Pimpri Chinchwad Education Trust's

# PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

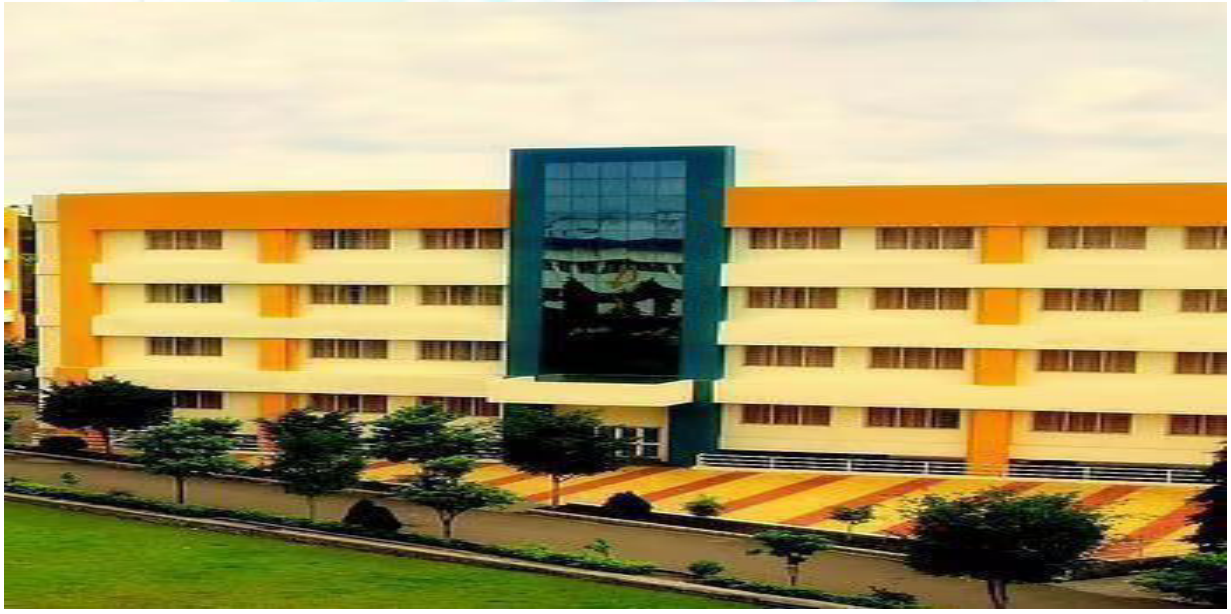
SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

## Curriculum Structure and Syllabus

## of

## Third Year B. Tech. Computer Engineering
## (Regulations 2023)



Effective from Academic Year 2025-26

## Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value-Added Quality Education through a matching ecosystem for building successful careers.

## Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

## EOMS Policy

“We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers, and entrepreneurs through Quality Education.

We are committed for Institute’s social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS).”

# Course Approval Summary

## Board of Studies - Department of Computer Engineering

| Sr. No. | Name of the Course | Course Code | Page Number | Signature and Stamp of BoS |
|---|---|---|---|---|
| 1. | Theory of Computation | BCE25PC01 | 11 | |
| 2. | Machine Learning | BCE25PC02 | 13 | |
| 3. | Computer Networks & Security | BCE25PC03 | 15 | |
| 4. | Computer Graphics and Gaming | BCE25PE01 | 18 | |
| 5. | Internet of Things | BCE25PE02 | 21 | |
| 6. | Data Mining and Warehousing | BCE25PE03 | 24 | |
| 7. | Technical Seminar | BCE25PC04 | 27 | |
| 8. | Digital Marketing | BCE25OE01 | 29 | |
| 9. | Data Security Resiliency and Governance | BCE25OE02 | 31 | |
| 10. | Operating Systems | BCE26PC01 | 54 | |
| 11. | Data Analysis and Algorithm | BCE26PC02 | 57 | |
| 12. | Software Engineering | BCE26PC03 | 60 | |
| 13. | Deep Learning | BCE26PE01 | 62 | |
| 14. | Blockchain Technology | BCE26PE02 | 65 | |
| 15. | UI and UX Design | BCE26PE03 | 68 | |
| 16. | Cloud Computing | BCE26PE04 | 71 | |
| 17. | Cyber Security and Forensics | BCE26PE05 | 74 | |
| 18. | Image and Video Processing | BCE26PE06 | 77 | |
| 19. | Full Stack Development | BCE26VS01 | 80 | |

Chairman
BoS, Computer Engineering
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

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## Board of Studies – Civil Engineering

| Sr. No. | Name of the Course | Course Code | Page Number | Signature and Stamp of BoS Chairman |
|---|---|---|---|---|
| 1 | Remote Sensing & GIS | BCI25OE04 | 34 | |

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PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

**Board of Studies – Electronics & Telecommunication**

| Sr. No. | Name of the Course | Course Code | Page Number | Signature and Stamp of BoS Chairman |
|---|---|---|---|---|
| 1 | Introduction to Advanced Driver Assistance System | BET25OE01 | 36 | |
| 2 | Engineering Psychology | BET25OE02 | 38 | |

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**Board of Studies – Mechanical Engineering**

| Sr. No. | Name of the Course | Course Code | Page Number | Signature and Stamp of BoS Chairman |
|---|---|---|---|---|
| 1 | Unmanned Aerial Vehicle | BME25OE01 | 40 | |
| 2 | Industrial Engineering | BME25OE02 | 42 | |
| 3 | Lean Six Sigma | BME25OE03 | 44 | |
| 4 | Safety, Health and Environment | BME25OE04 | 46 | |
| 5 | Battery Technologies for Electric Vehicles | BME25OE05 | 48 | |
| 6 | Professional Ethics and Sustainability in the Age of AI | BME25OE06 | 50 | |

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**Approved by Academic Council:**

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

# INDEX

# CURRICULUM FRAMEWORK
## (Regulations 2023)

## LIST OF ABBREVIATIONS

| Sr. No. | Abbreviation | Type of Course |
|---|---|---|
| 1 | BSC | Basic Science Course |
| 2 | ESC | Engineering Science Course |
| 3 | PCC | Programme Core Course |
| 4 | PEC | Programme Elective Course |
| 5 | MDM | Multidisciplinary Minor |
| 6 | OEC | Open Elective Course |
| 7 | VSEC | Vocational and Skill Enhancement Course |
| 8 | AEC | Ability Enhancement Course |
| 9 | EEM | Entrepreneurship/Economics/Management Course |
| 10 | IKS | Indian Knowledge System |
| 11 | VEC | Value Education Course |
| 12 | ELC | Experiential Learning Course |
| 13 | LLC | Liberal Learning Course |

## COURSE WISE CREDIT DISTRIBUTION

| Sr. No. | Type of Course | No. of Courses | Total Credits | |
|---|---|---|---|---|
| | | | No. | % |
| 1 | Basic Science Course (BSC) | 8 | 14 | 9 |
| 2 | Engineering Core Course (ECC) | 5 | 12 | 8 |
| 3 | Programme Core Course (PCC) | 20 | 44 | 28 |
| 4 | Programme Elective Course (PEC) | 7 | 20 | 13 |
| 5 | Multidisciplinary Minor (MDM) | 6 | 14 | 9 |
| 6 | Open Elective Course (OEC) | 4 | 8 | 5 |
| 7 | Vocational and Skill Enhancement Course (VSEC) | 4 | 8 | 5 |
| 8 | Ability Enhancement Course (AEC) | 2 | 4 | 3 |
| 9 | Entrepreneurship/ Economics/ Management Course (HSSM) | 2 | 4 | 3 |
| 10 | Indian Knowledge System (IKS) | 1 | 2 | 1 |
| 11 | Value Education Course (VEC) | 2 | 4 | 3 |
| 12 | Experiential Learning Courses | 5 | 22 | 14 |
| 13 | Liberal Learning Courses | 2 | 4 | 3 |
| | **Total** | **68** | **160** | **100** |

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## SEMESTER-WISE COURSE DISTRIBUTION

| COURSE DISTRIBUTION: SEMESTER WISE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SR NO | TYPE OF COURSE | NO. OF COURSES / SEMESTER | | | | | | | | Total |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1. | Basic Science Course (BSC) | 4 | 4 | - | - | - | - | - | - | 8 |
| 2. | Engineering Core Course (ECC) | 3 | 2 | - | - | - | - | - | - | 5 |
| 3. | Programme Core Course (PCC) | - | 1 | 4 | 4 | 4 | 3 | 4 | - | 20 |
| 4. | Programme Elective Course (PEC) | - | - | - | - | 1 | 2 | 2 | 2 | 7 |
| 5. | Multidisciplinary Minor (MDM) | - | - | 1 | 1 | 2 | 1 | 1 | - | 6 |
| 6. | Open Elective Course (OEC) | - | - | 2 | 1 | 1 | - | - | - | 4 |
| 7. | Vocational and Skill Enhancement Course (VSEC) | 1 | 1 | - | 1 | - | 1 | - | - | 4 |
| 8. | Ability Enhancement Course (AEC) | 1 | - | - | 1 | - | - | - | - | 2 |
| 9. | Entrepreneurship/ Economics/ Management Course (HSSM) | - | - | 1 | 1 | - | - | - | - | 2 |
| 10. | Indian Knowledge System (IKS) | - | 1 | - | - | - | - | - | - | 1 |
| 11. | Value Education Course (VEC) | - | - | 1 | 1 | - | - | - | - | 2 |
| 12. | Experiential Learning Courses | - | - | 1 | - | - | - | 2 | 2 | 5 |
| 13. | Liberal Learning Courses | 1 | 1 | - | - | - | - | - | - | 2 |
| Total | | 10 | 10 | 10 | 10 | 08 | 07 | 09 | 04 | 68 |

## SEMESTER-WISE CREDIT DISTRIBUTION

| CREDIT DISTRIBUTION: SEMESTER WISE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Lecture hour = 1 Credit, 2 Lab Hours = 1 Credit, 1 Tutorial Hour = 1 Credit | | | | | | | | | | |
| SR NO | TYPE OF COURSE | CREDITS / SEMESTER | | | | | | | | Total |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1. | Basic Science Course (BSC) | 7 | 7 | - | - | - | - | - | - | 14 |
| 2. | Engineering Core Course (ECC) | 7 | 5 | - | - | - | - | - | - | 12 |
| 3. | Programme Core Course (PCC) | - | 2 | 8 | 8 | 10 | 8 | 8 | - | 44 |
| 4. | Programme Elective Course (PEC) | - | - | - | - | 4 | 8 | 4 | 4 | 20 |
| 5. | Multidisciplinary Minor (MDM) | - | - | 2 | 2 | 4 | 2 | 4 | - | 14 |
| 6. | Open Elective Course (OEC) | - | - | 4 | 2 | 2 | - | - | - | 8 |
| 7. | Vocational and Skill Enhancement Course (VSEC) | 2 | 2 | 2 | - | - | 2 | - | - | 8 |
| 8. | Ability Enhancement Course (AEC) | 2 | - | - | 2 | - | - | - | - | 4 |
| 9. | Entrepreneurship/ Economics/ Management Course (HSSM) | - | - | 2 | 2 | - | - | - | - | 4 |
| 10. | Indian Knowledge System (IKS) | - | 2 | - | - | - | - | - | - | 2 |
| 11. | Value Education Course (VEC) | - | - | 2 | 2 | - | - | - | - | 4 |
| 12. | Experiential Learning Courses | - | - | - | 2 | - | - | 4 | 16 | 22 |
| 13. | Liberal Learning Courses | 2 | 2 | - | - | - | - | - | - | 4 |
| **Total** | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 160 |

# Curriculum Structure
## Third Year B. Tech.
## Computer Engineering

# CURRICULUM STRUCTURE

## Third Year B.Tech. (Computer Engineering) Semester – V

| Third Year Computer Engineering (Regulations 2023) (With effect from Academic Year 2025-26) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester V | | | | | | | | | | | | | | | | |
| Course Code | Course Name | Credit Scheme | | | | Teaching Scheme (Hours/Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | | | | | | | | | | FA | | SA | TW | PR | OR | Total |
| | | L | P | T | Total | L | P | T | O* | FA 1 | FA 2 | | | | | |
| BCE25PC01 | Theory of Computation | 2 | - | 1 | 3 | 2 | - | 1 | 1 | 20 | 20 | 60 | - | - | - | 100 |
| BCE25PC04 | Technical Seminar | - | 1 | - | 1 | - | 2 | - | 1 | - | - | - | 50 | - | - | 50 |
| | Open Elective Course IV | 2 | - | - | 2 | 2 | - | - | - | 10 | 10 | 30 | - | - | - | 50 |
| | Multidisciplinary Minor III | 3 | - | - | 3 | 3 | - | - | - | 20 | 20 | 60 | - | - | - | 100 |
| | Multidisciplinary Minor III Laboratory | - | 1 | - | 1 | - | 2 | - | - | - | - | - | 50 | - | - | 50 |
| **Theory cum Practical** | | | | | | | | | | | | | | | | |
| BCE25PC02 | Machine Learning | 3 | | - | 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |
| BCE25PC03 | Computer Networks & Security | 3 | | - | 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |
| BCE25PE01 -03 | Program Elective Course I | 4 | | - | 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | - | 50 | 150 |
| **Total** | | **19** | | **1** | **20** | **13** | **12** | **1** | **5** | **80** | **80** | **240** | **250** | **-** | **50** | **700** |

#Refer separate booklet for Multidisciplinary Minor (MDM Courses)
*O*: Others(Self Learning)*

**L**-Lecture, **P**-Practical, **T**-Tutorial, **FA**–Formative Assessment, **SA** – Summative Assessment, **TW**-Term Work, **OR**-Oral, **PR**-Practical

**Note: -**

1. Exit Policy: Available as a separate document
2. Students must ensure that the same course(Contents) is not selected under multiple categories (Core Courses, Professional Electives, Open Electives, or Multidisciplinary Minors (MDMS), or any other Course where choices are given. Each course can only be credited once towards the degree requirements.

# Semester - V

## List of Courses – Programme Elective Course I

| Course Code | Course Name | |
|---|---|---|
| BCE25PE01 | Computer Graphics and Gaming | Choose any one |
| BCE25PE02 | Internet of Things | |
| BCE25PE03 | Data Mining and Warehousing | |

## List of Courses – Open Elective Course IV

| Course Code | Department | Course Name | |
|---|---|---|---|
| BCI25OE04 | CIVIL | Remote Sensing and GIS | Choose any one |
| BCE25OE01 | COMP | Digital Marketing | |
| BCE25OE02 | | Data Security Resiliency and Governance | |
| BET25OE01 | E&TC | Introduction to Advanced Driver Assistance System | |
| BET25OE02 | | Engineering Psychology | |
| BME25OE01 | MECH | Unmanned Aerial Vehicle | |
| BME25OE02 | | Industrial Engineering | |
| BME25OE03 | | Lean Six Sigma | |
| BME25OE04 | | Health and Environment | |
| BME25OE05 | | Battery Technologies for Electric Vehicles | |
| BME25OE06 | | Professional Ethics and Sustainability in the Age of AI. | |

# Third Year B.Tech. (Computer Engineering) Semester – VI

| | Third Year Computer Engineering (Regulations 2023)<br>(With effect from Academic Year 2025-26) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Semester VI | | | | | | | | | | | | | | | |
| Course Code | Course Name | Credit Scheme | | | | Teaching Scheme (Hours/Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | | | | | | | | | | FA | | SA | TW | PR | OR | Total |
| | | L | P | T | Total | L | P | T | O* | FA 1 | FA 2 | | | | | |
| | Multidisciplinary Minor IV | 2 | - | - | 2 | 2 | - | - | - | 10 | 10 | 30 | - | - | - | 50 |
| BCE26VS01 | Full stack Development | - | 2 | - | 2 | - | 4 | - | - | - | - | - | 50 | 50 | - | 100 |
| Theory cum Practical | | | | | | | | | | | | | | | | |
| BCE26PC01 | Operating System | 3 | | - | 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |
| BCE26PC02 | Design and Analysis of Algorithms | 3 | | - | 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |
| BCE26PC03 | Software Engineering | 2 | | - | 2 | 1 | 2 | - | 1 | - | 25 | - | 25 | - | - | 50 |
| BCE26PE01-03 | Program Elective Course II | 4 | | - | 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | - | 50 | 150 |
| BCE26PE04-06 | Program Elective Course III | 4 | | - | 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | - | 50 | 150 |
| **Total** | | **20** | | - | **20** | **11** | **18** | - | **5** | **50** | **75** | **150** | **275** | **50** | **100** | **700** |

[#]Refer separate booklet for Multidisciplinary Minor (MDM Courses)
*O*: Others (Self Learning)*

**L**-Lecture, **P**-Practical, **T**-Tutorial, **FA –** Formative Assessment, **SA –** Summative Assessment, **TW**-Term Work, **OR**-Oral, **PR**-Practical

**Note: -**

3. **Exit Policy:** Available as a separate document
4. Students must ensure that the same course (Contents) is not selected under multiple categories (Core Courses, Professional Electives, Open Electives, or Multidisciplinary Minors (MDMS), or any other Course where choices are given. Each course can only be credited once towards the degree requirements.

# Semester - VI

## List of courses – Programme Elective Course – II

| Course Code | Course Name | |
|---|---|---|
| BCE26PE01 | Deep Learning | Choose any one |
| BCE26PE02 | Blockchain Technology | |
| BCE26PE03 | UI and UX Design | |

## List of courses – Programme Elective Course – III

| Course Code | Course Name | |
|---|---|---|
| BCE26PE04 | Cloud Computing | Choose any one |
| BCE26PE05 | Cyber Security and Forensics | |
| BCE26PE06 | Image and Video Processing | |

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# Course Syllabus
# Semester V

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|---|
| Course: | Theory of Computation | | | | | | Code: BCE25PC01 | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 3 | 2 | - | 1 | 1 | 20 | 20 | 60 | 100 |

**Prior knowledge of** discrete mathematics **is essential**

**Course Objectives:**

1. To study abstract computing models.
2. To model problems mathematically using basic types of Automata.
3. To develop skills of solving problems efficiently.
4. To learn Grammar, Push Down Automata, Turing Machine for language processing and algorithm design.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Analyze and design basic mathematical model of computation like deterministic and non- deterministic finite automata.
2. Design the Regular Expression for defining the search patterns.
3. Design formal languages using Context Free Grammar
4. Construct Push Down Automata for solving problems
5. Design model of computation using Turing Machine

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to Finite Automata**<br>Finite Automata (FA), Finite State Machine (FSM), Deterministic FA, Non-Deterministic FA, Equivalence of NFA and DFA, Non-Deterministic FA with epsilon moves, Equivalence of NFA with epsilon moves and NFA without epsilon moves. Minimization of DFA, Moore and Mealy machines, Inter- conversion of Moore and Mealy machine, Properties and Limitations of FA.<br>**Case Study:** Applications of Finite State Machine such as Vending Machine (OR) Lexeme recognition for set of keywords for any programming language. | 10 |
| II | **Regular Expressions (RE)**<br>Introduction, Equivalence of Regular Expressions and Finite Automata, RE to DFA Conversions, DFA to RE Conversions using Arden's theorem, Properties of Regular Languages, The pumping lemma for Regular language<br>**Case Study:** RE in text search and replace (OR) GREP utility in Unix. | 8 |
| III | **Context Free Grammars (CFG)**<br>Introduction, Regular Grammar, Context Free Grammar- Definition, Derivation, Context Free Language (CFL), Parse tree, Ambiguous Grammar, Simplification of CFG, Chomsky normal form, Chomsky Hierarchy.<br>**Case Study:** CFG for Parenthesis Match- XML and Document Type | 9 |

| | | |
|---|---|---|
| **IV** | **Pushdown Automata (PDA):**<br>Formal definition of a pushdown automaton, Examples of pushdown automata, Equivalence of PDA with CFG, Non deterministic PDA (NPDA), PDA and CFL. | 8 |
| **V** | **Turing Machines (TM)**<br>Introduction of Turing Machine Model, Language Acceptability by Turing Machines. Design of TM, Description of Turing machine, Techniques for TM Construction, Non- deterministic Turing machines, The Halting Problem, Multi Tape TM, Properties of recursive and recursively enumerable languages,<br>**Case Study:**String operation and arithmetic computation using Multitape Turing Machine | 10 |
| | **Self-Study**<br>Decidable and Undecidable Problems, Traveling salesman problem, Post Correspondence Problem, research paper reading. | 6* |
| | **Total** (* Not Included) | **45** |

**Text Books:**

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Pearson,3rd Edition, 2008, ISBN-13: 978-8131720479.
2. Vivek Kulkarni "Theory of Computation", Oxford University Press, 2013, ISBN-13 978-0198084587.

**Reference Books:**

1. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Pearson, 2nd edition,1997, ISBN- 13: 978-0132624787.
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGraw-Hill Education, 4th edition, 2010, ISBN-13: 978-0073191461.

**Online Sources:**

1. NPTEL Theory of Computation , https://nptel.ac.in/courses/106/106/106106049/
2. Coursera - Automata Theory by Stanford (Free audit option) https://www.coursera.org/learn/automata
3. MITOpenCourseWare Automata, Computability, and Complexity https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-045j-automata-computability-and-complexity-spring-2011/

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Machine Learning | | | | | | Code: BCE25PC02 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |

**Prior knowledge of** basic mathematics **is essential.**

**Course Objectives:**

This course aims at enabling students to:

1. Fundamental concepts and types of machine learning algorithms.
2. Use data preprocessing techniques essential for preparing datasets.
3. Applying appropriate machine learning algorithms to real-world problems.
4. Evaluate machine learning models using relevant performance metrics.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Examine data preprocessing techniques for effective data cleaning.
2. Evaluate the effectiveness of linear regression models.
3. Assess the performance of various classification algorithms.
4. Investigate the clustering algorithms for performance insights.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. 50% weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.
3. 50% weightage of term work is based on internal oral/practical examination.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative.
2. Programming tools recommended: PYTHON.
3. Programming tools like Jupiter notebook, Spyder, VS code etc.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | Artificial Intelligence, Machine Learning and Deep Learning, applications, type of Machine Learning, data formats, learnability, statistical learning approach, data cleaning, Exploratory data analysis, feature selection: select k best, variance threshold, PCA. | 7 |
| II | Linear Regression: Linear model, a bidimensional example, multiple regression, assumptions, evaluation metrics for regression model: MAE, MSE, RMSE, $R^2$-score, Adjusted $R^2$-score, Ridge, Lasso, ElesticNet, Polynomial regression, RANSAC. | 7 |

| | | |
|---|---|---|
| **III** | Supervised Learning Classification: Logistic regression, naïve bayes, support vector machine, Decision trees, Ensemble Learning, confusion metrics, Performance metrics to evaluate classifier:, precision, recall, f-score, AUC-ROC curve. | 8 |
| **IV** | Unsupervised Learning: K-means clustering, Hierarchical clustering, clustering metrics: Inertia, Silhouette Score, Davies-Bouldin Index, Introduction to artificial neural network, Perceptron model and limitations. | 8 |
| | **Self-Study**<br>Feature Engineering: Handling different types of data, feature transformation: normalization and standardization. Density Based clustering (DBSCAN)**,** research paper reading. | 6* |
| | **Total** (* Not Included) | **30** |

**Suggested Lab Assignments:**

1. Select/download dataset from UCI/Kaggle or any other repository. Perform data cleaning and exploratory data analysis (EDA) to gain insights from data
   Data cleaning can be following but not limited to:
   1. Handle missing values
   2. Detect and treat outliers
   3. Convert categorical data to numerical
   4. Plot distributions
   5. Analyze data using correlation
   6. Feature selection
2. You are a data scientist at a real estate company tasked with building a model to predict house prices based on features like area, number of bedrooms, location, and age of the house. (Dataset: https://www.kaggle.com/datasets/yasserh/housing-prices-dataset)
3. A car manufacturing company wants to predict the resale value of cars. Due to high variance and overfitting, they want to apply regularization techniques. (Dataset: https://www.kaggle.com/datasets/hellbuoy/car-price-prediction)
4. A telecom company wants to predict customer churn based on features like customer demographics, service usage, and billing information. The goal is to build a decision tree classifier and evaluate its performance. (Dataset:https://www.kaggle.com/datasets/blastchar/telco-customer-churn)
5. An image recognition system needs to classify handwritten digits (0-9) from the MNIST dataset using Support Vector Machines (SVM).
6. A botanist wants to classify different iris species based on their flower characteristics like sepal length, sepal width, petal length, and petal width.

**Text Books:**

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt Publishing Ltd. 2017, ISBN 978-1-78588-962- 2
2. Jiawei Han, Micheline Kamber, “Data mining: concepts and techniques", Morgan Kaufmann Publisher 2023, fourth edition, ISBN 13: 978-1-55860-901-3.

**Reference Books:**

1. Ethem Alpaydin, “Introduction to Machine Learning”, PHI second edition-2021, ISBN: 978-0-262-01243-0
2. Tom Mitchell, “Machine Learning” McGraw Hill Publication 1997, ISBN: 0070428077
3. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly Media, Inc. publisher 2017, ISBN: 9781491962299

**Online Sources:**

1. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
2. https://www.cin.ufpe.br/~cavmj/Machine%20-%20Learning%20-%20Tom%20Mitchell.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Computer Networks and Security | | | | | | Code: BCE25PC03 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |

**Prior knowledge of** Digital Electronics and Computer Organization **is essential.**

**Course Objectives:**

This course aims at enabling students:

1. To understand the fundamental concepts of networking standards, protocols and technologies.
2. To learn the role of protocols at various layers in the protocol stacks.
3. To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
4. To aware students with various algorithms of Cryptography.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Apply concepts of a network, its models, architectures for network design with data link layer services.
2. Determine the services and protocols used at upper layers of TCP/IP model.
3. Identify various security challenges, threats, attacks, and apply knowledge of security models to prevent attacks.
4. Use Cryptographic Techniques to encrypt and decrypt the messages.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. Weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.

"Knowledge Brings Freedom"

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative.
2. Programming tools recommended: - Open-Source C, C++, JAVA and PYTHON.
3. Programming tools like G++/GCC, Wireshark, Packet Tracer, etc.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Basic of Networking:**<br>**Physical Layer:**<br>Introduction, LAN, MAN, WAN, PAN; Physical Mediums, Networking Devices: Bridge, Switch, Router and Access Point; Concept of Network Topologies, OSI Model; TCP/IP Model; addressing, Network Architectures: Peer-to-Peer, Client-Server.<br>**Data Link Layer:**<br>Logical Link Control: Framing ; Error Control: Parity Bits and CRC; Flow Control Protocols: Simplex, Stop and Wait, Sliding Window protocol | 8 |

| | | |
|---|---|---|
| **II** | **TCP/IP Model:**<br>**Network Layer:** IPv4 and IPv6 protocols; Routing Algorithms: RIP, OSPF, BGP.<br>**Transport Layer:** Socket; Structure of TCP and UDP; Flow Control; Congestion Control<br>**Application Layer:** Protocols: HTTP (Overview, Persistent and Non-Persistent, Message Format, Cookies, Caches); Overview of SMTP, DNS, DHCP, FTP, Telnet | 8 |
| **III** | **Security Basics:**<br>**Computer Security Concepts** - Confidentiality, Integrity & Availability (CIA), The challenges of Security, Threats, Attacks, Operational Model of Security;<br>**Basics:** Symmetric and Asymmetric Cipher Model; Cryptography; Cryptanalysis and Brute-Force Attack<br>**Classical Encryption Techniques** - Substitution Techniques: Caesar Cipher, Play fair Cipher | 7 |
| **IV** | **Symmetric Cipher:** Stream ciphers and Block Ciphers; Feistel Cipher Structure, Data Encryption Standard (DES): DES Encryption; DES Decryption; DES Example; Strength of DES,<br>**Asymmetric Cipher:** Public-Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange Algorithm | 7 |
| | **Self-Learning**<br>Media Access Control: MAC Address; Overview of Multiple Access Protocols, Basics of Ethernet, Monoalphabetic Ciphers, Polyalphabetic Ciphers, Double DES and triple DES (with 2 & 3 keys), research paper reading. | 4* |
| | **Total** (*Not Included) | **30** |

**Suggested Lab Assignments:**

1. Setup a wired LAN using Layer 2 Switch and then IP switch of minimum four computers. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and preparing server to send file to client. Demonstrate the PING packets captured traces using Wireshark Packet Analyzer Tool.
2. Write a program for error detection for 7/8 bits ASCII codes using CRC.
3. Write a program to simulate Go back N of Sliding Window Protocol in peer-to-peer mode.
4. Write a program using TCP socket for wired network to implement peer to peer Chat.
5. Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa.
6. Write a program to implement Play fair Cipher and write a conclusion on the strength of play fair cipher.
7. Write a program to implement Simplified Data Encryption Standard (SDES) Algorithm and write a conclusion on the strength of SDES.
8. Write a program to implement RSA Algorithm and write a conclusion on the strength of RSA Algorithm.

**Text Books:**

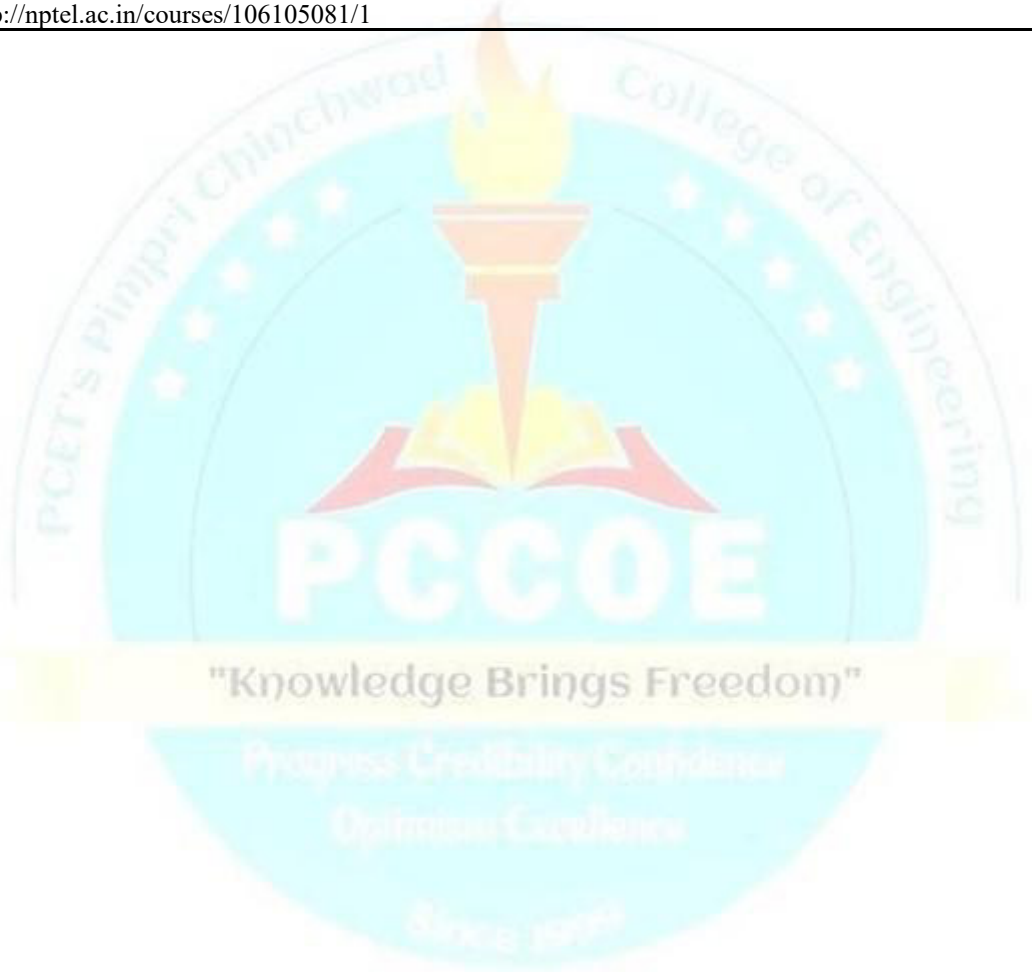
1. Andrew S. Tanenbaum, “Computer Networks”, Pearson Education India,6th Edition, 2021 ISBN: 9780136764052, 0136764053.
2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw- Hill Publications, 2013 ISBN: 1259064751 · 9781259064753.
3. William Stallings, “Cryptography and network security principles and practices”, Pearson, 6th Edition, ISBN: 978-93-325-1877-3
4. Atul Kahate, “Cryptography and Network Security”, McGraw Hill Publication, 2nd Edition, 2008, ISBN: 978- 0-07-064823-4

**Reference Books:**

1. Kurose, Ross , “Computer Networking a Top-Down Approach Featuring the Internet”, 8/E, 2021, ISBN-10:0136681557, ISBN-13: 9780136681557, 2021, Pearson.
2. Matthew S. G, “802.11 Wireless Networks”, O,,Reilly publications,3rd Edition, 2017, ISBN: 81-7656-992-5.
3. Eoghan Casey, “Digital Evidence and Computer Crime Forensic Science, Computers and the Internet”, ELSEVIER, 2011, ISBN 978-0-12-374268-1
4. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning India, 2014, ISBN No.: 8131513491

**Online Sources:**

1. https://www.javatpoint.com/computer-network-tutorial
2. http://nptel.ac.in/courses/106105081/1



| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Computer Graphics and Gaming | | | | | | Code: BCE25PE01 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Basic Geometry, Trigonometry, Vectors and Matrices, Data Structures and Algorithms **is essential**

**Course Objectives:**

This course aims at enabling students to:

1. Apply fundamental graphics algorithms such as line, circle drawing, polygon filling, and clipping.
2. study projection, windowing, clipping, and viewports in the context of image display.
3. Apply 2D and 3D geometric transformations using programming tools and graphics libraries.
4. Design interactive visual applications incorporating sprites, scenes, sound, and physics.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Apply various algorithms for scan conversion to draw the basic geometrical primitives.
2. Apply 2D and 3D transformation operations to graphical objects
3. Apply various viewing, filling and clipping techniques on 2D polygon.
4. Design and develop interactive applications or games using graphics tools and engines.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. 50% weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.
3. 50% weightage of term work is based on internal oral/practical evaluation.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative
2. Programming tools recommended: - OpenGL, Libgraph
3. Use of open-source tools is to be encouraged.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Basics of Computer Graphics**<br>**Introduction to computer graphics**: overview of graphics Systems, raster and random scan, basic display processor- CRT, input-output devices. Data, Images, and Computer Graphics, Applications of Computer Graphics, Color Models.<br>**Scan conversion**: Point, Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint. | 7 |
| II | **2D, 3D Transformations and Projections** | 8 |

| | | |
|---|---|---|
| | **2D Transformations:** Translation, Scaling, Rotation, Reflection and Shearing, Matrix representation and homogeneous coordinate system, composite transformations, rotation about an arbitrary point.<br>**3D Transformation:** Translation, scaling, rotation, and reflection.<br>**Projections:** Types of projections- Parallel and Perspective | |
| **III** | **Polygon, Windowing and Clipping**<br>**Polygons:** Polygons and its types, inside test<br>**Polygon filling methods:** Seed Fill – Flood fill and Boundary Fill, Scan-line Fill algorithms,<br>**Windowing:** Concept of window and viewport, viewing transformations<br>**Line Clipping:** Cohen Sutherland, Midpoint Subdivision, and Liang-Barsky Line Clipping Algorithm<br>**Polygon Clipping:** Sutherland Hodgeman method for convex and concave polygon clipping | 8 |
| **IV** | **Game Design**<br>**Introduction to gaming:** Types of games, Different aspects of game design; Different components in a game; Game engines & Gaming platform.<br>**Game Design Steps:** Storyboard layout, Object definitions, Animation using Key-frame Specifications, Generation of in between frames, Rendering<br>**OpenGL:** Graphics function, OpenGL Interface, primitives and attributes, Control functions, programming events. (Simple Interaction with the Mouse and Keyboard) | 7 |
| | **Self-Learning**<br>Game engines & Gaming platform- Unity, Unreal Engine, Godot, Twine, CoCoS 2D.<br>AI Tools for Game Development- Meshy AI, LPC Sprite Generator, Character.ai, Leonardo.ai, research paper reading. | 5 |
| | **Total** (*Not Included) | **30** |

**Lab Assignment:**

Game Theme Identification

1. Before starting with the assignments, each student/group must:
2. Choose the type of game: e.g., car racing, obstacle dodger, maze explorer, shooter, puzzle, etc.
3. Sketch a basic idea of game layout and objectives.
4. Identify key characters/objects needed.
5. Define what can be drawn with lines, circles, polygons, etc.

**Suggested list of Assignment:**

1. Implement DDA and Bresenham's line drawing algorithms to create static elements of your game, such as roads, platforms, ladders, or character outlines. .
2. Use Bresenham's or Midpoint circle drawing algorithm to design curved objects like wheels, buttons, coins, or character heads.
3. Apply 2D or 3D transformations—translation, rotation, and scaling—to animate your game objects. Demonstrate in-game actions like movement, rotation of wheels, or resizing of platforms using transformations.
4. Implement seed fill or scan line fill algorithm to color various parts of your game scene. Use appropriate colors to highlight zones
5. Use line or polygon clipping algorithms to simulate camera viewports or boundary-based movement. Demonstrate how objects or characters are clipped when they move outside the visible area.
6. Mini Project 1D/2D/ 3D game development using OpenGL/ 3D studio/ Flash/ Unity/ Unreal Engine/ Godot/ any similar tool
   - Installation of a game engine. Conceptualize the theme for a 1D/2D/3D game.
   - Character design, sprites, movement and character control.
   - Level design: design of the world in form of tiles along with interactive and collectible objects.

- Design of interaction between the player and the world, optionally using the physics engine.
- Insert audio.

Rendering

**Text Books:**

1. Donald D. Hearn and Baker, Computer Graphics with OpenGL, 4th Edition, ISBN-13: 9780136053583.
2. Nystrom Robert, Game Programming Patterns, 2014, 3rd edition, Genever Benning, 978-0990582908

**Reference Books:**

1. David F Rogers, “Procedural elements for Computer Graphics”, Second Edition, Tata Mc Graw Hill, ISBN 0-07-047371-4
2. F. Hill, “Computer Graphics: Using OpenGL”, Second Edition, Pearson Education, ISBN 81-297-0181-2
3. Paris Buttfield-Addison et al., Unity Game Development Cookbook: Essentials for Every Game, 1st Edition, O’Reilly Media, 2019

**Online Sources:**

1. https://onlinecourses.nptel.ac.in/noc20_cs90/preview
2. https://www.udemy.com/course/unitycourse/?couponCode=IND21PM
3. https://www.udemy.com/course/unreal-engine-5-3d-game-art-fantasy-swords-with-bonus-vfx/?couponCode=IND21PM
4. https://www.udemy.com/course/unityfpsgame/?couponCode=IND21PM
5. https://www.coursera.org/specializations/game-design
6. https://www.coursera.org/learn/game-development-html-to-unreal-engine-mastery

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Internet of Things | | | | | | Code: BCE25PE02 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Digital Electronics and Computer Organization **is essential.**

**Course Objectives:**

This course aims at enabling students:

1. To understand the fundamentals, reference architectures, communication models, and enabling technologies of the Internet of Things (IoT).
2. To apply IoT platform design methodology for modeling system requirements, functionality, and integration.
3. To explore sensor types, development boards, and communication interfaces relevant to IoT applications.
4. To analyze communication protocols and security mechanisms used in IoT systems for ensuring reliable and secure data exchange.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Interpret IoT architectures, communication models, enabling technologies, and associated challenges in IoT systems..
2. Apply IoT platform design methodology to define functional, operational, and integration views of IoT systems.
3. Select appropriate sensors, actuators, development boards, and communication interfaces for IoT applications.
4. Analyze IoT communication protocols and security mechanisms to determine suitable strategies for secure and reliable data transmission.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. Weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative.
2. Programming tools recommended: - Open-Source C, C++, JAVA and PYTHON. Python, OpenCV
3. Online Simulators: Tinkercad Circuits/ Wokwi Arduino Simulator/ iot-playground.com/ OpenDaylight SDN Controller

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Fundamentals of IoT:** Definition, Characteristics, Applications, Architecture (Physical & Logical), Communication Models and APIs (REST, WebSocket), IoT Levels, Enabling Technologies (WSN, RFID, Cloud, Big Data), Challenges (Security, Interoperability, Scalability) | 8 |
| II | **IoT Platform Design Methodology:** Purpose and Requirement Specification, Process Specification, Domain model specification, Information Model Specification, Service specifications, IoT Level Specifications, Functional view specification, Operational View Specification, Device and Component integration, Application development | 7 |

| | | |
|---|---|---|
| **III** | **Sensors and IoT Hardware:** Sensor types and categories, Actuators, Development Boards (Arduino, ESP8266, Raspberry Pi), Basics of Interfacing (GPIO, I2C, SPI) | 7 |
| **IV** | **IoT Protocol Stack:** PHY/MAC (BLE, Zigbee, Z-Wave, LoRa), Network (6LoWPAN, RPL), Application (CoAP, MQTT, XMPP, AMQP), Introduction to Next Generation Networks<br>**IoT Security:** Types of Attacks, Vulnerabilities in IoT, Key Elements of IoT Security, Security Model | 8 |
| | **Self-Study**<br>IoT Security basics: Encryption, Authentication, and Privacy Challenges, Comparing Arduino vs. Raspberry Pi vs. ESP32 for IoT Projects, Comparison between Cloud, Edge, and Fog Computing in IoT, Research Paper Reading. | 6* |
| | **Total** (*Not included) | **30** |

**Suggested Lab Assignments:**

1. A startup is developing an IoT-based home monitoring system. Engineers need to decide between Raspberry Pi and Arduino based on project requirements.
2. Design a system to monitor room temperature and alert the elderly if it crosses a safe limit. Interface LM-35 temperature sensor with Arduino. Display temperature values and activate a buzzer if it exceeds the threshold.
3. Build a wearable device for visually impaired users that alerts them to nearby obstacles. Interface an IR sensor with Arduino or Raspberry Pi. Light an LED or trigger a buzzer when an obstacle is detected.
4. Automate the Chrome Dino game using real-world sensors and actuators for STEM education tools. Use a light-dependent resistor (LDR) and servo motor with Arduino. Make the servo "jump" automatically based on game screen brightness.
5. A remote warehouse requires an automatic fire detection and alert system via SMS. Interface flame sensor with Arduino. Send SMS using GSM module or trigger buzzer when fire is detected.
6. An agricultural firm wants to remotely monitor field conditions using cloud services. Interface DHT11 or soil moisture sensor with Arduino. Push sensor data to ThingSpeak / Blynk platform for visualization.
7. Municipalities aim to monitor dustbin levels and optimize waste collection routes. Use ultrasonic sensor to detect fill level of a bin.Send alert when bin is full.
8. A smart greenhouse sends temperature and humidity data to a remote monitoring system using MQTT. Implement MQTT protocol using a NodeMCU or Raspberry Pi. Use DHT11 sensor, NodeMCU (ESP8266), Mosquitto broker or public broker (e.g., HiveMQ), MQTT Dash App, Publish sensor data to MQTT broker. Subscribe to data using mobile/PC.
9. Mini Project: Implement any societal problem using suitable IoT hardware and protocols.
   - Security management
   - Health emergencies
   - Road traffic management
   - Energy Conservation
   - Agricultural Problems
   - Rural development
   - Smart city

**Text Books:**

1. Bahga and V. Madisetti, *Internet of Things: A Hands-On Approach*, 1st ed. Hyderabad, India: Universities Press, 2015. ISBN: 978-8173719547.
2. Tim Pulver, Markus Wuebbeling, “Hands-On Internet of Things with MQTT”, Packt Publishing, 1st Edition, 2022, ISBN: 9781800567993.
3. Aryan Kaushik, “6G: The Road to the Future Wireless Technologies 2030”, Wiley-IEEE Press, 1st Edition, 2023, ISBN: 9781119903802.

**Reference Books:**

1. Peter Waher, “Mastering Internet of Things: Design and create your own IoT applications using Raspberry Pi 3”, Packt Publishing, 2nd Edition, 2020, ISBN: 9781800205260.

2. Patricia A. Morreale, James M. Anderson, “Software Defined Networking: Design and Deployment”, CRC Press, 2nd Edition, 2021, ISBN: 9780367332154.
3. Agus Kurniawan, “Internet of Things Projects with Arduino and ESP32”, Independently Published, 1st Edition, 2021, ISBN: 9798724812744.
4. Fei Hu (Ed.), “Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations”, CRC Press, 1st Edition, 2022, ISBN: 9780367558363.

**Online Sources:**

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
3. https://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know about-the-iot- right-now/

PCET's Pimpri Chinchwad College of Engineering
PCCOE
"Knowledge Brings Freedom"

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Data Mining and Warehousing | | | | | | Code: BCE25PE03 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Database Management System **is essential.**

**Course Objectives:**

This course aims at enabling students:

1. To introduce the fundamentals of Data mining and Data Warehousing.
2. To develop skills to select appropriate multi-dimensional schemas to design data warehouse model.
3. To develop skills to identify the appropriateness and need of data mining.
4. To study and use preprocessing techniques for preparing suitable dataset for data mining.
5. To apply data similarity and dissimilarity measures for statistical analysis
6. To study and apply various methods and algorithms in data mining for solving real world problems.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Use data preprocessing techniques for preparing suitable dataset for data mining.
2. Select appropriate multi-dimensional schema to design data warehouse model.
3. Apply data similarity and dissimilarity measures for statistical analysis.
4. Apply Data Mining functionalities to solve real world problems.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. Weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative.
2. Programming tools recommended: - Python, R, Jupyter Notebook etc. Use of Anaconda platform is encouraged.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | Data Mining, Need of data mining, Data, Information and Knowledge, Knowledge Discovery form Data (KDD), Attribute Types: Nominal, Binary, Ordinal and Numeric attributes; Data pre-processing: Data Cleaning, Data Integration, Data transformation, data reduction, Data Discretization, Binning techniques. | 8 |
| II | Data Warehouse, Operational Database Systems and Data Warehouses (OLTP Vs OLAP), Data Warehouse and Data Mining, Data Warehouse Architecture, Data Lake, A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model. | 8 |

| | | |
|---|---|---|
| **III** | Measuring Data Similarity and Dissimilarity Measuring Central Tendency of Data, Measuring Dispersion of Data, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data: Euclidean distance and Manhattan distance; Use of distance measures in Cluster analysis- partitioning methods: k-means | 6 |
| **IV** | Data Mining Functionalities Cluster analysis- Hierarchical Methods, Density-Based Methods Association Rule Mining: Market basket Analysis, Frequent Item Sets, Association Rules, Apriori Algorithm. Classification: Decision Tree Classification, Lazy Learner- K Nearest Neighbor Classifier | 8 |
| | **Self-Study**<br>Study of POWER-BI Tool for OLAP operations<br>Research Paper reading for use of distance measures in different data mining applications<br>Research Paper reading for use of data mining techniques in real world applications | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested Lab Assignments:**

1. **Pre Processing Techniques**

Create a dummy dataset or with missing values and duplicate entries or select any data set with missing values (such as Iris dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc.

Write a program or use a suitable tool to perform the following operations on the selected dataset and display the result.

1. Removal of duplicates
2. Handle missing values
3. Normalizing the data using normalizing technique
4. Apply min-max scalar / Robust scalar / standard scalar to scale the data
5. Use measures of Central Tendency and Dispersion of Data

"Knowledge Brings Freedom"

2. **OLAP operations**

Select any suitable dataset from standard repository of data and perform **OLAP operations** such as Slicing, Drill-Down, Drill-Up etc. using POWER-BI or any suitable tool.

3. **K-Means Clustering**

Consider a normalized dataset collected from schools showing details of student performance in two subjects S1 and S2. For clustering of data instances in different groups, apply k-mean clustering with initial centroids as C1=P1 =Cluster#1 and C2=P8=cluster#2. Answer the following and visualize the clusters using suitable method. 1. Which cluster does P6 belong to? 2. What is the population of cluster around C2? 3. What is the updated value of C1 and C2?

| Points | S1 | S2 |
|---|---|---|
| P1 | 0.1 | 0.6 |
| P2 | 0.15 | 0.71 |
| P3 | 0.08 | 0.9 |
| P4 | 0.16 | 0.85 |
| P5 | 0.2 | 0.3 |
| P6 | 0.25 | 0.5 |
| P7 | 0.24 | 0.1 |
| P8 | 0.3 | 0.2 |

4. **Association Rule Mining**

Apply Apriori algorithm to find frequently occurring items from selected data set and generate strong association rules using support and confidence thresholds.
For Example: Market Basket Analysis of shopping mall dataset.

5. **KNN Classification**

A dataset collected from hospital showing details of medical test reports with symptom values observed in the patient's and medical test either positive or negative.
Write a program to build k-NN classifier models. If k=3, find the class of the point (6, 6).

| S1 | S2 | Test Class |
|---|---|---|
| 2 | 4 | Negative |
| 4 | 6 | Negative |
| 4 | 4 | Positive |
| 4 | 2 | Negative |
| 6 | 4 | Negative |
| 6 | 2 | Positive |

6. **WEKA tool**

Install **WEKA tool** and perform different Data Mining operations such as Data Preprocessing, Data filtering, Classification and clustering in it.

7. **Mini Project**

Using Data mining concepts covered in the assignments and Data Mining and Warehouse theory course design and develop an application/Decision Support System for the selected problem statement. Visualize the results using suitable tools and methods and prepare a report in suitable format.
**For Example**: Health Care Domain for predicting disease, Shopping mall application for Market Basket Analysis.

**Text Books:**


1. Jiawei Han, Micheline Kamber, "Data mining: concepts and techniques", Morgan Kaufmann Publisher 2012, third edition, ISBN 978-0-12-381479-1.
2. 2. G. K. Gupta, "Introduction to Data mining with Case Studies", PHI Learning Private Limited, Delhi 2014, third edition, ISBN-978-81-203-5002-1.
3. 3. William H Inmon, "Building the data Warehouse", Wiley Publication 2005, fourth edition, ISBN: 978-0-764- 59944-6.


**Reference Books:**


1. Dunham, M. H., "Data mining: Introductory and advanced topics", Upper Saddle River, N.J: Pearson education/Prentice Hall 2003.
2. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit", 3rd Edition, Wiley 2013, ISBN-13: 978-11185308 01.
3. Ian H. Witten and Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Morgan Kaufmann Publishers 2005, ISBN: 0-12-088407-0
4. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Ltd. 2017, ISBN 978-1-78588-962- 2


**Online Sources:**

1. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining. Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf
2. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/DataMining/Witten_and_Frank _DataMining_ Weka_2nd_Ed_2005.pdf
3. http://scikit-learn.org/stable/datasets/
4. https://scikit-learn.org/stable/modules/model_evaluation.html
5. https://www.kaggle.com/datasets

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|---|
| Course: | Technical Seminar | | | | | | Code: BCE25PC04 | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | TW | OR | PR | Total |
| 1 | - | 2 | - | - | 50 | - | - | 50 |

**Course Objectives:**

This course aims at enabling students to:

1. Explore and analyze recent trends, technologies, and research advancements in their area of interest
2. Cultivate the skill of conducting systematic literature surveys using authentic and credible research sources
3. Enhance critical thinking and analytical skills by evaluating existing research work, identifying research gaps, and proposing ideas.
4. Solve potential research problems, laying a foundation for final year projects or publications.
5. Improve students' technical communication, including writing seminar reports and delivering effective oral presentations.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Conduct a detailed literature review using research databases and analyze the state-of-the-art techniques and methodologies.
2. Compare and critically evaluate existing solutions, technologies, or frameworks.
3. Define a research problem based on recent developments and gaps in the literature.
4. Prepare a comprehensive technical report that adheres to academic writing standards

**Guidelines for Students:**

1. Seminar teams: 3-4 students can form a team within the same or different discipline and their area of interest is to be registered with seminar Coordinator.
2. Selection of Seminar Topic:
3. a. Students shall identify the area or topics in recent trends and developments in consultation with seminar guides or industry or any research organization.
4. Guide Allotment:
   a. Considering registered teams' area of interest/domain and expertise of guide, the Seminar coordinator in consultation with HOD allots Seminar guides.
   b. Guide should be allotted from the same program.In case of interdisciplinary Seminar, along with the guide from same program, co-guide should be allotted from the other program
5. Teams in consultation with guides will prepare Seminar Synopsis.
6. Each student/ group shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student.
7. Seminar Review:
   a. The Seminar coordinator with the Head of the department shall constitute a review committee comprising of domain experts and senior faculty members.
   b. The review committee will approve the Seminar group and title. Discussion / presentation may be arranged covering topics listed in the synopsis.
   c. The seminar Review committee will evaluate the timely progress of the projects.
   d. Students with group members are expected to appear for minimum three reviews as per the seminar calendar.
8. Attendance for all the reviews is mandatory.
9. Report should be prepared as per the template provided by the department. Seminar reports shall be submitted in softcopy form/ Hard bound reports as per the decision of the department. In case of Interdisciplinary Seminar, students must submit a Completion certificate with the signature of Co-Guide

from other department.

10. Students will be evaluated twice in the semester based on seminar evaluation guidelines / Rubrics as follows:

| Review | Rubrics | Marks |
|---|---|---|
| Review-I<br>25 Marks | Literature Review and Algorithm Study | 10 |
| | Comparative analysis and Gap identification | 10 |
| | Problem definition, Synopsis Preparation & Submission | 5 |
| Review-II<br>25 Marks | Draft of Review Paper / Paper publication/ IPR/ industry collaboration | 10 |
| | Seminar Report (check for technical content, overall quality, templates followed, adequacy of references) | 10 |
| | Attendance and maintenance of seminar dairy | 5 |

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|---|
| Course: | Digital Marketing (Offered by Computer Engineering) | | | | | | Code: BCE25OE01 | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Understanding of design thinking and planning **is essential.**

**Course Objectives:**

This course aims at enabling students:

1. To introduce the fundamental concepts and various types of digital marketing.
2. To familiarize students with different social media advertising platforms and their role in effective digital marketing campaigns.
3. To equip students with essential skills to implement Search Engine Optimization (SEO) technique.
4. To provide an understanding of E-commerce principles and business models, and to develop the ability to apply E-marketing techniques in digital environments.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Understand the different types of Digital Marketing.
2. Learn social media advertising platforms for digital marketing campaigns.
3. Apply the fundamental principles and concepts of Search Engine Optimization (SEO).
4. Apply e-commerce and e-marketing concepts in Business Models.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Types of Digital Marketing**<br>Digital Marketing – The concept, Digital Marketing Types : Mobile Marketing, Online Marketing, Email Marketing, | 6 |
| II | **Digital marketing using social media**<br>Consumer Generated Contents (CGC), Impact of Social Media, Advantages and Disadvantages of Social Media, Types of Social Media, Social Media Marketing using Instagram, Snap Chat, Twitter and LinkedIn | 8 |
| III | **Search Engine Optimization (SEO)**<br>Search Engine Optimization Basics, Keyword Research, SEO Tool- SEMrush: Overview and Features, Top Search Engine Ranking Factors.<br>Case Study: Dominos India: Building Traffic through content propagation. | 8 |
| IV | **E-commerce Business Models & E-marketing**<br>E-commerce: Meaning, Benefits and limitations, Business Models for E-commerce: Business-to-Consumer (B2C), Business-to-Business(B2B), Consumer-to-Consumer (C2C), Consumer To-Business (C2B).<br>Case Study: Revenue sources at YouTube<br>Traditional Marketing Vs. E-Marketing, Impact of E-commerce on markets, Issues in E-Marketing<br>Case Study: Create an own business EC model example -Shopify | 8 |

| | |
|---|---|
| **Total** | **30** |

**Text Books:**


1. Damian Ryan& Calvin Jones . Understanding DIGITAL Marketing
2. Vandana Ahuja(2015), Digital Marketing. Oxford University Press, New Delhi
3. Neetu Kapoor, Concept Building Approach to Digital Marketing, Cengage, 2nd Edition.
4. The digital marketing Handbook, A step by step guide, Mohit Pawar,2015 Edition.
5. Joseph P. T., E - Commerce – An Indian Perspective, PHI publication, 6th Edition


**Reference Books:**


1. George Pain(2019). Marketing Automation and Online Marketing: Automate Your Business through Marketing Best Practices such as Email Marketing and Search Engine Optimization
2. Barker, M., Barker, D., & Bormann, N. (2016), Social Media Marketing: A Strategic Approach, Boston, MA : Cengage Learning.
3. Tuten, T., Solomon M., Social Media Marketing, SAGE, 2nd Edition.
4. Ian Dodson, The art of Digital Marketing, 2016, Wiley, 978-1-119-26570-2.


**Online Sources:**

1. https://www.coursera.org/learn/foundations-of-digital-marketing-and-e-commerce
2. https://open.umn.edu/opentextbooks/textbooks/1602
3. https://www.coursera.org/learn/social-media-marketing-introduction
4. https://www.coursera.org/specializations/social-media-marketing
5. https://www.coursera.org/projects/create-your-ecommerce-store-with-shopify

| **Program:** | **B. Tech. (Computer Engineering)** | | | | | | | **Semester: V** |
|---|---|---|---|---|---|---|---|---|
| **Course:** | **Data Security Resiliency and Governance** (offered by Computer Engineering) | | | | | | | **Code: BCE25OE02** |
| **Credit** | **Teaching Scheme (Hrs./Week)** | | | | **Evaluation Scheme and Marks** | | | |
| | **Lecture** | **Practical** | **Tutorial** | **Other** | **FA** | | **SA** | **Total** |
| | | | | | **FA1** | **FA2** | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Database Management System **is essential**.

**Course Objectives:**

This course aims at enabling students:

1. To get acquainted with the high-level phases of data life cycle management.
2. To acquire knowledge about the various aspects of data storage, data availability, data protection.
3. To gain exposure to various solutions/reference architectures for various use-cases.
4. To understand the technical capabilities and business benefits of data protection.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Understand the data management world, challenges, best practices and compare various concepts and technologies for enabling data storage and high availability.
2. Describe the various concepts related to data protection.
3. Illustrate various types of data threats and approaches to ensure data center security.
4. Identify different standards for compliance and governance of data and discuss various approaches for designing data enterprise applications

**Detailed Syllabus**

| **Unit** | **Description** | **Duration (Hrs)** |
|---|---|---|
| **I** | **Introduction to data life cycle management (DLM) and Data Resiliency**<br>● Goals of data life cycle management,<br>● Challenges involved,<br>- Volume of data source<br>- Ubiquity of data locations<br>- User demand for access<br>- Stages of data life cycle - creation, storage, usage, archival, destruction<br>- Risks involved without DLM, benefits, best practices<br>**Data Resiliency**<br>- Storage technology<br>- Data center End to End View – overview of complete stack including storage, network, host, cluster, applications, virtual machines, cloud storage<br>- Storage virtualization technologies - RAID level, storage pooling, storage provisioning<br>- Advance topics in storage virtualization – storage provisioning, thin provisioning<br>- Cloud & Kubernetes storage stack – S3, glacier, storage tiering<br>- High Availability<br>- Introduction to high availability<br>- Clustering, failover, parallel access<br>- New edge technology stack (cloud, containers, AI applications) | 8 |

| | | |
|---|---|---|
| | - Disaster Recovery<br>- Need of disaster recovery (DR)<br>- Building blocks - global cluster, wide-area-connector (WAC), heartbeat<br>- Split-brain – problem and solutions<br>- Preparing for DR – firedrill | |
| **II** | **Introduction to data protection**<br>-Introduction<br>- Need for data protection<br>- basic of back-up/restore<br>- Snapshots for data protection, copy-data management (cloning, DevOps)<br>- De-duplication<br>- Replication<br>- Tiering & Long-Term Retention - LTR<br>- Design considerations<br>-System recovery & Solution architecture<br>-Backup v/s Archival<br>-media considerations and management (tapes, disks, cloud)<br>-Protection for new edge technology (cloud, containers, workloads) | 7 |
| **III** | **Data Threats and Data center security**<br>- Design and architecture considerations for data & platform security<br>- Identity Management, Transport Layer Security (TLS), Encryption & Key Management, Compliance<br>- Cloud Security – API Security, Challenges<br>- Type of Threats<br>- Denial of Service (DoS), man in the middle attacks<br>- Unintentional data loss<br>-Repudiation<br>- Malicious attacks to steal data<br>- Ransomware/Malware, Threat Detection<br>- Understanding Threat modelling tools | 7 |
| **IV** | **Data Security Posture & Recovery**<br>- Introduction Data Security Posture Management<br>- Data classification and tagging<br>- Information Governance<br>- Auditing<br>- Legal Hold<br>- AI dimensions<br>- Site Continuity, Cyber Recovery<br>- Bulk Recovery & Response<br>**Applications uninterrupted - Understand data management asp**<br>-Understand data management aspects of traditional and new edge applications<br>- Reference architecture/best practices *(pick 2-3 case studies from below topics)*<br>- AI Applications<br>-NoSQL Databases (MongoDB, Cassandra)<br>-Distributed applications (micro service architectures)<br>-Cloud applications – Platform as Service (PaaS), Software as Service (SaaS), Kubernetes<br>- Multi-Tiered applications<br>- ETL workloads<br>- Data analytics (AI/ML) | 8 |
| | **Total** | 30 |
| **Text Books:**<br>1. Storage Networks: The complete Reference. Robert Spalding | | |

2. Vic (J.R.) Winkler, "Securing The Cloud: Cloud Computing Security Techniques and Tactics" (Syngress/Elsevier) 2011

**Reference Books:**

1. Martin Kleppmann, Designing Data-Intensive Applications , O'Reilly, 17th Release 2021
2. TBD: provide more online material details and books (This can include some publicly available white-paper, solution guides etc.)

**Hands On/Demos**

• Demonstrate the use of Veritas InfoScale Logical Volume Manager for cover storage management aspects.
• Demonstrate Veritas InfoScale CFT on AWS can help create 2-node cluster for some hand-on
• Demonstrate the use of Veritas Backup Exec for data protection related hands-on. Concepts like backup storage targets, deduplication, retention periods, backup selections, data protection SLAs, students can relate to.
• Demonstrate using AWS/Azure console, we can demonstrate some aspects on data security aspects in Cloud Computes.
• Demonstrate data governance and archiving basic use cases using Veritas Archiving Solution
• Application Unit, data will be provided with details.

**Online Sources:**

1. https://www.enterprisestorageforum.com/storage-hardware/storage-virtualization.html
2. https://searchstorage.techtarget.com/definition/data-life-cycle-management
3. https://www.hitechnectar.com/blogs/three-goals-data-lifecycle-management/
4. https://www.bmc.com/blogs/data-lifecycle-management/
5. https://medium.com/jagoanhosting/what-is-data-lifecycle-management-and-what-phases-would-it-pass-through-94dbd207ff54
6. https://www.spirion.com/data-lifecycle-management/
7. https://www.bloomberg.com/professional/blog/7-phases-of-a-data-life-cycle/
8. https://www.datacore.com/storage-virtualization/
9. https://www.veritas.com/content/dam/Veritas/docs/solution-overviews/V0907_SB_InfoScale-Software-Defined-Infrastructure.pdf
10. https://www.veritas.com/solution/digital-compliance
11. https://www.veritas.com/solution/data-protection
12. https://www.veritas.com/gdpr

| Program: | B. Tech. (Computer Engineering) | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|
| Course: | Remote Sensing and GIS (OE Offered by Civil Department) | | | | | Code: BCI25OE04 | |
| Credits | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | FA | | SA | Total |
| | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | 10 | 10 | 30 | 50 |

**Prior Knowledge of** Fundamental related to Surveying, Types and Importance of various surveys, Global Positioning System (GPS) **is essential**

**Course Objectives:**

This course aims at enabling students,

1. To understand the fundamental principles and techniques of remote sensing and GIS.
2. To develop skills in processing, analyzing, and interpreting remote sensing data.
3. To gain proficiency in GIS concepts, spatial data models, and geospatial analysis.
4. To integrate remote sensing and GIS for applications in urban planning, environmental monitoring, and disaster management.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Demonstrate a clear understanding of remote sensing principles, systems, and sensor characteristics.
2. Apply remote sensing and GIS techniques to analyze data for various civil engineering and interdisciplinary applications.
3. Use GIS tools for spatial data processing, analysis, and visualization.
4. Integrate remote sensing data with GIS to solve real-world problems in urban planning, environmental monitoring, and disaster management.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Fundamentals of Remote Sensing:** Introduction to Remote Sensing: Definition, History, and Applications Electromagnetic Radiation (EMR): Spectrum, Energy Interactions with Atmosphere and Earth Surface, Remote Sensing Sensors and Platforms: Optical, Microwave, and Hyperspectral Sensors, Resolution in Remote Sensing: Spatial, Spectral, Temporal, and Radiometric Resolution, Recent Advances: UAV (Drone) Remote Sensing, AI-based Remote Sensing | 8 |
| II | **Satellite Image Processing and Interpretation:** Types of Remote Sensing Data, Satellite Image Acquisition and Preprocessing Techniques: Radiometric and Geometric Corrections, Image Enhancement and Filtering Techniques, Image Classification Methods: Supervised and Unsupervised Approaches, Cloud-based Remote Sensing: Google Earth Engine and Big Data GIS | 8 |
| III | **Geographic Information System (GIS) Fundamentals:** Introduction to GIS: Definitions, Components, and Functions, Spatial Data Models: Raster vs. Vector Data, Topology, GIS Data Sources: Digitization, GPS Data Collection, Open-Source Data, GIS Software and Tools: ArcGIS, QGIS, Python for GIS, Georeferencing, Map Projections, and Coordinate Systems, Thematic Mapping and Visualization Techniques | 7 |
| IV | **GIS Data and Case Studies:** Role of AI & Machine Learning in GIS: Object Detection, Land Cover Classification Real-time GIS and Web-based GIS Technologies, Case Studies: GIS Applications in Urban Planning, Disaster Management, Environmental Monitoring, and Smart Cities | 7 |
| | **Total** | **30** |

**Text Books:**

1. Bhatta, B. – Remote Sensing and GIS (Oxford University Press, 2011)
2. Lillesand, T., Kiefer, R., & Chipman, J. – Remote Sensing and Image Interpretation (Wiley, 7th Ed., 2015)

3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022

**Reference Books:**

1. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000.
2. Campbell, J. B., & Wynne, R. H. – Introduction to Remote Sensing (Guilford Press, 5th Ed., 2011)
3. Chang, K. – Introduction to Geographic Information Systems (McGraw Hill, 9th Ed., 2019)

**Online Sources:**

1. https://onlinecourses.nptel.ac.in/noc22 ce84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ce52/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/

| Program : | B. Tech. (Computer Engineering) | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|
| Course : | Introduction to Advanced Driver Assistance Systems (Offered by E&TC to all) | | | | | Code : BET25OE01 | |
| Credits | Teaching Scheme (Hrs./Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | FA | | SA | Total |
| | | | | FA1 | FA2 | | |
| 02 | 02 | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Electronics and electrical engineering, Basic programming concepts**is essential.**

**Course Objectives:**

1. Equip students with a comprehensive understanding of ADAS technologies.
2. Enable students to evaluate and apply sensor technologies.
3. Foster proficiency in integrating embedded systems and real-time data processing.
4. Prepare students to design and implement testing strategies for ADAS

**Course Outcomes:**

After learning the course, the students should be able to:

1. Analyze the role of ADAS in vehicle safety and automation.
2. Evaluate sensor technologies and sensor fusion methods for ADAS functionality.
3. Apply embedded system concepts and real-time processing in ADAS.
4. Create testing strategies for ADAS using V2X communication.

**Detailed Syllabus:**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Overview of ADAS and Core Functionalities:** Introduction to ADAS, importance of ADAS in vehicle safety, ADAS levels of automation, sensor technologies in ADAS, lane-keeping assist, adaptive cruise control, automatic emergency braking, collision avoidance, parking assist, and traffic sign recognition. | 7 |
| II | **Sensor Technologies and Sensor Fusion in ADAS:** Types of sensors used in ADAS, principles of sensor operation, sensor fusion for enhanced ADAS functionality, challenges of sensor calibration, sensor performance in various conditions, sensor integration with vehicle control systems. | 8 |
| III | **Embedded Systems and Real-Time Data Processing in ADAS:** Role of embedded systems in ADAS, microcontroller architectures for ADAS, real-time operating systems for data processing, system integration and communication between ECUs, decision-making algorithms, embedded software for ADAS, fault detection and self-diagnostics in ADAS systems. | 7 |
| IV | **Vehicle-to-Everything (V2X) Communication and Testing ADAS:** Introduction to V2X communication (Vehicle-to-Vehicle, Vehicle-to-Infrastructure, Vehicle-to-Pedestrian), V2X communication protocols, integration of V2X with ADAS, testing methodologies for ADAS, validation of sensor fusion algorithms, ethical concerns, regulatory standards for ADAS. | 8 |
| | **Total** | **30** |

**Text Books:**


1. Hussein T. Mouftah, Melike Erol-Kantarci, and Mubashir Husain Rehmani, "Connected and Autonomous Vehicles in Smart Cities", CRC Press, 1st Edition, 2020.
2. Claire Vishik, Simon Winberg, and Axel Sikora, "Cybersecurity for Connected and Automated Vehicles", Artech House, 1st Edition, 2021.
3. Andreas Herrmann, Walter Brenner, and Rupert Stadler, "Autonomous Driving: How the Driverless Revolution Will Change the World", Emerald Publishing, 1st Edition, 2018.

**Reference Books:**

1. Burkhard Huhnke, Markus Maurer, and Christoph Stiller, "Handbook of Driver Assistance Systems: Basic Information, Components and Systems for Active Safety and Comfort", Springer, 1st Edition, 2016.
2. Ramiro Liscano, Juan Carlos Garcia, and Miguel Angel Sotelo, "Advanced Driver Assistance Systems: Fundamentals, Applications, and Advances", CRC Press, 1st Edition, 2021.
3. Wolfgang Runge, "Autonomous Driving: Technical, Legal and Social Aspects", Springer, 1st Edition, 2016.

| Program : | B. Tech. (Computer Engineering) | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|
| Course : | **Engineering Psychology** (Offered by E&TC) | | | | | Code :BET25OE02 | |
| Credits | Teaching Scheme (Hrs./Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | FA | | SA | Total |
| | | | | FA1 | FA2 | | |
| 02 | 02 | - | - | 10 | 10 | 30 | 50 |

**Course Objectives:**

This course aims at enabling students,

1. Introduce engineers to key psychological principles relevant to personal and professional development.
2. Understand human behavior, cognition, and emotion to improve interpersonal effectiveness and teamwork.
3. Develop skills to integrate psychological insights into problem-solving and innovation.
4. Foster ethical decision-making and leadership through Emotional Intelligence.

**Course Outcomes:**

After learning the course, the students should be able to:

1. Understand fundamental psychological concepts and their engineering applications.
2. Understand the theories of cognitive works
3. Apply psychological principles to improve teamwork and leadership.
4. Integrate human-centered approaches in engineering design and problem-solving.

**Detailed Syllabus:**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to Engineering Psychology**<br>History of Engineering Psychology, Methods of Engineering Psychology Perspective on Engineering Psychology-Human-Centric Design, Balance in Cognitive Load, Ethical & Sustainable Technology, Holistic Decision-Making: | 08 |
| II | **Design of Cognitive Work-1**<br>Attention Vigilance and Fatigue<br>Information Processing<br>Training and Automaticity<br>Stress and Workload<br>Displays, Monitors, and Screens<br>Usability<br>Teams and Performance | 08 |
| III | **Design of Cognitive Work-2**<br>Situation Awareness<br>Emotion, Motivation, and Boredom<br>Decision-Making and Expertise<br>Language and Artificial Intelligence | 07 |
| IV | **Importance of EI for engineering professionals**<br>Components of EI (as per Goleman's Model)<br>Daniel Goleman's Model (Five components: Self-awareness, Self-regulation, Motivation, Empathy, Social skills)<br>Role of EI in team collaboration, leadership, and conflict resolution<br>Applications of EI in decision-making and problem-solving<br>Examples of high-EI engineering leaders<br>Developing Emotional Intelligence- Techniques for enhancing self-awareness and empathy, Managing emotions under stress | 07 |
| | **Total** | **30** |

**Text Books:**

1. Elliott, L. J. (2021). Engineering psychology. Penn State University Libraries. https://doi.org/10.26209/engin-psych

2. D. Goleman, Emotional Intelligence: Why It Can Matter More Than IQ. New York, NY, USA: Bantam Books, 1995.

**Reference Books:**

1. Baron, R. A., & Branscombe, N. R. Psychology (13th Edition). Pearson.Nagraj, Vyavhar Darshan (The Conduct Perspective)
2. Schultz, D. P., & Schultz, S. E. Psychology and Work TodayNagraj, Jeevan Vidya: Ek Parichay
3. R.R. Gaur, R. Sangal, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics

| Program: | B. Tech. (Computer Engineering) | Semester: V |
|---|---|---|
| Course: | **Unmanned Aerial Vehicle**<br>(Open Elective –IV offered by Mechanical department)<br>Applicable to E&Tc, Comp, Civil, IT, CSE (AIML), Computer regional | **Code : BME25OE01** |

| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
|---|---|---|---|---|---|---|---|---|
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Basic knowledge of Engineering Physics, Mechanics and Materials Engineering **is essential.**

**Course Objectives:**

This course aims at enabling the students to
1. To introduce students to the fundamental principles of UAV systems, including types, components, flight dynamics, materials and manufacturing.
2. To equip students with the fundamental knowledge for designing lightweight and smart UAV.

**Course Outcomes:**

After learning the course, the students will be able to:
1. Describe the classification, anatomy, and flight principles of various UAV systems used in different applications.
2. Select appropriate materials and explain relevant manufacturing techniques for UAV structural components.
3. Investigate UAV airframe design principles to develop structural configurations by analyzing aerodynamic loads and stress distribution
4. Explain the role of AI, ML, IoT, and cyber security in enhancing UAV intelligence, connectivity, and real-world applications.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Fundamentals of UAV Systems, Anatomy, and Flight Principles**<br>Overview of UAVs: Types, Applications and DGCA Rules, Applications of UAVs: Military, commercial, agriculture, environmental monitoring, surveillance, logistics; Anatomy of UAV: Key Components, Airframe, Propulsion, Avionics, Payload; Basic Flight Principles: Lift, Thrust, Drag, Weight; Aerodynamics: Bernoulli's Principle, Airfoil Characteristics; Flight Dynamics: Stability, Control Surfaces (Ailerons, Elevators, Rudder) | 7 |
| II | **Materials & Manufacturing for UAV Design**<br>Material Selection: Lightweight materials – composites, polymers, carbon fiber, aluminum alloys; Structural Materials for UAV Airframes; Manufacturing Techniques: Traditional: Machining, forming; Modern: 3D printing, additive manufacturing, CNC techniques, Assembly and Integration: Joining methods (gluing, bolting), modular UAV design, Maintenance & Repair: Field repair techniques, material durability, lifecycle assessment | 8 |
| III | **Design Approach of UAVs**<br>UAV Airframe Design Principles, Wing, Fuselage, and Tail Design Concepts, Structural Design Aspects: Load paths, stress points, vibration and fatigue considerations, Load Analysis and Stress Calculations, Introduction to Structural Simulation Tools | 8 |

| | | |
|---|---|---|
| **IV** | **Smart Technologies in UAVs**<br>IoT Integration in UAVs: Sensor networks, telemetry, data acquisition, cloud interfacing, AI/ML Applications, Swarm UAVs and Cooperative Missions: Communication protocols, decentralized control, Cyber security for UAVs: Threats, encryption techniques, safe data transmission, Use Cases: Precision agriculture, disaster monitoring, smart delivery drones | 7 |
| | **Total** | **30** |

**Text Books:**

1. Garg, P. K. (2021). Unmanned aerial vehicles: An introduction.
2. Sebbane, Y. B. (2022). A first course in aerial robots and drones. CRC Press.
3. Gundlach, J. (2014). Designing unmanned aircraft systems. Reston: American Institute of Aeronautics & Astronautics.

**Reference Books**

1. Yang, L. J., & Esakki, B. (2021). Flapping Wing Vehicles: Numerical and Experimental Approach. CRC Press.
2. Barnhart, R. K., Marshall, D. M., & Shappee, E. (Eds.). (2021). Introduction to unmanned aircraft systems. Crc Press.
3. Austin, R. (2011). Unmanned aircraft systems: UAVS design, development and deployment. John Wiley & Sons.

**Online Sources:**

1. https://archive.nptel.ac.in/courses/101/104/101104073/
2. https://onlinecourses.swayam2.ac.in/ntr24_ed12/preview

| Program: | B. Tech. (Computer Engineering) | | | | | | | Semester: V |
|---|---|---|---|---|---|---|---|---|
| Course: | **Industrial Engineering**<br>(Open Elective –IV offered by Mechanical department)<br>Applicable to E&Tc, Comp, Civil, IT, CSE (AIML), Computer regional | | | | | | | **Code :** BME25OE02 |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Basic manufacturing processes**,** Basic mechanical components **is essential**

**Course Objectives:**

This course aims at enabling the students to

1. To introduce the concepts, principles and framework of contents of Industrial Engineering.
2. To acquaint the students with various productivity enhancement techniques.
3. To acquaint the students with different aspects of Production Planning and Control and Facility Design.
4. To introduce the concepts of various cost accounting and financial management practices as applied in industries.

**Course Outcomes:**

After learning the course students will be able to-

1. Apply principles of management and evaluate productivity of an organization/Scenario.
2. Determine work content and standard time using different methods of work measurement.
3. Apply/use different techniques / concepts of production planning and control.
4. Analyze the strategic and operational aspects of plant location and layout, apply assembly line balancing techniques, and inventory control models

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to Industrial Engineering and Productivity**<br>Definition and Role of Industrial Engineering, Functions of management, Types of production systems and organization structure. Measurement of productivity: Factors affecting the productivity, Productivity improvement techniques, Productivity Models and Index. | 7 |
| II | **Work Study**<br>Definition, objective and scope of work-study, Human factors in work-study. Work Measurements: Definition, objectives and uses, Work measurement techniques. Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids, micro motion study. Time Study: Definition, time study equipment, selection of job, steps in time study. | 8 |
| III | **Production Planning and Control**<br>Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning. Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II. Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical). | 8 |

| | | |
|---|---|---|
| **IV** | **Plant Location and Inventory Management**<br>Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing. Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis. | 7 |
| | **Total** | **30** |

**Text Books:**


1. Industrial Engineering and Production Management, M Mahajan, Dhanpat Rai and Co., 2015
2. Industrial Engineering and Production Management, M. Telsang, S. Chand Publication, 2018


**Reference books:**


1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.
2. Maynard‘s Industrial Engineering Hand Book, H. B. Maynard, K Jell, McGraw Hill Education, 2001
3. Design and Analysis of Lean Production System, R. Askin, Wiley, 2001
4. Most Work Measurement Systems, Zandin K.B., ISBN 0824709535, CRCPress, 2002
5. SAP ERP: Functionality and Technical Configuration, Martin Murry, SAP Press, 2010
6. Motion and time Study design and Measurement of Work, R. Barnes, Wiley, 2009
7. ‘Process Simulation using WITNESS’, R. Al-Aomar, A. Williams, O. M. Uigen, Wiley, 2015
8. Applied Ergonomics, Hand Book, Brien Shakel, Butterworth Scientific, 1988
9. Introduction to Human factor and Ergonomics, R. C. Bridger, McGraw Hill, 2017
10. Human Factor Engineering and Design, M. Sanders and E. McCormick, McGraw Hill, 1992
11. Ergonomics: How to Design for Ease and Efficiency, K. Elbert and H. Kroemer, Prentice Hall, 2018


**Online sources**

**1.** https://onlinecourses.nptel.ac.in/noc21_me15/preview

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|---|
| Course: | Lean Six Sigma<br>(Open Elective –IV offered by Mechanical department)<br>Applicable to E&Tc, Comp, Civil, IT, CSE (AIML), Computer regional | | | | | | Code: BME25OE03 | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Prior knowledge of** Statistics **is essential.**

**Course Objectives:**

This course aims at enabling the students to

1. To equip students with foundational knowledge of Lean and Six Sigma methodologies, including key tools such as DMAIC, 7QC tools.
2. To develop students' ability to apply continuous improvement techniques for effective decision-making and sustainable operational excellence.

**Course Outcomes:**

after learning the course students will be able to-

1. Analyze quality-related issues using Cost of Quality and 7QC tools to improve product and process performance.
2. Analyze data using statistical tools like Pareto charts, histograms, and process capability indices to evaluate process performance.
3. Apply risk assessment and control tools such as FMEA, control charts to sustain process improvements.
4. Apply the continuous improvement techniques in the industry to improve the process performance.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to lean and quality**<br>Lean and Six Sigma history, Eight wastes in lean, Lean tools, Quality values, Cost of Quality, Introduction to 7QC tools. Introduction to DMAIC. | 7 |
| II | **Six Sigma: Define and Measure**<br>Define stage: Project Charters, VOC, CTQ, SIPOC, Gantt Charts, PERT-CPM.Measure stage: Process flowchart, Histogram, Pareto chart, Gage R&R study, Basic statistics, Probability theory, Process capability analysis, OEE. | 8 |
| III | **Six Sigma: Analyze, Improve and Control**<br>Hypothesis testing, 5-Whys, Fishbone diagram, Regression analysis, Design of Experiments (DOE), Risk assessment (FMEA), Control chart (X and R chart). | 8 |
| IV | **Continuous Improvement Methods**<br>Case studies on implementation of continuous improvement methods like Kaizen, Poka-Yoke, Kanban, 5'S, Just in Time, 3M and 4M method. | 7 |
| | **Total** | **30** |

**Text Books:**

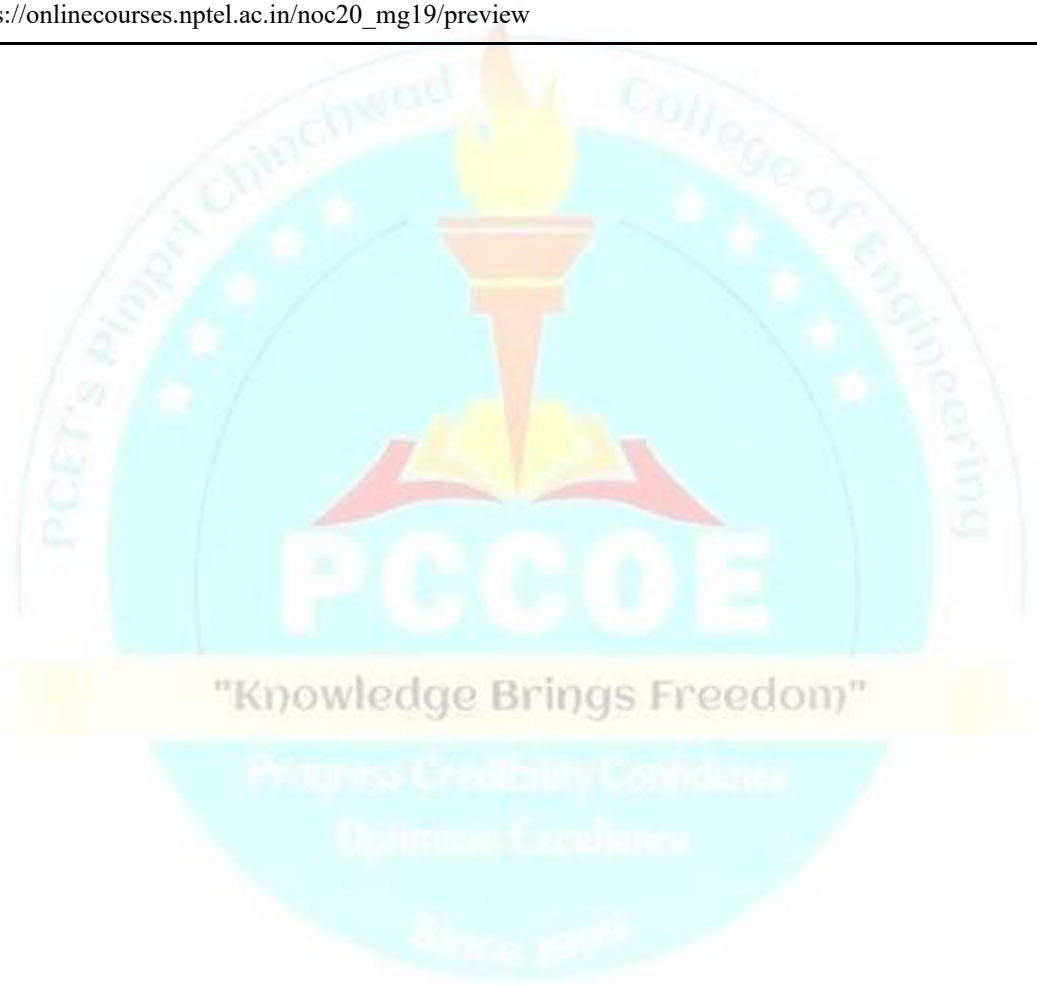
1. Six Sigma: A Complete Step-by-Step Guide, Craig Joseph Setter and the Council for Six Sigma Certification, Harmony Living, LLC, ISBN: 1732592624, 2018.
2. The Six Sigma Handbook: A Complete Guide for Green Belts, Black Belts, and Managers at All Levels,Thomas Pyzdek, Paul A. Keller, Third Edition, McGraw-Hill, ISBN: 978-0-07-162337-7, 2010.

**Reference books:**

1. The Six Sigma Way: How to Maximize the Impact of Your Change and Improvement Efforts, Peter S. Pande, Robert P. Neuman, and Roland Cavanagh, McGraw Hill Professional, ISBN:0071823018, 2014.

**Online Sources:**

1. https://www.sixsigmacouncil.org/six-sigma-training-material/
2. https://onlinecourses.nptel.ac.in/noc20_mg19/preview



| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | |
|---|---|---|---|---|---|---|---|---|
| Course: | Safety, Health and Environment<br>(Open Elective –IV offered by Mechanical department)<br>Applicable to E&Tc, Comp, Civil, IT, CSE (AIML), Computer regional | | | | | | Code :BME25OE04 | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Course Objectives:**

This course aims at enabling the students to

1. To provide exposure to the students about safety and health provisions, including the need for and methods of safety training.
2. To create awareness on safety standards in residential, commercial and agricultural applications.
3. To help students to learn about Factory act 1948, Environment act 1986 and rules framed under the act.
4. To describe the chemistry of fire & explosion and select & use appropriate fire-fighting and explosion proof equipment.

**Course Outcomes:**

After learning the course students will be able to-

1. Demonstrate the safety, ethical issues, and importance of safety training that may arise from industrial processes.
2. Identify the safety standards in residential, commercial and agricultural applications
3. List out important legislations related to Health, Safety and Environment
4. Select a suitable method for prevention of fire and explosion

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Concepts and Techniques:**<br>History of safety movement – Evolution of modern safety concept, safety survey, safety inspection, safety sampling. Safety Audits- Non-Conformity Reporting (NCR), audit checklist- identification of unsafe acts of workers and unsafe conditions in the industry, Safety training- needs and methods. | 7 |
| II | **Safety in residential, commercial, agricultural, installation & Protective equipment:**<br>Electricity, its Usefulness and Hazards, statutory Provisions, Indian Standards, Effects of Electrical parameters on human body, Safety measures for electric shock, portable electrical apparatus, Electric work in hazardous atmosphere. | 8 |

"Knowledge Brings Freedom"

| | | |
|---|---|---|
| **III** | **Factories Act – 1948 & Environment Act – 1986:**<br>**Factories Act – 1948:** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Maharashtra Factories Rules 1963. **Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001. Air Act 1981 and Water Act 1974 -audit, penalties and procedures. | 8 |
| **IV** | **Fires and Explosions and concepts to prevent fires and explosions:**<br>Fire triangle, Distinction between fires and explosions, Flammability characteristics of liquids and vapors, limiting oxygen concentration and inerting, Controlling static electricity, Explosion-proof equipment and instruments, Ventilation. | 7 |
| | **Total** | **30** |

**Reference books:**

1. Philip E. Hagan, John F. Montgomery, James T. O'reilly ―Accident Prevention Manual for Business and Industry: Administration and Programs‖, 14th Edition, National Safety Council, Illinois, Chicago, 2015.
2. Heinrich H.W. ―Industrial Accident Prevention‖ McGraw-Hill Company, New York, 1980.
3. Krishnan N.V. ―Safety Management in Industry‖ Jaico Publishing House, Bombay, 1997.

**Online Sources:**

1. https://nptel.ac.in/courses/114106039

| Program: | B. Tech. (Computer Engineering) | | | | | | | Semester: V |
|---|---|---|---|---|---|---|---|---|
| Course: | Battery Technologies for Electric Vehicles<br>(Open Elective –IV offered by Mechanical department)<br>Applicable to E&Tc, Comp, Civil, IT, CSE (AIML), Computer regional | | | | | | | Code: BME25OE05 |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Course Objectives:**

This course aims at enabling the students to

1. To make the learners conversant with various battery chemistries used for Electric Vehicles and impart a thorough understanding of Lithium-Ion Battery
2. To understand the various battery performance parameters and testing procedures
3. To understand the requirements and functioning of the battery management system
4. To make the learners conversant with battery pack design procedure and Equivalent Circuit Cell Modeling of Battery

**Course Outcomes:**

after learning the course students will be able to-

1. Compare various battery chemistries and select a suitable battery for EV application
2. Analyze Li-ion Battery's performance based on various parameters
3. Select BMS for a given battery pack
4. Design a battery pack for a given EV application

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Overview of Battery Technology of Electric Vehicle (EV):** Electric vehicle (EV) requirements, Primary Battery, Secondary Battery, Past, current, and future EV battery technologies (Pb-acid, NiCd, NiMH, Li-ion, Na-air, Al-air, Li-S, Li-air, Na-ionetc)Lithium-Ion Battery Technology: Introduction, Components, Cathode, Anode, separators & Electrolytes Material comparison, Battery Working, Cylindrical, prismatic and Pouch cells, Battey cell Manufacturing | 7 |
| II | **Battery Performance and Testing:**<br>Battery operating and performance parameters (Voltage, Capacity, Energy, Power, C-rate, SOC, DOD, Coloumbic & energy Efficiency, Calendar and Cycle life etc.), CC-CV charging, CC discharging tests. Effect of parameters on the charge-discharge characteristics of Li-ion battery, SOC Estimation: Coulomb Counting method, OCV-SOC method, Estimation of SoH, Capacity, efficiency. | 7 |
| III | **Battery Thermal Management:** Heat generation inside battery, Thermal issues of Li-Ion Battery, impact of temperature on capacity, cycle life, thermal Runaway, different Cooling strategies<br>Battery Electric Management: Primary functions of BMS, BMS Architecture, voltage, current and temperature sensing, SOC estimation, BMS safety features, selection of BMS , battery pack balancing: Passive and active balancing. BMS topologies, A.I. based BMS | 8 |
| IV | **Battery Pack Design:** Vehicle dynamics, Estimation of battery pack Energy, Voltage and Capacity using Drive-cycle simulation of EV, trade-off between | 8 |

| | | |
|---|---|---|
| | parallel and series cell connections, parallel-cell-module (PCM), series-cell-module (SCM).<br>**Equivalent Circuit Model (ECM) of Li-ion cell:** Modeling SOC & temperature dependence of OCV, polarization and diffusion voltage, Estimation of model parameter values, use of ECM to simulate constant voltage/ power charge/discharge characteristics | |
| | **Total** | **30** |

**Text Books:**

1. Gregory L. Plett, Battery Management Systems, Volume I: Battery Modeling, Artech House, London
2. Gregory L. Plett, Battery Management Systems Volume II, Equivalent-Circuit Methods, Artech House, London
3. Gianfranco Pistoia, Boryann Liaw (eds.), Behaviour of Lithium-Ion Batteries in Electric Vehicles_ Battery Health, Performance, Safety, and Cost, Springer International Publication
4. Jiuchun Jiang, Caiping Zhang - Fundamentals and Application of Lithium-ion Batteries in Electric Drive Vehicles,Wiley

**Online Sources:**

1. https://www.coursera.org/learn/battery-management-systems
2. https://www.coursera.org/learn/equivalent-circuit-cell-model-simulation?specialization=algorithms-for-battery-management-systems

| Program: | B. Tech. (Computer Engineering) | | | | | Semester: V | | |
|---|---|---|---|---|---|---|---|---|
| Course: | **Professional Ethics and Sustainability in the Age of AI**.(Open Elective-IV offered by Mechanical department) Applicable to all branches of Engineering | | | | | Code: BME25OE06 | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | Total |
| | | | | | FA1 | FA2 | | |
| 2 | 2 | - | - | - | 10 | 10 | 30 | 50 |

**Course Objectives:**

This course aims at enabling the students to

1. Develop an understanding of ethical principles, professional conduct, and responsibilities in engineering and artificial intelligence (AI) practices.
2. Adapt the ability to identify and apply ethical frameworks for decision-making in research, AI system design, intellectual property, and sustainable engineering activities.
3. Create awareness of environmental ethics, sustainability principles, and the societal impacts of engineering and AI-based technological advancements.
4. Promote a global and culturally inclusive perspective on ethical issues, focusing on regulatory frameworks and the role of engineers in addressing contemporary challenges related to AI governance and sustainable development.

**Course Outcomes:**

After learning the course students will be able to-

1. Understand fundamental ethical principles and professional responsibilities related to engineering, artificial intelligence (AI), and emerging technologies
2. Apply ethical frameworks and decision-making models to analyze dilemmas involving AI systems, research practices, intellectual property, and sustainable engineering solutions.
3. Evaluate the environmental and societal impacts of engineering and AI technologies, and promote sustainable and responsible innovations aligned with ethical standards.
4. Demonstrate awareness of global, cultural, and regulatory perspectives in professional practice, with an emphasis on ethics in AI governance, sustainability initiatives, and inclusive technological development.

**Detailed Syllabus**

| Unit | Description | Duration, (Hrs) |
|---|---|---|
| I | **Foundations of Professional Ethics and Emerging Technologies** Role of ethics in engineering and AI; moral autonomy; types of ethics; professional responsibilities in AI-driven world; ethical theories (utilitarianism, deontology, virtue ethics) with practical case studies. | 8 |
| II | **Ethical Decision-Making, AI Ethics, and Research Practices** Frameworks for ethical decision-making (with AI case examples); analyzing dilemmas; stakeholder responsibilities; ethical considerations in AI model development (bias, fairness, accountability); ethical issues in research, intellectual property, and emerging technologies. | 8 |
| III | **Sustainability, Environmental Ethics, and Social Responsibility** Introduction to sustainability in engineering; ethical resource management; circular economy; environmental impact of AI technologies; social justice, health, and safety responsibilities in sustainable design; role of engineers in building sustainable futures. | 7 |

| | | |
|---|---|---|
| **IV** | **Global, Cultural, and Regulatory Perspectives in AI and Sustainability** Ethical issues in global engineering projects; cultural perspectives on technology adoption; diversity, equity, and inclusion in AI; international regulations and governance of AI (GDPR, AI Act, IEEE standards); sustainability goals (SDGs) in a global context. | 7 |
| | **Total** | **30** |

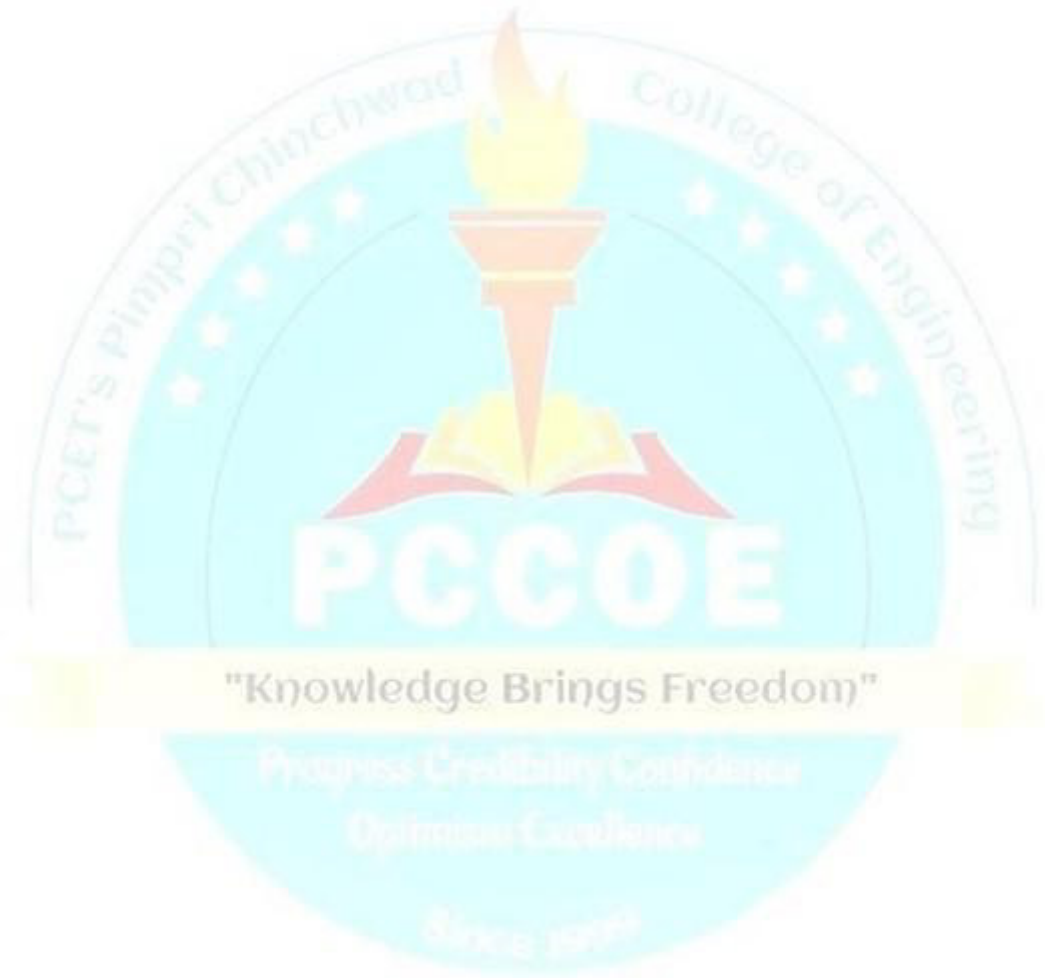
**Text Books:**

1. Harris, C. E., Pritchard, M. S., &Rabins, M. J. (2019). Engineering ethics: Concepts and cases. 6th Edition, Cengage Learning, Inc.
2. Coeckelbergh, M. (2020). AI Ethics (1st ed.). MIT Press.

**Reference books:**

1. Mike W. Martin and Roland Schinzinger, (2019). Ethics in Engineering, 3rdEdition,Tata McGraw Hill, New Delhi,
2. Caroline Whitbeck, Ethics in Engineering practice and Research. (2011) 2nd Edition, Cambridge.
3. Virginia Dignum (2019). Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way. Springer.
4. Wendell Wallach and Colin Allen (2008). Moral Machines: Teaching Robots Right From Wrong. Oxford University Press.

# Course Syllabus
# Semester VI


PCCOE
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| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Operating Systems | | | | | | Code: BCE26PC01 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 3 | 2 | 2 | - | - | 10 | 10 | 30 | 50 | - | - | 100 |

**Prior knowledge of** Computer Organization, Data Structures, basics of Linux commands, and programming **is essential**

**Course Objectives:**

This course aims at enabling students:

1. To introduce the Operating system and process, threads and CPU scheduling
2. To explore inter process communication mechanisms, to introduce the critical-section problem and solutions.
3. To explore various techniques of allocating memory to processes and explain the concepts of demand paging, page-replacement algorithms.
4. To describe the details of implementing local file systems and directory structures

**Course Outcomes:**

After learning the course, the students will be able to:

1. Compare various process scheduling algorithms for a given snapshot of the system.
2. Analyze IPC mechanisms and solutions of process synchronization for critical section problems.
3. Analyze the performance of memory management algorithms for a given problem.
4. Apply disk scheduling policies for a given I/O request sequence with file management concepts

**Laboratory related guidelines:**

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, Index, and handwritten write- up of each assignment. Each assignment write - up should have Title, Objectives, Theory - Concept in brief, Algorithm/Flowchart, Test cases, Conclusion.
2. Program codes with sample output of all assignments are to be submitted in softcopy.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work will be based on overall performance of Laboratory assignments by a student.
2. Each Laboratory assignment will be assessed based on the rubric approved by DUPC.

**Guidelines for Laboratory Conduction:**

1. Set of suggested assignments is provided for reference. Lab instructors may design the assignments with variations or suitable updates as required.
2. Operating System recommended: 64 -bit Open-source Linux or its derivative.
3. Programming tools recommended: Open-source/C/C++/JAVA/Python

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|

| | | |
|---|---|---|
| **I** | **Introduction to Operating Systems**: Introduction, Evolution, Types, Services, system calls.<br>**Process Management**: Process Concept -Process states, Process control block, Threads -Introduction, POSIX / pthreads. Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms. | 7 |
| **II** | **IPC and Process Synchronization**: Inter process Communication mechanisms: Pipes, Shared memory, Message passing Process Synchronization: Introduction, Critical-Section Problem, Hardware Support for Synchronization, Mutex Locks, Semaphores, Synchronization problem: Reader-writer, producer-consumer problem, Dining Philosophers problem.<br>**Deadlocks:**<br>Introduction, Methods for Handling Deadlocks. | 8 |
| **III** | **Memory management:**<br>Introduction, Contiguous and non-contiguous, Swapping, Memory Allocation Strategies, Paging, Segmentation, Virtual Memory: Background, Demand paging, Page Replacement Policies. | 8 |
| **IV** | **I/O Management**<br>Concept of Files, File Allocation Methods, Free -Space Management. Disk Scheduling-FIFO, SSTF, SCAN, C-SCAN. | 7 |
| | **Self Study**<br>Study the corresponding components and services of contemporary Linux distribution, research paper reading. | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested Lab Assignments:**

1. A set of processes is to be executed on a processor. Implement scheduling FCFS, SJF, Round Robin and Priority algorithms to identify the optimal schedule for executing these processes.
2. Various in-build inter-process communication mechanisms (like POSIX, FIFO, FUTEX, SysV) are available in the Linux based operating systems. Simulate such inter-process communication mechanisms using pipes.
3. Write a program to demonstrate the reader-writer/ producer- consumer/ dining philosophers synchronization problem and its solution.
4. Write a program to compare paging replacement algorithms:
   a) FCFS
   b) Least Recently Used (LRU)
   c) Optimal algorithm
5. Write a program to compare disk scheduling algorithms: FIFO, SSTF, SCAN, C - SCAN

**Text Books:**

1. 1. Silberschatz, Galvin, Gagne, "Operating System Principles", 10th Edition,2018, Wiley, ISBN 978 – 1 – 118 - 063330
2. Stallings W., "Operating Systems - internals and design principles", 9th Edition - 2018, Pearson, ISBN - 13: 978 – 013 – 467 – 0959
3. H.M. Deitel, P. J. Deitel, D. R. Choffnes, “Operating Systems “, Pearson, 3rd Edition, ISBN 0131828274, 97801318282

**Reference Books:**

1. Dhamdhere D., "Systems Programming and Operating Systems", Revised 2nd Edition- 2009, McGraw Hill, ISBN - 13: 9780074635797
2. Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 4th Edition - 2015. ISBN - 13: 978 – 0133 - 591620

**Online Sources:**

1. https://www.kernel.org/
2. https://github.com/torvalds/linux
3. NPTEL Course: Operating System- by Prof. Sorav Bansal, IIT Delhi
   https://archive.nptel.ac.in/courses/106/102/106102132/
3. NPTELCourse : Operating System Fundamentals – by Prof. Santanu Chattopadhyay, IITKhargpur
4. https://archive.nptel.ac.in/courses/106/105/106105214/

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Design and Analysis of Algorithm | | | | | | Code: BCE26PC02 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 3 | 2 | 2 | - | 1 | 10 | 10 | 30 | 50 | - | - | 100 |

**Prior knowledge of** Data Structure **is essential**

**Course Objectives:**

This course aims at enabling students:

1. To develop problem solving abilities using mathematical theories
2. To analyze the performance of algorithms
3. To apply algorithmic strategies while solving problems
4. To develop time and space efficient algorithms
5. Apply Strategy-Specific Algorithms to Real-World Problems

**Course Outcomes:**

After learning the course, the students will be able to:

1. Analyze the efficiency of algorithms using mathematical techniques to evaluate algorithm performance.
2. Analyze the efficiency of algorithm using either Divide and Conquer or Greedy strategy
3. Apply computational techniques to solve optimization and decision-making problems using either Dynamic programming or Branch and Bound.
4. ApplyBacktracking approach to implement solutions for combinatorial problems.

**Guidelines for Laboratory/Term Work Assessment:**

The laboratory assignments are to be submitted by students in the form of a journal.

1. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, data description, conclusion, and assessor's sign.
2. Program codes with sample output of all performed assignments should be submitted.
3. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
4. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
5. Suggested parameters for overall assessment as well as each laboratory assignment assessment include timely completion, performance, innovation, efficiency, punctuality and neatness.
6. All assignments are mandatory.
7. Recommended Tools for the implementation of above assignments: Python, Java etc.

**Best Practices:** GitHub, Leetcode, Hacker Rank and other similar platforms.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Problem solving and Algorithmic Analysis:** Asymptotic notations, lower bound and upper bound: Best case, worst case, average case analysis, classification of time complexities (linear, logarithmic etc)-Growth of function, Recurrences: Formulation and solving recurrence equations using Master Theorem, Introduction: P,NP, NP hard, NP Complete. | 8 |

| | | |
|---|---|---|
| | | |
| **II** | **Divide and Conquer Strategy:** Problem subdivision – Divide and Conquer: Binary search, Quick sort, Integer Arithmetic- Multiplication.<br>**Greedy strategy:** Principle, control abstraction, time analysis of control abstraction, knapsack problem, Job scheduling algorithm with deadlines, Single Source Shortest Path Dijkstra's. | 7 |
| **III** | **Dynamic Programming Strategy:** Principle, control abstraction, time analysis of control abstraction, binomial coefficients, multistage graphs, 0/1 knapsack, All Pair Shortest Path - Floyd- Warshall, Bellman-Ford, Sum of subset. | 8 |
| **IV** | **Backtracking Strategy:**Principle, control abstraction, 8-queen problem, graph coloring problem, knapsack problem<br>**Branch and Bound Strategy:** Principle, control abstraction, strategies – FIFO, LIFO and LC approaches, knapsack problem(FIFO,LIFO,LC), Branch and Bound using TSP | 7 |
| | **Self Study:**<br>Solving recurrence relation using substitution and Tree method.<br>Implement Selection sort, Insertion sort, Merge Sort, Quick Sort and compare performance.<br>Solution and Comparative analysis of one example with all strategies e.g. knapsack problem, sum of subset problem etc., research paper reading. | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested Lab Assignments:**

1. You are working as a data analyst for a financial institution that handles high-precision transactions involving large, multi-digit monetary values. Recently, the institution needs to calculate the product of two exceptionally large numbers (each over 15 digits) representing aggregated transaction amounts for quarterly reports. Due to the size of these values, traditional multiplication methods are computationally inefficient. Implement the algorithm to perform high-precision multiplication of these large integers accurately and efficiently. Test your implementation with multiple large-number pairs to ensure reliability and precision in financial reporting.
2. Design a greedy algorithm to maximize profit in a warehouse by selecting and transporting items to a single destination within a given weight limit. Each item has a specified weight and profit. Implement the algorithm and verify that it maximizes profit while staying within the weight constraint.
3. You find yourself in a labyrinthine dungeon with multiple rooms and connecting passageways. Each passage has a specific time to travel, and some passages are blocked due to cave-ins. Starting from the main entrance, you must find the shortest escape routes to every other room in the dungeon. Use Dijkstra's algorithm to determine the quickest time required to reach each room from the entrance. If any room is isolated and unreachable, mark it as -1. Test this with a dungeon of at least 15 rooms and random travel times for each accessible passage.
4. You are on a treasure hunt and have a map that shows various caves connected by tunnels. Each tunnel has a different cost to cross, representing difficulty or danger levels. You need to calculate the safest path between each pair of caves (i.e., the path with the minimum danger). Use the Floyd-Warshall algorithm

to determine the safest paths between all pairs of caves, and apply it to a network with at least 8 caves and randomly assigned danger levels for each tunnel.

5. You are given a set of items, each with a weight and profit, and a maximum weight capacity. Using the Branch and Bound approach, find the optimal subset of items that maximizes total profit while staying within the weight limit. Implement and compare FIFO, LIFO, and Least Cost (LC) approaches (any 2) for this problem.

6. .Implement a backtracking algorithm to solve a Sudoku puzzle. The program should read an incomplete puzzle grid and output a solution, if one exists. Ensure the program handles edge cases like unsolvable puzzles, and test it with multiple inputs.

7. Mini Project

**Text Books:**

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, " Design And Analysis of Algorithms",Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2

**Reference Books:**

1. Thomas H Cormen and Charles E.LLeiserson, "Introduction to Algorithms", The MIT Press; 4th edition, April 5, 2022, ISBN-13: 978-0262046305
2. Horowitz, Sahani, "Fundamentals of computer Algorithms", Galgotia. 2Nd Edition, 2008.ISBN 13. 978-8173716126

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Software Engineering | | | | | | Code: BCE26PC03 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 2 | 1 | 2 | - | - | - | 25 | - | 25 | - | - | 50 |

**Prior knowledge of** Basic Programming skills, fundamental of Computer Science, understanding of Object-Oriented Concepts **is essential**

**Course Objectives:**

This course aims at enabling students:

1. Understand core software engineering concepts, life-cycle models, and guiding principles.
2. Analyze and select suitable software process models for various development scenarios.
3. Apply requirements engineering techniques to define and document software requirements.
4. Design and model software systems using UML diagrams and develop basic test cases.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Apply the principles and phases of the Software Development Life Cycle (SDLC) and different software process models based on their characteristics and suitability for various project scenarios.
2. Apply software engineering principles to analyze problems, classify requirements, and develop basic requirements engineering artifacts.
3. Apply software design principles and effectively use UML modeling techniques to represent system functionality, structure, and behavior through various diagrams

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. 50% weightage of term work is based on suggested parameters for lab assignment includes- contents, requirement understanding, participation, timely completion, punctuality and neatness, overall professional behavior.
3. 50% weightage of term work is based on internal oral/practical examination.

**Guidelines for Laboratory/Tutorial Conduction:**

**Tools:** StarUML, Lucidchart , Taiga, Kanboard,Jira

**Best Practices:** Use of Docker, Kubernetes, Github

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to Software Engineering and Unified Process:** Software Engineering, Software Myth, Software Development Life-cycle. Software engineering Practices and principles, Software engineering Knowledge-core Principles, Principles that guide each framework Activity. Software process Models: Generic process model-Prescriptive process model-Waterfall, Rapid Application Development (RAD) Process Model, Prototyping Process Model, Agile Methodology- principles, life cycle, types of Agile methodology. | 5 |
| II | **Software Requirement Specification:** Requirements Engineering- Problem and requirement analysis, types of requirements, Establishing the Groundwork-Eliciting Requirements- Developing use cases-Building the requirements model-Negotiating. | 5 |

| | | |
|---|---|---|
| **III** | **Software Modelling and Design:**<br>**Design Process:** Design within the context of Software Engineering(Abstraction, Information hiding, modularity, verification etc.) The Design Process, Design Model.<br>**Modeling with UML:** Class Diagrams - Activity Diagrams - Package Diagrams - Component Diagrams – Deployment Diagram.<br>**Testing:** Manual and Automated testing, test plan | 5 |
| | **Self-Study**<br>Waterfall with Feedback-Incremental Process Model, Spiral Process Model, Review and summarize all the Process Models, Requirements modeling strategies and different approaches for organizing and structuring requirements, validating Requirements-Requirements Analysis-Requirements Modeling Strategies, Study of a testing tool, AI tool for software development, research paper reading. | 6* |
| | **Total** (*Not Included) | **15** |

**Suggested Lab Assignments:**

**1.** Identify the Application based case study (Hospital management, AI-Powered Healthcare App for Chronic Disease Management, Logistics management & Optimization, Continuous Risk Assessment and other applications)

- Identify the problem statement, scope, objective
- Identify the stakeholders
- Identify domain

2. Based on above problem statement:
   - Identify the initial(broadly) requirement. (In detail requirement identification will be in lab 4)
   - Identify and Compare the Process Models for selection of appropriate process models for software development.
3. Introduction to UML: Modelling Concepts and Diagrams, Use Case Diagram.
4. Elaborate the functional requirement as per the Use case scenario template.
5. Prepare SRS Document
6. For given case study prepare the
   - UML diagrams: Class Diagram
   - Activity Diagram, Sequence Diagram
   - Package and deployment diagram

**7.** Prepare Test case report

**Text Books:**

1. Roger S Pressman, "Software Engineering – A Practitioner‟s Approach", Pearson Education, 8th Edition, 2019.
2. Ian Sommerville, "Software Engineering", 9th edition, 2011.
3. Unified Modeling Language User Guide, The (2nd Edition) (Addison-Wesley Object Technology Series), May 2005.

**Reference Books:**

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 10: 0133056996, 2002.
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 13: 978-8120348981, 2014.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715, 2010.

**Online Sources:**

1. https://staruml.io/
2. https://www.lucidchart.com/blog/types-of-UML-diagrams

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Deep Learning | | | | | | Code: BCE26PE01 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Machine Learning **is essential.**

**Course Objectives:**

This course aims at enabling students:

1. Learn fundamental concepts of artificial neural network
2. Introduce neural network architecture and its training
3. Learn fundamental concepts of convolution neural network
4. Understand the Recurrent neural network
5. Learn concepts of autoencoders

**Course Outcomes:**

After learning the course, the students will be able to:

1. Articulate the fundamental concepts of deep learning.
2. Apply convolutional neural networks for image classification tasks using visual features
3. Analyze the working principles and architectures of sequence models such as RNN, LSTM, and GRU for processing sequential data.
4. Generate the synthetic data using generative models and process language data by using sequence-to-sequence models

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as softcopy.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include-timely completion, performance, innovation, efficiency, punctuality, and neatness.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative
2. Programming tools recommended: - Python, OpenCV, Pytorch, tensorflow, matlab
3. Use of Anaconda platform is encouraged.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Artificial Neural Networks:** Introduction to biological and artificial neural networks; McCulloch-Pitts model; perceptron model and perceptron learning algorithm. multilayer perceptrons (MLP), activation functions (Sigmoid, Tanh, ReLU, Leaky ReLU, Softmax), and loss functions (Mean Squared Error, Cross-Entropy), gradient descent methods (batch, stochastic, mini-batch) and the backpropagation algorithm. | 7 |

| | | |
|---|---|---|
| **II** | **Convolutional Neural Networks:** CNN Introduction, Convolution Operation, Pooling, Fully Connected Layers, Activation Functions (ReLU, Leaky ReLU), Parameter Sharing, Sparse Connectivity, Stride, Padding, Feature Maps, CNN Architectures (LeNet, AlexNet, VGGNet, ResNet), Batch Normalization, Dropout, Regularization, Optimization. | 8 |
| **III** | **Sequence Models:** Introduction to sequential data; Recurrent Neural Networks (RNN), issues of vanishing and exploding gradients, Backpropagation Through Time (BPTT); Long Short-Term Memory networks (LSTM) architecture, Gated Recurrent Units (GRU). | 7 |
| **IV** | **Generative and Advanced Models:** Autoencoders (architecture, reconstruction loss, latent representation, types: denoising, variational); Generative Adversarial Networks, Encoder-Decoder architecture (sequence-to-sequence models, applications in translation and summarization); Transformers (self-attention mechanism, positional encoding, multi-head attention, encoder-decoder architecture, popular transformer models: BERT, GPT). | 8 |
| | **Self-Study:**<br>Explainable AI methods like LIME, GRADCAM, SHAP, Integrated Gradients, Agentic AI, research paper reading. | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested Lab Assignment:**

1. Perceptron Algorithm -
   (a) Create and plot a linearly separable dataset in 2D with at least 1000 data points. Clearlylabel the two classes.
   (b) Train the Perceptron Learning Algorithm on this dataset. Plot the decision boundary after training .
   (c) Add noise to the dataset by flipping the labels of 10% of the points.
   - Plot the noisy dataset.
   - Train the Perceptron Learning Algorithm for different numbers of iterations.
   - Compare the results visually (decision boundaries) and quantitatively (accuracy or number of misclassifications).

2. CNN for Image Classification- Design and implement a Convolutional Neural Network (CNN) for image classification on the CIFAR-10 dataset. Tune key hyperparameters such as-
   - learning rate,
   - optimizer (SGD, Adam, etc.),
   - batch size, dropout,
   - number of convolutional layers and
   - filters

   Additionally, apply data augmentation techniques such as flipping and rotation. Each group must experiment through trial and error to identify the best hyperparameter combination that maximizes accuracy and minimizes error. [Benchmarking of model performance will be recorded across the class for comparative evaluation and accordingly marks will be assigned].
3. Sequence Models for Next word Prediction- Develop and compare RNN, LSTM, and GRU models for next-word prediction using a small text dataset.
   - Preprocess the dataset using tokenization and convert words to integer indices.
   - `Create input sequences (e.g., 5 words → predict the 6th word).`
   - Use an embedding layer for input representation.
   - Train each model using CrossEntropy loss and Backpropagation Through Time (BPTT).
   - Apply gradient clipping to handle vanishing/exploding gradients.
   - Evaluate models based on prediction accuracy.
4. Basic Autoencoder for Image Reconstruction- Implement a basic autoencoder using the MNIST dataset for

image reconstruction.

- Design an encoder to compress 28×28 images into a lower-dimensional latent representation.
- Design a decoder to reconstruct the original image from the latent space.
- Use Mean Squared Error (MSE) as the reconstruction loss.
- Train the model for a suitable number of epochs (e.g., 10–20).
- Visualize original vs. reconstructed images and plot the training loss curve

5. GAN for Synthetic Image Generation- Implement a basic GAN using the MNIST dataset to generate synthetic handwritten digit images.

- Generator should take random noise as input and output 28×28 grayscale images.
- Discriminator should classify input images as real or fake.
- Use Binary Cross-Entropy loss for both networks.
- Train using Adam optimizer and alternate updates between generator and discriminator.
- Run training for 10–20 epochs.
- Execute the assignment on GPU for faster training. [Kaggle/Google Colab/Lab GPUs/ Virtual Computing Power]

6. Mini Project- Design and implement a deep learning-based mini-project to solve a real-world problem,

- covering model selection,
- data preparation, training,
- evaluation, and
- deployment for inference using suitable tools or platforms.

**Text Books:**


1. Ian Goodfellow Yoshua Bengio Aaron Courville, Deep Learning, MIT Press, 2017.
2. Nikhil Ketkar (Author), Jojo Moolayil, Deep Learning with Python: Learn Best Practices of Deep Learning Models with PyTorch, Paperback, 2021
3. Aggarwal, Charu C. Neural networks and deep learning. Vol. 10. No. 978. Cham: springer, 2018.


**Reference Books:**


1. Jacek M. Zurada,"Introduction to artificial neural systems", West Publishing Co., 1992, ISBN: 0-3 14-93391 - 3.
2. Bishop C. M., "Pattern Recognition and Machine Learning", Springer, 2006, ISBN: 978-0-387-31073-2
3. Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks,
4. Umberto Michelucci, Apress, 2018.
5. Deep Learning with Python", Francois Chollet, Manning Publications, 2017.


**Online Sources:**

1. Deep Learning NPTEL - Prof. Mitesh Khapra- https://www.youtube.com/playlist?list=PLEAYkSg4uSQ1r-2XrJ_GBzzS6I-f8yfRU
2. Deep Learning For Computer Vision - Prof. Vineeth N Balasubramanian https://www.youtube.com/playlist?list=PLEAYkSg4uSQ0Q5Z1IYI-0g2cbD-2Rt-I6
3. Stanford CS224N NLP (for more detail in RNN, LSTMs)- https://www.youtube.com/playlist?list=PLoROMvodv4rMFqRtEuo6SGjY4XbRIVRd4
4. Stanford CS231N CV (for more detail in CNNs)- https://www.youtube.com/playlist?list=PL3FW7Lu3i5JvHM8ljYj-zLfQRF3EO8sYv
5. https://pytorch.org/
6. Research Paper - Attention Is All You Need- https://arxiv.org/abs/1706.03762
7. Research Paper- fairseq: A Fast, Extensible Toolkit for Sequence Modeling- https://arxiv.org/abs/1904.01038

"Knowledge Brings Freedom"

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Blockchain Technology | | | | | | Code: BCE26PE02 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Computer Network and Security **is essential**

**Course Objectives:**

This course aims at enabling students to:

1. Analyze blockchain architecture and explain its core components.
2. Compare leading consensus algorithms and demonstrate how smart contracts function within them.
3. Evaluate major blockchain platforms and illustrate their real-world applications.
4. Assess common security vulnerabilities in blockchain networks and explore contemporary trends shaping the ecosystem.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Evaluate Blockchain Architecture and Key Components.
2. Develop and deploy Consensus Algorithms and Smart Contractson Ethereum/Hyperledger Fabric.
3. Analyze Blockchain Platforms and build decentralized Real-World Use Case.
4. Evaluate Blockchain Security Issues and Contemporary Trends.

**Guidelines for Laboratory/Term Work Assessment:**

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted
4. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
5. 50% weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.
6. 50% weightage of term work is based on internal oral/practical evaluation.

**Guidelines for Laboratory Conduction**

1. For a mini project, select a real-world application in the group of 3-4 students and formulate a problem statement for application to be developed. Potential applications are Education Certificate Chain, Drug Logistics Supply Chain, GST Enforcement activities, State Excise Supply chain, Public Distribution System, Blood Bank, Government e-Marketplace (GeM), National Health Records, Electronics & Semiconductor supply chain, Trace & Track supply chain applications, Blockchain enabled Digilocker etc.
2. Student groups are required to continue the same problem statement throughout all the assignments in order to design and develop an application as a part of a mini project.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Blockchain Fundamentals &Architecture**<br>Origin and need for blockchain, Bitcoin and early developments, Blockchain vs. Traditional Databases, Components of blockchain: Blocks, Hashes, Nodes, | 8 |

| | | |
|---|---|---|
| | Transactions, Ledgers, Types of blockchain: Public, Private, Consortium, Hybrid, Cryptography basics: Hashing (SHA-256), Digital Signatures, Merkle Trees. | |
| **II** | **Consensus Mechanisms & Smart Contracts**<br>Importance of consensus in distributed networks, Consensus algorithms: Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, Practical Byzantine Fault Tolerance (PBFT), Proof of Authority (PoA). Ethereum overview and architecture, Smart contracts: Concept, design, and deployment. | 8 |
| **III** | **Blockchain Platforms, Tools**<br>Layer 0 – Network Layer / Protocol Layer:Polkadot,<br>Layer 1 – Base Blockchain Layer: Bitcoin, Ethereum, Solana, Hyperledger Fabric,<br>Layer 2 – Scaling Layer: Polygon,<br>Layer 3 – Application Layer: Metamask,<br>Layer 4 – Governance Layer:DAOs,<br>Layer 5 – Data/Storage Layer: IPFS<br>Case studies: Supply Chain, Digital Identity | 8 |
| **IV** | **Security, Privacy, & Future Trends**<br>Types of attacks on blockchain: 51% Attack, Sybil Attack, Replay Attack, Double Spending, Smart contract vulnerabilities (Reentrancy, Integer overflow)<br>Privacy enhancement techniques: CoinJoin, Ring Signatures, zk-SNARKs (Zero-Knowledge Proofs) ,Contemporary Issues<br>Future Trends: Decentralized AI | 6 |
| | **Self-Learning**<br>BFSI, Blockchain in Governance, Blockchain Solutions like Digiyatra Implemented by Indian Government, research paper reading. | 4* |
| | **Total** (*Not Included) | **30** |

**Lab Assignment:**

**Suggested list of Assignment:**

1. Design a smart contract deployed on a blockchain network.
2. Set up a Polygon test network. Deploy the previously created smart contract to Polygon for improved scalability.
3. Design a web interface where users can sign and send transactions (e.g., product transactions) to the blockchain using MetaMask.
4. Implement IPFS for decentralized file storage.
5. Set up a basic DAO framework using a smart contract

**Sample Project Title:**

Develop a **decentralized supply chain management system** that integrates blockchain technologies at multiple layers. The system will allow participants to securely and transparently track and manage products as they move through different stages of the supply chain, ensuring data integrity, scalability, and governance.

The system should include:

1. **Layer 1 Blockchain** (e.g., **Ethereum** or **Hyperledger Fabric**): To securely record and verify transactions related to goods at each step of the supply chain.
2. **Layer 2 Scaling Solution** (e.g., **Polygon**): To improve transaction speed and reduce costs while interacting with the blockchain network.
3. **Layer 3 Application Layer** (e.g., **MetaMask**): To enable users (suppliers, producers, distributors, etc.) to interact with the system in a user-friendly manner by signing transactions and viewing product details.

4. **Layer 4 Data Storage** (e.g., **IPFS**): To securely store large files (e.g., invoices, shipping documents, product details) in a decentralized manner while maintaining the integrity of the data.
5. **Layer 5 Governance Layer** (e.g., **DAOs**): To manage and govern the decision-making process in the system. Implement a DAO to manage approvals for product verification, supply chain modifications, and dispute resolution.

**Text Books:**


1. Daniel Drescher, Blockchain Basics, A Non-Technical Introduction in 25 Steps, Publisher-Apress Berkeley, CA, 978-1-4842-2603-2 Published: 16 March 2017
2. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-on Approach, PublisherArshdeepBahga, 2017, ISBN 0996025561, 9780996025560
3. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, 2018, 1st edition, Apress, New York.


**Reference Books:**


1. Tiana Laurence, Blockchain For Dummies, Edition 2, Publisher:John Wiley & Sons, 2019 ISBN:1119555019, 9781119555018
2. Pethuru Raj and Ganesh Chandra Deka. 2018. Blockchain Technology: Platforms, Tools and Use Cases, Volume 111 (1st. ed.). Academic Press, Inc., USA.
3. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020, ISBN:9781839213199,book website: https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199


**Online Sources:**

1. https://ethereum.org/en/whitepaper/
2. https://www.bitcoin.com/satoshi-archive/whitepaper/
3. "Blockchain - Complete Blockchain Course for Beginners." https://www.udemy.com/course/learn-blockchain-technology-and-cryptocurrency-for-beginners
4. Blockchain and its Applications By Prof. Sandip Chakraborty, Prof. Shamik Sural | IIT Kharagpur 12 Week Course on NPTEL Swayam.
5. Hyperledger Tutorials - https://www.hyperledger.org/use/tutorials
6. Ethereum Development Resources - https://ethereum.org/en/developers

"Knowledge Brings Freedom"

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | UI and UX Design | | | | | | Code: BCE26PE03 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** basic programming language **is essential.**

**Course Objectives:**

This course aims at enabling students to:

1. Introduce students to modern system design practices with a focus on UI/UX design.
2. Develop skills in design thinking, user research, wireframing, and prototyping.
3. Integrate front-end development with systematic UI design principles and tools.
4. Equip students with tools and frameworks relevant to current industry practices (e.g., Figma, Design Systems).

**Course Outcomes:**

After learning the course, the students will be able to:

1. Explore the design thinking process and the distinction between UI and UX in system design.
2. Create user personas and journey maps based on findings from user research.
3. Apply visual design principles and design systems to develop effective wireframes.
4. Develop interactive UI prototypes and responsive front-end interfaces using design tools and frameworks.

**Guidelines:**

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.
4. The laboratory assignments are to be submitted by students in the form of a journal.
5. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
6. Program codes with sample output of all performed assignments should be submitted

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative

2. List of Tools: Figma, Penpot, Gravit Designer, Vectr, Draw.io, Miro, Google form, typeform, Tally.so, Canvanizer, Notion
3. Use of open-source tools is to be encouraged:
   - UI Design & Prototyping: Figma (or Penpot)
   - Wireframing & Mapping: FigJam / Miro (Free plan)
   - Surveys & Research: Google Forms + Microsoft Clarity
   - Personas & Empathy Maps: UXPressia (Free), Canvanizer

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| **I** | Introduction: Overview of system design with a focus on UI/UX. Design Thinking Process: Empathize, Define, Ideate, Prototype, Test, Human-centered design principles, Difference between UI and UX, Role of UX in system-level architecture. | 8 |
| **II** | User Research, Personas, and Journey Mapping: User research techniques: Interviews, surveys, contextual inquiry, creating empathy maps and personas, Task flows and user journey mapping, identifying pain points and defining opportunities. | 8 |
| **III** | Visual Design Principles and Design Systems UI Design principles: hierarchy, consistency, feedback, accessibility, Typography, color, spacing, iconography, Introduction to Design Systems: Atomic design, Material Design, Wireframing: Low, mid, and high-fidelity wireframes | 7 |
| **IV** | Prototyping, Usability Testing, and UI Development Prototyping using tools (Figma, Penpot), User testing methods: heuristic evaluation, usability testing, Basics of front-end development: HTML, CSS, Design-to-code practices and developer handoff (Anima, Figma Plugins) | 7 |
| | **Self-Study**<br>AI-Driven UX Personalization, Metaverse & Web3 UX, , research paper reading | 4* |
| | **Total** (*Not Included) | **30** |

"Knowledge Brings Freedom"

**Suggested Lab Assignment:**

1. Conduct user research for a real-world problem and define 2 user personas.
2. Create user journey maps and task flows for the selected application.
3. You have to redesign user experience of food delivery app. From current app users are dissatisfy and app suffers with low retention. Your first task is to understand the users of the application through qualitative and quantitative research methods. (expected: research docs such as interview script, survey summary, Empathy map, personas)
4. Design low-fidelity wireframes (paper or digital) for a multi-screen app.
5. Develop mid-fidelity wireframes in Figma for 3–4 screens.
6. Build interactive prototypes in Figma or Adobe XD.
7. Perform usability testing and document user feedback.
8. Convert UI mockups to responsive front-end using HTML/CSS/React (basic level).
9. Design and implement reusable UI components (e.g., buttons, cards).
10. Mini Project: Define problem statement, personas, journey, wireframes, Finalize high-fidelity design and build front-end screens, Final testing, iteration, and presentation/demo.

**Text Books:**

1. Don Norman, The Design of Everyday Things, MIT Press, Revised Edition, 2013.

2. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, About Face: The Essentials of Interaction Design, Wiley, 4th Edition, 2014.
3. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley, 1st Edition, 2011.

**Reference Books:**

1. Jennifer Tidwell, Designing Interfaces: Patterns for Effective Interaction Design, O'Reilly Media, 3rd Edition, 2019.
2. Steve Krug, Don't Make Me Think: A Common Sense Approach to Web Usability, New Riders, 3rd Edition, 2014.
3. Joel Marsh, UX for Beginners: A Crash Course in 100 Short Lessons, O'Reilly Media, 1st Edition, 2015.

**Online Sources:**

1. Interaction Design Foundation (IDF), Website: https://www.interaction-design.org
2. Figma Learn & Community, Website: https://www.figma.com/learn
3. Coursera – Google UX Design Professional Certificate Website: https://www.coursera.org/professional-certificates/google-ux-design

PCCOE
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| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Cloud Computing | | | | | | Code: BCE26PE04 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge** Computer Networks ,Operating Systems and Database Management System is essential.

**Course Objectives:**

This course aims at enabling students to:

1. To introduce various cloud computing services and models.
2. To learn how to select the appropriate configuration to compute a node.
3. To configure appropriate storage service for the specific application.
4. To understand networking and security settings in a cloud environment.
5. To design the application using high scalability and reliability considerations.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Understand various cloud computing services ,models and virtualization..
2. Analyse the various storage-related services while computing..
3. Apply appropriate database services during application deployment. .
4. Apply various networking and security options to the cloud.

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as softcopy.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include-timely completion, performance, innovation, efficiency, punctuality, and neatness.

**Guidelines for Laboratory Conduction**

1. All Assignments are mandatory
2. AmazonWS/MicroSoft Azure/Google CP is open source– use the appropriate service as per the requirement.
3. All Assignments should be conducted as per the sequence

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Introduction to Cloud Computing:** Introduction, Characteristics of Cloud Computing, Cloud Models, Cloud Services Examples, Cloud-based Services and Applications, Cloud Concepts and Technologies. | 8 |

| | | |
|---|---|---|
| | **Virtualization:** Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, VMware vSphere, Understanding Machine Imaging, Capacity Planning. Basics of Containerization with Docker and Kubernetes. | |
| **II** | **Web Services:** Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Exploring Platform as a Service: Defining Services, SaaS versus PaaS. | 7 |
| **III** | **Database Services in Cloud Computing :** Need for cloud databases, considerations for cloud databases, architecture and common characteristics,DataModels Relational database(MYSQL),Key–value- based database (DynamoDB), In-memory database, Document based database (Mongo DB), Graph based database (Neo4j), Time series database, Ledger based database. | 7 |
| **IV** | **Security in Cloud Computing:**<br>Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing.Data Security in Cloud: Security Issues, Challenges, Advantages, Disadvantages, Cloud Digital persona and Data security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.High Availability and Scalability Services in Cloud Computing | 8 |
| | **Self-Study**<br>virtual machines and containers,Storage for Backups and databases- in Azure and GCP, Databases, Storage gateway for hybrid cloud storage systems,Time series database, Ledger based database,Cloud Security in Azure and GCP, , research paper reading. | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested list of Assignment:**

1. **First Virtual Machine on AWS/MicroSoft Azure/GCP**: Launch the virtual machine on AWS/MicroSoft Azure/GCP and do basic settings.
2. **Storage Configuration**:Configure the various storages available on AWS/MicroSoft Azure/GCP and storing, retrieving, deleting the data from those storage applications.
3. **Database Configuration**:Configure and using various databases available on AmazonWS/MicroSoft Azure/GCP.
4. **Networking and Security Services Configuration**:Configuring various networking and security options on AmazonWS /MicroSoft Azure/GCP.
5. **High availability and scalability services**:Configuration of high availability and scalability services AmazonWS /MicroSoft Azure/GCP.
6. **Mini Project**:Implement a project based on all the services studied for a given application on AWS/MicroSoft Azure/GCP.

**Text Books:**


1. A.Srinivasan,J.Suresh,"CloudComputing:APracticalApproachforLearningandImplementation", Pearson, ISBN: 978-81-317-7651-3.
2. RajkumarBuyya,ChristianVecchiola,andThamaraiSelvi Mastering Cloud. Computing McGraw Hill Education, 2023.
3. Wittig,Michael,AndreasWittig,and Ben Whaley.Amazonwebservices in action. Manning, 2022.
4. Murty,James.Programming amazon web services:S3,EC2,SQS,FPS,andSimpleDB,"O'Reilly Media, Inc.", 2015.


**ReferenceBooks:**

1. Kavis, MichaelJ.Architecting the cloud:design decisions for cloud computing service models (SaaS, PaaS, and IaaS). John Wiley Sons, 2024.
2. Vacca,JohnR.,ed.Cloud computing security:foundationsandchallenges.CRCPress,2023.
3. Furht,Borivoje, and Arman do Escalante.Handbook of cloud computing. Vol.3.NewYork: springer, 2021.
4. Piper, Ben,and David Clinton. AWS Certified Solutions Architect Study Guide: Associate SAA-C02 Exam. John Wiley Sons, 2020.
5. Anthony,Albert.MasteringAWSSecurity: Create and maintain a secure cloud ecosystem. Packt Publishing Ltd, 2017.

**E-Resources:**

1. CloudComputingbySoumyaGhosh,https://nptel.ac.in/courses/106105167
2. Indian Institute of Technology Delhi: https://library.iitd.ac.in/arpit_2020-2021/Week%2016%20-%20Module%2039%20-%20PPT-%20Cloud%20Computing%20and%20Its%20Application%20in%20Libraries.pdf
3. IIT Roorkee: Intellipaat.com/advanced-certification-cloud-computing.
4. Cloud computing By Prof. SoumyaKantiGhosh | IIT Kharagpur: https://onlinecourses.nptel.ac.in/noc21_cs14/preview.

| Program: | B. Tech. (Computer Engineering) | | | | | | Semester: V | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Cyber Security and Forensics | | | | | | Code: BCE26PE05 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 4 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Operating systems, Computer Networks **is essential**

**Course Objectives:**

This course aims at enabling students:

1. To understand the fundamentals of cyber crimes, security and legal aspects
2. To develop deeper understanding of the digital security especially OS and web applications
3. To get an insight into the digital forensics
4. To gain knowledge of vulnerabilities and become familiar with VAPT tools

**Course Outcomes:**

After learning the course, the students will be able to:

1. Analyze the tools, methods and legal aspects of cyber crimes
2. Analyze the security aspects of digital security.
3. Develop a forensic plan for ascertaining the crime
4. Apply Vulnerability Assessment and Penetration Testing using relevant tools

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of students. Each lab assignment assessment will assign marks based on parameters with appropriate weightage.
2. 50% weightage of term work is based on suggested parameters for lab assignment includes- understanding and participation, timely completion, punctuality and neatness, overall professional behavior.
3. 50% weightage of term work is based on internal oral/practical evaluation.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative
2. Programming tools recommended: C/C++/ Java/Python
3. Use of open-source tools is to be encouraged.

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Cyber crimes and law fundamentals:** Classification of Cyber crimes, Cybercriminals modus-operandi - planning, tools and methods. SSL/TLS, HTTPS. Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and compliance, NIST CISF, Organisations dealing with Cyber crime and Cyber security in India. | 8 |
| II | Operating System Security: Common operating system vulnerabilities and attacks, Securing operating systems. SE Linux (Security Enhanced)<br>Web Application Security: Common web application vulnerabilities and attacks, Securing web applications, Secure coding practices. | 8 |

| | | |
|---|---|---|
| **III** | Computer and Mobile Forensics: Digital evidence, forensics life cycle, chain of custody, Approaches to computer forensics investigation, Mobile phones and basics of SIM, mobile phone forensics tools and methods, Threats to mobile applications, Mobile access permissions, analyzers for Mobile Applications to discover Security vulnerabilities, Android Security Architecture, social media forensics on mobile devices, Cloud Forensics | 8 |
| **IV** | Vulnerability analysis and penetration testing :Psychology of attackers, Social engineering attacks, physical penetration attacks, insider attacks. Trusted execution environment. | 6 |
| | **Self-Study:**<br>Recent cyber crimes and its modus operandi, Testing code vulnerability. Machine Learning for cyber security, Windows forensics using Belkasoft, Forensic tools for computer and mobile devices, OWASP Top10, CTF, Bounties, research paper reading. | 6* |
| | **Total** (*Not Included) | **30** |

**Suggested list of Assignment:**

1. Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User)
2. Installation and configuration of Computer Host Firewall.
3. Capture and analyze the network traffic
4. Computer Forensics using Sleuthkit
5. Mobile Forensics using open source tools like Volatility/ Autopsy / CAINE (Computer-Aided Investigative Environment)
6. Web application assessment using open source tools like Acunetix / Burpsuite / (JFrogXRay)
7. Vulnerability scanning using open source tools like OpenVAS /Nikto / Nuclei/ SecretScanner
8. Installation and basic usage of Metasploit for penetration testing

Self Study/practice:

- Perform security vulnerability assessment of website (with permission from the web-admin), say for PCCOE website or your own website.
- Study how permissions given to applications in mobile work. E.g. can location be accessed stealthily even though the location is turned off.
- How various passkeys – PIN, finger print are used/shared by various applications in mobile

**Text Books:**

1. Nina Godbole, SunitaBelapure, “Cyber Security- Understanding cyber crimes, computer forensics, and legal perspectives,” Wiley India,
2. Allen Harper, Jonathan Ness, Gideon Lenkey, Shon Harris, CrisEagle, Terron Williams, “ GrayHat Hacking- The ethical hackers handbook”, McGrawHill 3rd edition
3. Bill Nelson, Amelia Phillips, Christ Steuart, “Guide to Computer Forensics and Investigations- Processing Digital Evidence,” Cengage Learning, 4th Edition

**Reference Books:**

1. The Web Application Hacker’s Hand Book - Discovering and Exploiting Security flaws, DafyddSuttard, Marcuspinto,2nd Edition, Wiley Publishing.
2. William Stallings, “Cryptography and Network Security: Principles and Practice”, 6th Edition, Pearson Education, ISBN 13: 9781292158587
3. Forouzan, B.A., “Cryptography & Network Security” Tata McGraw-Hill Education, ISBN-13: 978-0070702080

**Online Sources:**

1. Cyber Security and Privacy, by Prof. Saji K Mathew, IIT Madras, https://nptel.ac.in/courses/106106248
2. Introduction to Cyber Security, JeetendraPande.http://uou.ac.in/foundation-course
3. https://belkasoft.thinkific.com/courses/windows-forensics-with-belkasoft
4. https://www.youtube.com/@DEFCONConference/videos

| Program : | B. Tech. (Computer Engineering) | | | | | | Semester: VI | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Course: | Image and Video processing | | | | | | Code: BCE26PE06 | | | | |
| Credit | Teaching Scheme (Hrs./Week) | | | | Evaluation Scheme and Marks | | | | | | |
| | Lecture | Practical | Tutorial | Other | FA | | SA | TW | OR | PR | Total |
| | | | | | FA1 | FA2 | | | | | |
| 2 | 2 | 4 | - | 1 | 10 | 10 | 30 | 50 | 50 | - | 150 |

**Prior knowledge of** Matrix Operations and Binarization **is essential**

**Course Objectives:**

This course aims at enabling students for

1. Application of point processing methods on digital image.
2. Application of spatial domain methods on digital image.
3. Application of image compression methods like RLE/Huffman coding and orthogonal transforms on digital image
4. Comprehension of the video processing techniques and the role of AI in video analysis.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Apply point processing methods on digital image.
2. Apply spatial domain methods on digital image.
3. Apply the image compression methods like RLE/Huffman coding and orthogonal transforms on digital image
4. Comprehend the video processing techniques and the role of AI in video analysis.

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as softcopy.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality, and neatness.

**Guidelines for Laboratory Conduction:**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative
2. Programming tools recommended: - Matlab, Python, OpenCV

**Detailed Syllabus**

| Unit | Description | Duration (Hrs) |
|---|---|---|
| I | **Fundamentals of Image Processing**<br>Basic steps of Image Processing System, Applications of Image Processing, Digital Image Acquisition: Sampling and Quantization, Basic relationship, between pixels, Spatial domain image processing methods: point processing, techniques: Image negation, Thresholding, gray level slicing, bit plane slicing, darkening and lightening of image. | 8 |
| II | **Spatial Domain Image Enhancement Techniques**<br>Histogram processing: Image Histogram and Histogram Equalization, Mask processing methods, smoothing spatial filters (Low pass filter), Sharpening spatial filters (High pass filters), High boost filter, Gradient filters: Prewit, Sobel and Robert. | 7 |

| | | |
|---|---|---|
| III | **Fundamentals of Image Compression**<br>Types of redundancies: coding, spatial, temporal, Compression models:<br>Lossy & Lossless, Lossless compression: Run length encoding (RLE) and Huffman coding, Lossy compression: Introduction to JPEG, Introduction to orthogonal transforms: Haar transform, cosine transform, significance of transforms, applying transform on image, inverse of transformed image. | 8 |
| IV | **AI in video analysis**<br>Introduction to Video Processing and AI: Introduction to Digital Video, Video Preprocessing and Frame Analysis, Role of machine learning and deep learning in video analysis, Extraction of visual and audio parts from digital video, Object Detection and Tracking in Video, Human-Centric Video Analytics. | 7 |
| | **Self-Study:**<br>Image Texture Analysis, Morphological Image Processing, Scene change detection, clustering-based summarization, reinforcement learning in video summarization, research paper reading. | 6* |
| | **Total** (*Not Included**)** | **30** |

**Suggested list of Assignment:**

1. Apply point processing techniques such as image negative, contrast stretching, thresholding,brightening and darkening an image. Display the original and processed images with analysis of the results.
2. Apply Spatial filters, Median and High boost filter on image. Display the original and processed images with brief analysis of the results.
3. Apply histogram equalization to improve the contrast of a low-contrast image. Use a real-world image (e.g., medical, satellite, or low-light photograph) and compare the visual quality of the enhanced image against the original image.
4. Perform Edge detection using First order and Second order derivatives like Laplacian, Robert , Prewitt and Sobel.
5. Implement an Image compression on a sample image using Huffman coding and Run length Coding.
6. Implement an Image compression on a sample image using DCT and Haar Transformation.
7. Implement a program to extract frames from a video file and perform basic point and mask processing methods on extracted frames. Also apply edge detection on Extracted frames using Sobel ,roberts and prewitt methods.
8. Implement a program to extract the audio from a video file. Save the extracted audio in a common format (e.g., WAV or MP3) and analyze the properties of the extracted audio, such as its duration, sampling rate, and file size.
9. Implement object detection to detect objects in a sample image or video. Use a pre-trained YOLO model(not limited to) and apply it to detect multiple objects in real-time. Highlight the detected objects with bounding boxes and labels.
10. Mini Project based on a problem statement approved by the faculty member.
    Note:
    ● Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work
    ● Oral examination will be on the Solution Proposed in Mini Project and Image and video processing Concepts used in the laboratory assignments.
    ● Mini Projects in this course should facilitate Project Based Learning among students.

**Text Books:**

1. Rafael.C, Gonzalez, Richard E Woods, “Digital Image Processing”,4th Edition, Pearson India,ISBN:9353062985, 2018.
2. Maria Petrou,“Image Processing: The Fundamentals”, 2nd Edition, Wiley, ISBN: 978-1119740462, 2022.

**Reference Books:**

1. Mukesh D Patil, Gajanan K Birajdar, Sangita S Chaudhari, "Computational Intelligence in Image and Video ProcessinG”, 1st edition, ISBN 9781032420769, 2023.
2. Milan Sonka, Vaclav Hlavac, and Roger Boyle,"Image Processing, Analysis, and Machine VisioN”, 4th edition, ISBN-13: 978-1473738201,2014.
3. B.Chanda, D. DuttaMajumder, “Digital Image Processing and Analysis”, 2 nd Edition, PHI learning, ISBN-978-81-203-4325-2, 2011.

**Online Sources:**

1. https://www.coursera.org/learn/digital
2. https://www.imageprocessingplace.com/
3. https://image-net.org/
4. https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/

| **Program:** | **B. Tech. (Computer Engineering)** | | | | | **Semester: VI** | |
|---|---|---|---|---|---|---|---|
| **Course:** | **Full Stack Development Lab** | | | | | **Code: BCE26VS01** | |
| **Credit** | **Teaching Scheme (Hrs./Week)** | | | **Evaluation Scheme and Marks** | | | |
| | **Lecture** | **Practical** | **Tutorial** | **TW** | **OR** | **PR** | **Total** |
| 2 | - | 4 | - | 50 | - | 50 | 100 |

**Prior knowledge of Basics of** Web Technologies **is essential**

**Course Objectives:**

This course aims at enabling students:

1. To familiarize with the core concepts of frontend and backend programming.
2. To explore the MERN (Mongo, Express, React, Node) web development technologies.
3. To get acquainted with NOSQL databases.

**Course Outcomes:**

After learning the course, the students will be able to:

1. Explore the latest technological stack for web application development.
2. Apply the concepts of React.js for web applications development.
3. Evaluate the features of NOSQL databases for designing data models.
4. Design dynamic web applications for real life scenarios.

**Guidelines for Students:**

1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as softcopy.

**Guidelines for Laboratory/Term Work Assessment:**

1. Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of students.
2. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality, and neatness.

**Guidelines for Laboratory Conduction**

1. Operating System recommended: - 64-bit Open-source Linux or its derivative
2. Programming tools recommended: - VS Code, React JS, HTML, CSS, JS, MongoDB Compass.
3. Use of Visual Studio Code platform is encouraged.

**Detailed Syllabus**

**Suggested List of Assignments**

| **Assignment No.** | **Assignment Title** |
|---|---|
| 1. | Create a static web page which defines all text formatting tags of HTML in tabular format. |
| 2. | Design a Personal Portfolio Page using HTML and CSS. Use bootstrap CDN if required. |
| 3. | Design a dynamic web app like fashion store / E- Commerce product using HTML, CSS & JS. Also use bootstrap CDN if required. |
| 4. | Create any interactive data visualization dashboard for any real-life application like weather dashboard. Visualize data using charts and graphs (use libraries like Chart.js or D3.js). |
| 5. | Create a simple functional college website / travel agency website / insurance website using Node.js and Express using any NoSQL data set like MongoDB if required. |

| | |
|---|---|
| 6. | Create Online appointment booking application / E-commerce portal for used items sales like car, bike etc. or similar type application using Node.js and Express use any NoSQL data set like MongoDB if required. |
| 7 | Design a web application for e-commerce or students feedback review systems or any other applications with MongoDB Backend. using React.js and Express. |
| 8 | Mini project -Build a full-stack MERN Project using React JS, MongoDB, Node & Express. |

**Text Books:**


1. HTML CSS and JavaScript for Beginners - A Web Design Course, by Laurence Svekis Released January 2019, Publisher(s): Packt Publishing, ISBN: 9781838551278.
2. Learning React, 2nd Edition by Alex Banks, Eve Porcello, Released June 2020, Publisher(s): O'Reilly Media, Inc. ISBN: 9781492051725
3. MongoDB: The Definitive Guide, 3rd Edition by Shannon Bradshaw, Eoin Brazil, Kristina Chodorow Released December 2019, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954461


**Reference Books:**


1. Kyle Banker, Peter Bakkum, Shaun Verch, Dough Garrett, Tim Hawkins “MongoDB in Action”, Manning Publications, Second Edition, 2016.
2. Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App by Greg Lim (Author)


**Online Sources:**

1. https://www.w3schools.com/whatis/whatis_fullstack.asp
2. https://www.geeksforgeeks.org/what-is-full-stack-development/
3. https://github.com/bmorelli25/Become-A-Full-Stack-Web-Developer

# Vision and Mission of Computer Department

## Department Vision

To be a premier Computer Engineering Department by achieving excellence in Academics and Research for creating globally competent and ethical professionals.

## Department Mission

M1: To develop technologically competent and self-sustained professionals through contemporary curriculum.
M2: To nurture innovative thinking and collaborative research, making a positive impact on society.
M3: To provide state-of-the art computing environment and learning opportunities through Center of Excellence.
M4: To foster leadership skills and ethics with holistic development.