| MC2404 | | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES:**

1. The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

Understanding the need and role of State and politics. Development of Nation-State, sovereignty, sovereignty in a globalized world. Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government unitary-federal, Presidential-Parliamentary, The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India. Goals, objective and philosophy. Why a federal system? National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari) New social movements. The changing nature of Indian Political System, the future scenario. What can we do?

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOMES:**

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

CO1 It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system
with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

**REFERENCES:**


1. Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.
2. Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
3. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
4. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy,
5. Picador India, 2013.
6. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
7. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
8. vii. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005

| Course Code | | L | T | P | C |
|---|---|---|---|---|---|
| MC2405 | INDUSTRIAL SAFETY | 3 | 0 | 0 | 0 |

**COURSE OBJECTIVES**:

1 To Understand the Introduction and basic Terminologies safety.
2. To enable the students to learn about the Important Statutory Regulations and standards.
3. To enable students to Conduct and participate the various Safety activities in the Industry.
4. To have knowledge about Workplace Exposures and Hazards.
5. To assess the various Hazards and consequences through various Risk Assessment Techniques.

**UNIT I SAFETY TERMINOLOGIES** 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold Limit Value (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

**UNIT II STANDARDS AND REGULATIONS** 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

**UNIT III SAFETY ACTIVITIES** 9

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

**UNIT IV WORKPLACE HEALTH AND SAFETY** 9

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane SafetyToxic gas Release.

**UNIT V HAZARD IDENTIFICATION TECHNIQUES** 9

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

**TOTAL NUMBER OF PERIODS: 45**

**COURSE OUTCOMES**:

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

CO1 Understand the basic concept of safety.
CO2 Obtain knowledge of Statutory Regulations and standards.
CO3 Know about the safety Activities of the Working Place.
CO4 Analyse on the impact of Occupational Exposures and their Remedies
CO5 Obtain knowledge of Risk Assessment Techniques.

**TEXTBOOKS:**

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

**REFERENCES:**

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publications, UK, 4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring. (1996).Safety management system: Chapman & Hall, England Society of Safety Engineers, USA

Web Reference:


1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html
3. Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf
4. Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf


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