# South Indian Education Society's

## Graduate School of Technology

NAAC 'A+' , NBA Accredited (EXTC,CE,IT)

## Autonomous Institute Affiliated to University of Mumbai


## Department of Computer Engineering

## Curriculum Structure FE to B.E

## and

## Second Year Syllabi

**Board of Studies**
**Department of Computer Engineering**

**Academic Council**
**SIES Graduate School of Technology**

**Effective from: AY 2025-26**

## PREAMBLE

Dear Students, Faculty, and Stakeholders,

Greetings and congratulations to all the stakeholders of SIES Graduate School of Technology for getting autonomous status to the college from the year 2024-25. University Grant Commission vide letter No. F. 2- 10/2023(AC-Policy) dated 10 July 2024 conferred the autonomous status affiliated to University of Mumbai for a period of 10 years from the academic year 2024-2025 to 2033-2034 as per clause 7.5 of the UGC (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations,2023. Autonomy will help design and implement curriculum which is more learner centric and robust to cater to the changing need of Society and Industry.

The Department of Computer Engineering SIES Graduate School of Technology, Nerul, Navi Mumbai, was established in 2002 and the current intake capacity is 180.One of the notable achievements is accreditation by the National Board of Accreditation (NBA) in 2011,2021,2024 which reflects our commitment in maintaining high standards of education and infrastructure.
We are delighted to announce the introduction of the newly designed curriculum for autonomy at SIES Graduate School of Technology, The newly designed curriculum for the Computer Engineering course at our autonomous institute is a reflection of our commitment to excellence, innovation, and inclusivity in higher education. Guided by the principles and objectives of the National Education Policy (NEP), this curriculum aims to create a robust framework that not only equips students with in-depth technical knowledge but also fosters holistic development, ethical values, and a lifelong passion for learning.

Curriculum emphases on flexibility, multidisciplinary education, and a learner-centric approach. It aims to develop well-rounded engineers with a strong foundation in core computer engineering skills, while integrating emerging technologies such as AI, machine learning, and cybersecurity. The curriculum also offers flexibility through electives, allowing students to tailor their education and foster interdisciplinary learning for a comprehensive skill set.

This curriculum is designed with strong industry collaboration to provide students with real-world experience through internships and projects, ensuring they are industry-ready upon graduation. We promote lifelong learning, ensuring that students remain curious, adaptable, and committed to growth throughout their careers. This curriculum empowers students to become innovative engineers, ethical leaders, and global citizens who will contribute to the advancement of technology and the betterment of society.

We would like to express our sincere gratitude to the faculty, alumni, students, industry experts, academicians, and stakeholders for their continuous support in strengthening our academics, making SIESGST one of the top engineering colleges in the nation and the premier choice for engineering aspirants.

Chairperson
Board of Studies
Computer Engineering
SIES Graduate School of Technology

Chairperson
Academic Council
SIES Graduate School of Technology

HEAD
Department of Computer Engineering
S.I.E.S. Graduate School of Technology
Sri Chandrasekarendra Saraswathy Vidyapur
Plot-1-C & E, Sector-V, Nerul, Navi Mumbai-400706

S.I.E.S. GRADUATE SCHOOL OF TECHNOLOGY (AUTONOMOUS) NERUL NAVI MUMBAI 400 706.

PRINCIPAL
S.I.E.S. GRADUATE SCHOOL OF TECHNOLOGY (AUTONOMOUS)
Plot 1C/D/E, Sri Chandrasekarendra Saraswathy Vidyapuram
Sector - V, Nerul, Navi Mumbai - 400 706.

# Semester-wise Credit Distribution Structure for Four Year UG Engineering

## Program – Computer Engineering: One Major, One Minor

| Semester | | I | II | III | IV | V | VI | VII | VIII | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course (BSC) | BSC/ESC | 7 | 6 | | -- | -- | -- | -- | -- | 13 |
| Engineering Science Course (ESC) | | 9 | 10 | | -- | -- | -- | -- | -- | 19 |
| Program Core Course (PCC) | Program Courses | -- | -- | 17 | 11 | 11 | 11 | 04 | -- | 54 |
| Program Elective Course (PEC) | | -- | -- | -- | -- | 04 | 04 | 07 | -- | 15 |
| Multidisciplinary Minor (MDM) | Multidisciplinary Courses | | - | | 03 | 04 | 04 | 04 | -- | 15 |
| Open Elective (OE) Other than a particular program | | -- | -- | -- | -- | -- | -- | 03 | 03 | 06 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 01 | 01 | 02 | 02 | -- | 02 | -- | -- | 08 |
| Ability Enhancement Course (AEC - 01, AEC-02) | Humanities Social Science and Management (HSSM) | | 02 | -- | -- | 02 | -- | -- | -- | 04 |
| Entrepreneurship/Economics/ Management Courses | | -- | | 02 | 02 | -- | -- | -- | -- | 04 |
| Indian Knowledge System (IKS) | | | 02 | | -- | -- | -- | -- | -- | 02 |
| Value Education Course (VEC) | | -- | -- | -- | 02 | -- | -- | -- | -- | 02 |
| Research Methodology (RM) | Experiential Learning Courses | -- | -- | -- | -- | -- | -- | -- | 03 | 03 |
| Community Engagement Project. / Field Project (FP) | | -- | -- | 01 | 01 | -- | -- | - | - | 02 |
| Project | | -- | -- | -- | -- | 01 | 01 | 02 | 02 | 06 |
| Internship/On Job Training (OJT) | | -- | --- | | -- | -- | -- | | 09 | 09 |
| Co-curricular Courses (CC) | Liberal Learning Courses | 04 | | | -- | -- | -- | -- | - | 04 |
| **Total Credits (Major)** | | **21** | **21** | **22** | **21** | **22** | **22** | **20** | **17** | **166** |

# CURRICULUM STRUCTURE

## SECOND YEAR ENGINEERING

## (COMPUTER ENGINEERING)

## ACADEMIC YEAR 2025-26

| Nomenclature of the courses in the curriculum | |
|---|---|
| **Abbreviation** | **Title** |
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| PCC | Program Core Courses |
| PEC | Program Elective Course |
| MDM | Multidisciplinary Minor |
| OE | Open Elective |
| VSEC | Vocational and Skill Enhancement Course |
| AEC | Ability Enhancement Course |
| IKS | Indian Knowledge System |
| VEC | Value Education Course |
| RM | Research Methodology |
| CEP/FP | Community Engagement Project/Field Project |
| OJT | Internship/On Job Training |
| CC | Cocurricular Courses |
| ISE | In Semester Examination |
| MSE | Mid Semester Examination |
| ESE | End Semester Examination |
| CIAP | Continuous Internal Assessment Practical |
| ESEP | End Semester Examination Practical |

# SIES Graduate School of Technology
## Department of Computer Engineering
### Bachelor of Engineering

**Program Structure for First Year Engineering**

**W.E.F. A.Y. 2024-25**

## Semester I

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| FEC101 | Applied Mathematics -I | BSC | 3 | -- | -- | 3 | -- | -- | 3 |
| FEC1021/ FEC1022 | Applied Physics/ Applied Chemistry @ | BSC | 3 | -- | -- | 3 | -- | -- | 3 |
| FEC103 | Basic Electrical & Electronics Engineering | ESC | 2 | -- | -- | 2 | -- | -- | 2 |
| FEC104 | C-Programming | ESC | 2 | -- | -- | 2 | -- | -- | 2 |
| FEC105 | Applied Mechanics and Robot Dynamics | ESC | 2 | -- | -- | 2 | -- | -- | 2 |
| FEL1011/ FEL1012 | Applied Physics Lab/ Applied Chemistry Lab @ | BSC | -- | 1 | -- | -- | 0.5 | -- | 0.5 |
| FEL102 | Basic Electrical & Electronics Engineering Lab | ESC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL103 | C-Programming Lab | ESC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL104 | Applied Mechanics and Robot Dynamics Lab | ESC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL105 | Engineering Workshop-I | VSEC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL106 | Health, Wellness and Mindfulness | CC | -- | 2#+2 | -- | -- | 2 | -- | 2 |
| FEL107 | Induction Cum Universal Human Values | CC | -- | 5* | -- | -- | 2.5 | -- | 2.5 |
| | **Total** | | **12** | **18** | -- | **12** | **9** | -- | **21** |

## Examination Scheme-FY Semester-I

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| FEC101 | Applied Mathematics -I | 20 | 20 | 60 | 3 | -- | -- | 100 |
| FEC1021/ FEC1022 | Applied Physics/ Applied Chemistry @ | 20 | 20 | 60 | 3 | -- | -- | 100 |
| FEC103 | Basic Electrical & Electronics Engineering | 15 | 15 | 45 | 2 | -- | -- | 75 |
| FEC104 | C-Programming | 15 | 15 | 45 | 2 | -- | -- | 75 |
| FEC105 | Applied Mechanics and Robot Dynamics | 15 | 15 | 45 | 2 | -- | -- | 75 |
| FEL1011/ FEL1012 | Applied Physics Lab/ Applied Chemistry Lab@ | -- | -- | -- | -- | 25 | -- | 25 |
| FEL102 | Basic Electrical & Electronics Engineering Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL103 | C-Programming Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL104 | Applied Mechanics and Robot Dynamics Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL105 | Engineering Workshop-I | -- | -- | -- | -- | 25 | -- | 25 |
| FEL106 | Health, Wellness and Mindfulness | -- | -- | -- | -- | 25 | -- | 25 |
| FEL107 | Induction Cum Universal Human Values | -- | -- | -- | -- | 25 | -- | 25 |
| **Total** | | **85** | **85** | **255** | | **175** | **75** | **675** |

@Physics/Chemistry in one semester.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.
Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
*Indicates workload of a learner for UHV. Faculty Load: ½ hour per week per four groups
# Two hours of practical class to be conducted for full class as demo/ discussion.
ISE: In Semester Examination**:** To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks.
MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP).

# Program Structure for First Year Engineering
**W.E.F. A.Y. 2024-25**

## Semester II

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| FEC201 | Applied Mathematics -II | BSC | 3 | -- | -- | 3 | -- | -- | 3 |
| FEC2021/ FEC2022 | Applied Physics/ Applied Chemistry @ | BSC | 3 | -- | -- | 3 | -- | -- | 3 |
| FEC203 | Engineering Graphics | ESC | 2 | -- | -- | 2 | -- | -- | 2 |
| FEC204 | Digital System Design | ESC | 3 | -- | -- | 3 | -- | -- | 3 |
| FEC205 | Professional Communication Techniques | AEC | 2 | -- | -- | 2 | -- | -- | 2 |
| FEL2011/ FEL2012 | Applied Physics Lab/ Applied Chemistry Lab @ | BSC | -- | 1 | -- | -- | 0.5 | -- | 0.5 |
| FEL202 | Engineering Graphics Lab | ESC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL203 | Digital System Design Lab | ESC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL204 | Professional Communication Techniques Lab | AEC | -- | 1 | -- | -- | 0.5 | -- | 0.5 |
| FEL205 | Object Oriented Programming Methodology Lab | ESC | -- | 2*+2 | -- | -- | 2 | -- | 2 |
| FEL206 | Engineering Workshop-II | VSEC | -- | 2 | -- | -- | 1 | -- | 1 |
| FEL207 | Indian Knowledge System | HSSM | -- | 2*+2 | -- | -- | 2 | -- | 2 |
| | **Total** | | **13** | **16** | -- | **13** | **8** | -- | **21** |

**Examination Scheme-FY Semester-II**

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| FEC201 | Applied Mathematics -II | 20 | 20 | 60 | 03 | -- | -- | 100 |
| FEC2021/ FEC2022 | Applied Physics/ Applied Chemistry @ | 20 | 20 | 60 | 03 | -- | -- | 100 |
| FEC203 | Engineering Graphics | 15 | 15 | 45 | 03 | -- | -- | 75 |
| FEC204 | Digital System Design | 20 | 20 | 60 | 03 | -- | -- | 100 |
| FEC205 | Professional Communication Techniques | 15 | 15 | 45 | 02 | -- | -- | 75 |
| FEL2011/ FEL2012 | Applied Physics Lab/ Applied Chemistry Lab @ | -- | -- | -- | -- | 25 | -- | 25 |
| FEL202 | Engineering Graphics Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL203 | Digital System Design Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL204 | Professional Communication Techniques Lab | -- | -- | -- | -- | 25 | -- | 25 |
| FEL205 | Object Oriented Programming Methodology Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| FEL206 | Engineering Workshop-II | -- | -- | -- | -- | 25 | -- | 25 |
| FEL207 | Indian Knowledge System | -- | -- | -- | -- | 25 | -- | 25 |
| **Total** | | **90** | **90** | **270** | -- | **175** | **75** | **700** |

@Physics/Chemistry in one semester.
* Two hours of practical class to be conducted for full class as demo/ discussion.
# Course evaluation is an activity based which may be an individual or group of students.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.
Theory 1 credit for 1 hour and practical 1 credit for 2 hours.
ISE: In Semester Examination**:** To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test etc. of 20/15 marks.
MSE: Mid Semester Examination: To be conducted as written examination for 20/15 marks of duration 1 Hr.
ESE: End Semester Examination
CIAP: Continuous Internal Assessment Practical. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
ESEP: End Semester Examination Practical. Oral/Practical Examination will be conducted as End Semester Examination Practical (ESEP).

# Program Structure for Second Year

**W.E.F. A.Y. 2025-26**

## Semester III

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| CEC301 | Applied Mathematics III | PCC | 3 | | | 3 | | | 3 |
| CEC302 | Data structure | PCC | 3 | | | 3 | | | 3 |
| CEC303 | Discrete structure and Graph Theory | PCC | 3 | | | 3 | | | 3 |
| CEC304 | Database Management system | PCC | 3 | | | 3 | | | 3 |
| CEC305 | Computer Organization and Architecture | PCC | 2 | | | 2 | | | 2 |
| CEC306 | Engineering Economics | HSSM | 2 | | | 2 | | | 2 |
| CEL301 | Data structure Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL302 | Database Management system Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL303 | Computer Organization and Architecture Lab | PCC | | 2 | | | 1 | -- | 1 |
| CEL304 | Skill Lab (Python Programming) | VSEC | -- | 2*+2 | -- | -- | 2 | -- | 2 |
| CEM301 | Mini Project 1A | CEP | -- | 2# | -- | -- | 1 | -- | 1 |
| **Total** | | | **16** | **12** | **--** | **16** | **6** | **--** | **22** |

## Examination Scheme - CE Semester-III

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC301 | Applied Mathematics III | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC302 | Data structure | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC303 | Discrete structure and Graph Theory | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC304 | Database Management system | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC305 | Computer Organization and Architecture | 15 | 15 | 45 | 2 | -- | -- | 75 |
| CEC306 | Engineering Economics | 50 | -- | -- | -- | -- | -- | 50 |
| CEL301 | Data structure Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL302 | Database Management system Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL303 | Computer Organization and Architecture Lab | -- | -- | -- | -- | 25 | | 25 |
| CEL304 | Skill Lab (Python Programming) | -- | -- | -- | -- | 25 | 25 | 50 |
| CEM301 | Mini Project 1A | | | | | 25 | 25 | 50 |
| **Total** | | **145** | **95** | **285** | **--** | **125** | **100** | **750** |

* Two hours of practical class to be conducted for full class as demo/ discussion.

# Indicates workload of a learner (Not faculty) for Mini Project 1A. Faculty Load: ½ hour per week per four groups

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours is of 60 marks and scaled to 45.

# Program Structure for Second Year

**W.E.F.A.Y.2025-26**

## Semester IV

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| CEC401 | Applied Mathematics IV | PCC | 3 | -- | -- | 3 | -- | -- | 3 |
| CEC402 | Operating System | PCC | 3 | | -- | 3 | -- | -- | 3 |
| CEC403 | Analysis of Algorithm | PCC | 3 | -- | -- | 3 | -- | -- | 3 |
| CEC404 | Critical Thinking and Design | HSSM | 2 | -- | -- | 2 | -- | -- | 2 |
| MDMC40X1 | Multidisciplinary Minor (MDM -I) | MDM | 3 | -- | -- | 3 | -- | -- | 3 |
| CEL401 | Operating System Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL402 | Analysis of Algorithm Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL403 | Skill Lab (Web Technology) | VSEC | -- | 2*+2 | -- | -- | 2 | -- | 2 |
| CEL404 | Value Education Course (UHV) | HSSM (VEC) | -- | 4 | -- | -- | 2 | -- | 2 |
| CEM401 | Mini Project 1B | CEP | -- | 2# | -- | -- | 1 | -- | 1 |
| **Total** | | | **14** | **16** | **--** | **14** | **7** | **--** | **21** |

## Examination Scheme - CE Semester-IV

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC401 | Applied Mathematics IV | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC402 | Operating System | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC403 | Analysis of Algorithm | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC404 | Critical Thinking and Design | 15 | 15 | 45 | 2 | -- | -- | 75 |
| MDMC40X1 | Multidisciplinary Minor (MDM -I) | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEL401 | Operating System Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL402 | Analysis of Algorithm Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL403 | Skill Lab (Web Technology) | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL404 | Value Education Course (UHV) | | | | | 50 | | 50 |
| CEM401 | Mini Project 1B | -- | -- | -- | -- | 25 | 25 | 50 |
| **Total** | | 95 | 95 | **285** | -- | **150** | **100** | **725** |

* Two hours of practical class to be conducted for full class as demo/ discussion.
UHV: Universal Human Values

# Indicates workload of a learner (Not faculty) for Mini Project 1B. Faculty Load: ½ hour per week per four groups.

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

# Program Structure for Third Year
**W.E.F.A.Y.2026-27**

## Semester V

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| CEC501 | Theoretical Computer Science | PCC | 3 | -- | -- | 3 | -- | -- | 3 |
| CEC502 | Software Engineering and Project Management | PCC | 3 | -- | -- | 3 | -- | -- | 3 |
| CEC503 | Computer Network | PCC | 3 | -- | -- | 3 | -- | -- | 3 |
| MDMC50X2 | Multidisciplinary Minor (MDM-II) | MDM | 3 | -- | -- | 3 | -- | -- | 3 |
| CEPEC501X | Program Elective-I | PEC | 3 | -- | -- | 3 | -- | -- | 3 |
| CEL501 | Software Engineering and Project Management Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL502 | Computer Network Lab | PCC | -- | 2 | -- | -- | 1 | -- | 1 |
| CEL503 | Professional Communication and Ethics Lab | HSSM (AEC) | -- | 2*+2 | -- | -- | 2 | -- | 2 |
| MDML50X2 | Multidisciplinary Minor (MDM-II) Lab | MDM | -- | 2 | -- | -- | 1 | -- | 1 |
| CEPEL501X | Program Elective-I Lab | PEC | | 2 | | | 1 | | 1 |
| CEM501 | Mini Project 2A | Project | -- | 2# | -- | -- | 1 | -- | 1 |
| **Total** | | | **15** | **14** | **--** | **15** | **7** | **--** | **22** |

## Examination Scheme - CE Semester-V

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC501 | Theoretical Computer Science | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC502 | Software Engineering and Project Management | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC503 | Computer Network | 20 | 20 | 60 | 3 | -- | -- | 100 |
| MDMC50X2 | Multidisciplinary Minor (MDM-II) | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEPEC501X | Program Elective-I | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEL501 | Software Engineering and Project Management Lab | -- | -- | -- | | 25 | | 25 |
| CEL502 | Computer Network Lab | -- | -- | -- | | 25 | 25 | 50 |
| CEL503 | Professional Communication and Ethics Lab | -- | -- | -- | | 25 | 25 | 50 |
| MDML50X2 | Multidisciplinary Minor (MDM-II) Lab | -- | -- | -- | | 25 | 25 | 50 |
| CEPEL501X | Program Elective-I Lab | | | | | 50 | | 50 |
| CEM501 | Mini Project 2A | -- | -- | -- | -- | 25 | 25 | 50 |
| **Total** | | **100** | **100** | **300** | | **175** | **100** | **775** |

* Two hours of practical class to be conducted for full class as demo/ discussion.

# Indicates workload of a learner (Not faculty) for Mini Project 2A. Faculty Load: ½ hour per week per four groups

$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

# Program Elective – I

| Technology Bucket | | | |
|---|---|---|---|
| **General** | **Embedded System** | **Security / Blockchain** | **Artificial Intelligence** |
| **CEPEC5011:** Advanced Database Management System | **CEPEC5012:** Internet of things | **CEPEC5013:** Ethical Hacking | **CEPEC5014:** Data Mining |

# Program Structure for Third Year
**W.E.F.A.Y.2026-27**

## Semester VI

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | Credits Assigned | | |
|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Theory | Pract. | Total |
| CEC601 | System Programming and Compiler Construction | PCC | 3 | -- | 3 | -- | 3 |
| CEC602 | Cryptography and System Security | PCC | 3 | -- | 3 | -- | 3 |
| CEC603 | Artificial intelligence and Soft Computing | PCC | 3 | -- | 3 | -- | 3 |
| MDMC60X3 | Multidisciplinary Minor (MDM-III) | MDM | 3 | -- | 3 | -- | 3 |
| CEPEC601X | Program Elective-II | PEC | 3 | -- | 3 | -- | 3 |
| CEL601 | Cryptography and System Security Lab | PCC | -- | 2 | -- | 1 | 1 |
| CEL602 | Artificial intelligence and Soft Computing Lab | PCC | -- | 2 | -- | 1 | 1 |
| CEL603 | Skill Lab (Cloud Computing) | VSEC | -- | 2*+2 | -- | 2 | 2 |
| MDML60X3 | Multidisciplinary Minor (MDM-III) Lab | MDM | -- | 2 | -- | 1 | 1 |
| CEPEL601X | Program Elective-II Lab | PEC | | 2 | | 1 | 1 |
| CEM601 | Mini Project 2B | Project | -- | 2# | -- | 1 | 1 |
| **Total** | | | **15** | **14** | **15** | **7** | **22** |

## Examination Scheme - CE Semester-VI

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC601 | System Programming and Compiler Construction | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC602 | Cryptography and System Security | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEC603 | Artificial intelligence and Soft Computing | 20 | 20 | 60 | 3 | -- | -- | 100 |
| MDMC60X3 | Multidisciplinary Minor (MDM-III) | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEPEC601X | Program Elective-II | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEL601 | Cryptography and System Security Lab | | | | | 25 | 25 | 50 |
| CEL602 | Artificial intelligence and Soft Computing Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEL603 | Skill Lab (Cloud Computing) | -- | -- | -- | -- | 25 | 25 | 50 |
| MDML60X3 | Multidisciplinary Minor (MDM-III) Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEPEL601X | Program Elective-II Lab | -- | -- | -- | -- | 25 | | 25 |
| CEM601 | Mini Project 2B | -- | -- | -- | -- | 25 | 25 | 50 |
| **Total** | | 100 | 100 | **300** | -- | **150** | **125** | **775** |

* Two hours of practical class to be conducted for full class as demo/ discussion.
# Indicates workload of a learner (Not faculty) for Mini Project 2B. Faculty Load: ½ hour per week per four groups
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours are of 60 marks and scaled to 45.

## Program Elective – II

| Technology Bucket | | | |
|---|---|---|---|
| **General** | **Embedded System** | **Security / Blockchain** | **Artificial Intelligence** |
| **CEPEC6011:** Digital Signal and Image Processing | **CEPEC6012:** Robotics and Applications | **CEPEC6013:** Information Theory and Coding | **CEPEC6014:** Natural Language Processing |

# Program Structure for Fourth Year
**W.E.F.A.Y.2027-28**

## Semester VII

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | Credits Assigned | | |
|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Theory | Pract. | Total |
| CEC701 | Machine Learning | PCC | 3 | -- | 3 | -- | 3 |
| MDMC70X4 | Multidisciplinary Minor (MDM-IV) | MDM | 3 | -- | 3 | -- | 3 |
| CEPEC701X | Program Elective – III | PEC | 3 | -- | 3 | -- | 3 |
| CEPEC702X | Program Elective-IV | PEC | 3 | -- | 3 | -- | 3 |
| OEC701X | Open Elective -I | OE | 3 | -- | 3 | -- | 3 |
| CEL701 | Machine Learning Lab | PCC | -- | 2 | -- | 1 | 1 |
| MDML70X4 | Multidisciplinary Minor (MDM-IV) | MDM | -- | 2 | -- | 1 | 1 |
| CEPEL701X | Program Elective-III Lab | PEC | -- | 2 | -- | 1 | 1 |
| CEP701 | Major Project Stage-I | MJP | -- | 4# | -- | 2 | 2 |
| **Total** | | | **15** | **10** | **15** | **5** | **20** |

## Examination Scheme - CE Semester-VII

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC701 | Machine Learning | 20 | 20 | 60 | 3 | -- | -- | 100 |
| MDMC70X4 | Multidisciplinary Minor (MDM-IV) | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEPEC701X | Program Elective – III | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEPEC702X | Program Elective-IV | 20 | 20 | 60 | 3 | | -- | 100 |
| OEC701X | Open Elective -I | 20 | 20 | 60 | 3 | -- | -- | 100 |
| CEL701 | Machine Learning | -- | -- | -- | -- | 25 | 25 | 50 |
| MDML70X4 | Multidisciplinary Minor (MDM-IV) | -- | -- | -- | -- | 25 | 25 | 50 |
| CEPEL701X | Program Elective-III Lab | -- | -- | -- | -- | 25 | 25 | 50 |
| CEP701 | Major Project Stage-I | | | | | 25 | 25 | 50 |
| **Total** | | 100 | **100** | **300** | -- | **100** | **100** | **700** |

#Indicates workload of Learner (Not faculty), for Major Project. Project Guide Load = ½ hour per week per project group.
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours is of 60 marks and scaled to 45.

## Program Elective-III

| Technology Bucket | | | |
|---|---|---|---|
| **General** | **Embedded System** | **Security / Blockchain** | **Artificial Intelligence** |
| **CEPEC7011:** High Performance Computing | **CEPEC7012:** Fog and Edge Computing | **CEPEC7013:** Blockchain | **CEPEC7014:** Deep Learning |

## Program Elective-IV

| Technology Bucket | | | |
|---|---|---|---|
| **Data Science** | **Embedded System** | **Security / Blockchain** | **Artificial Intelligence** |
| **CEPEC7021:** Augmented Reality and Virtual Reality | **CEPEC7022:** Quantum Computing | **CEPEC7023:** Intelligent Forensic | **CEPEC7024:** Generative AI |

## Open Elective-I

| Course Code | Course Name |
|---|---|
| OEC7011 | Project Management |
| OEC7012 | Finance Management |
| OEC7013 | Management Information System |
| OEC7014 | Entrepreneurship Development and Management |
| OEC7015 | Operation Research |
| OEC7016 | Disaster Management and Mitigation Measures |
| OEC7017 | Product Design |

# Program Structure for Fourth Year
**W.E.F.A.Y.2027-28**

## Semester VIII

| Course Code | Course Name | Category | Teaching Scheme (Contact Hours) | | Credits Assigned | | |
|---|---|---|---|---|---|---|---|
| | | | Theory | Pract. | Theory | Pract. | Total |
| CEC801 | Research Methodology | RM | 3 | - | 3 | - | 3 |
| OEC801X | Open Elective-II | OE | 3 | -- | 3 | -- | 3 |
| CEP801 | Major Project Stage-II | MJP | -- | 4# | -- | 2 | 2 |
| CEINT801 | Internship/Project/Research | Internship | -- | -- | -- | 9 | 9 |
| **Total** | | | **6** | **4** | **6** | **11** | **17** |

## Examination Scheme - CE Semester-VIII

| Course Code | Course Name | Examination Scheme | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | CIAP | ESEP | Total |
| | | Internal Assessment | | ESE$ | Exam Duration (Hrs.) | | | |
| | | ISE | MSE | | | | | |
| CEC801 | Research Methodology | 20 | 20 | 60 | 3 | | -- | 100 |
| OEC801X | Open Elective-II | 20 | 20 | 60 | 3 | | -- | 100 |
| CEP801 | Major Project Stage-II | | | | | 100 | 50 | 150 |
| CEINT801 | Internship/Project/Research | | | | | 200 | | 200 |
| **Total** | | 40 | **40** | **120** | -- | **300** | **50** | **550** |

#Indicates workload of Learner (Not faculty), for Major Project. Project Guide Load = ½ hour per week per project group
$ ESE of duration 3 hours are of 80 marks and scaled to 60. ESE duration of 2 hours is of 60 marks and scaled to 45.

# Open Elective-II

| Course Code | Course Name |
|---|---|
| OEC8011 | Enterprise Resource Planning |
| OEC8012 | Cyber Security and Laws |
| OEC8013 | Energy Audit and Management |
| OEC8014 | IPR and Patenting |
| OEC8015 | Environmental Management |
| OEC8016 | Digital Business Management |
| OEC8017 | Human Resource Management |

# Multidisciplinary Minor (MDM)

| Track | Minor Track | Partner Institute if any | Module | Code | Eligible |
|---|---|---|---|---|---|
| 1 | Machine Learning | SIES GST | Artificial Intelligence | MDMC4011 | IT/EXTC/CSE IOT |
| | | | Machine Learning | MDMC5012 | |
| | | | Natural Language Processing | MDMC6013 | |
| | | | Deep Learning | MDMC7014 | |
| 2 | Data Science | SIES GST | Statistical Foundation for Data Science | MDMC4021 | ECS/CE/EXTC |
| | | | Data Analytics & Visualization | MDMC5022 | |
| | | | Data Analytics & Visualization Lab | MDML5022 | |
| | | | Decision Making & Business Intelligence | MDMC6023 | |
| | | | Decision Making & Business Intelligence Lab | MDML6023 | |
| | | | Big Data Analytics | MDMC7024 | |
| | | | Big Data Analytics Lab | MDML7024 | |
| 3 | Embedded Systems | SIES GST | Microprocessor and Microcontrollers | MDMC4031 | CE/AIDS/AIML |
| | | | RTOs and Embedded systems | MDMC5032 | |
| | | | RTOs and Embedded systems Lab | MDML5032 | |
| | | | Sensor Technology | MDMC6033 | |
| | | | Sensor Technology Lab | MDML6033 | |
| | | | Industrial Internet of Things | MDC7034 | |
| | | | Industrial Internet of Things Lab | MDL7034 | |
| 4 | Cyber Security | SIES GST | Computer Network | MDMC4041 | AIDS/AIML |

| | | | | | |
|---|---|---|---|---|---|
| | | | Cryptography & System Security | MDMC5042 | |
| | | | Cloud Computing and Security | MDMC6043 | |
| | | | Digital Forensics | MDMC7044 | |
| 5 | System Programming | SIES GST | Advance Data Structure | MDMC4051 | CSEIOT/ECS/IT |
| | | | Advance Algorithm | MDMC5052 | |
| | | | System Programming and Compiler Construction | MDMC6053 | |
| | | | Distributed Systems | MDMC7054 | |
| 6 | Management | SIESSBS | Cost Management | MDMC4061 | EXTC/CE/IT/ECS/AIDS/AIML/CSE IOT |
| | | | Supply Chain Management | MDMC5062 | |
| | | | HR & Organization | MDMC6063 | |
| | | | Marketing Management | MDMC7064 | |

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC301 | Applied Mathematics-III | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC301 | Applied Mathematics-III | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. FEC101- Applied Mathematics I
2. FEC201 - Applied Mathematics II

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigation of Complex Problems

**Course Objectives:**

1. To learn the Laplace transform of various functions and its applications.
2. To learn Inverse Laplace Transform of various functions and its applications.
3. To understand the concept of Fourier Series, its complex form and enhance the problem-solving skill.
4. To understand the concept of complex variables, C-R equations, harmonic functions and their conjugate and mapping in complex plan.
5. To familiarize with the concepts of statistics for data analysis.
6. To acquaint with the concepts of probability, random variables with their distributions and expectations.

**Course Outcomes: Learners will be able to**

1. Apply the properties of Laplace transform to the functions. Describe the various functions of Physical Layer.
2. Determine inverse Laplace transform using convolution theorem and partial fraction method.
3. Construct the Fourier series of periodic functions for real life problems and complex engineering problems.
4. Apply the concept of complex numbers, complex functions, and their significance in data science and engineering.
5. Evaluate the strength and direction of relationships between variables using correlation and Regression techniques.
6. Apply the concepts of probability and expectation for getting the spread of the data and distribution of the data.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Laplace Transform** | **07** | |
| | **1.1** | Definition of Laplace transform: Condition of Existence of Laplace transform, Laplace Transform (L) of Standard Functions like $e^{at}, \sin(at), \cos(at), \sin h(at), \cos h(at)$ *and* $t^n, n \geq 0$ . | | **CO1** |
| | **1.2** | Properties of Laplace Transform: Linearity, First shifting theorem, Second Shifting Transform, Change of Scale property, Multiplication by t, Division by t, Laplace Transform of derivatives and integrals (Properties without proof). | | |
| | **1.3** | Evaluation of integrals for particular value of 's' by using Laplace Transformation. | | |
| | | **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function. | | |
| **2.0** | | **Inverse Laplace Transform** | **06** | |
| | **2.1** | Introduction of Inverse Laplace Transform, Linearity property, Use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. | | **CO2** |
| | **2.2** | Partial fractions method to find inverse Laplace transform | | |
| | **2.3** | Inverse Laplace transform using Convolution theorem (without proof). | | |
| | **2.4** | Applications to solve initial and boundary value problems involving ordinary differential equations. | | |
| | | **Self-learning Topics:** Applications to solve simultaneous initial and boundary value problems involving ordinary differential equations. | | |
| **3.0** | | **Fourier Series** | **07** | |
| | **3.1** | Dirichlet's conditions, Definition of Fourier series. | | **CO3** |
| | **3.2** | Fourier series of periodic functions with period $2\pi$ and 2l. | | |
| | **3.3** | Fourier series of even and odd functions (No examples on Parseval Identity) | | |
| | **3.4** | Half range Sine and Cosine Series. | | |
| | | **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform. | | |
| **4.0** | | **Complex Variables** | **07** | |
| | **4.1** | Function f(z) of complex variable, limit, continuity and differentiability off(z) Analytic function, necessary and sufficient conditions for f(z) to be analytic (without proof). | | **CO4** |
| | **4.2** | Cauchy-Riemann equations in cartesian coordinates (without proof). | | |
| | **4.3** | Milne-Thomson method to determine analytic function f(z) when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given. | | |

| | | | | |
|---|---|---|---|---|
| | **4.4** | Harmonic function, Harmonic conjugate and orthogonal trajectories. | | |
| | | **Self-learning Topics**: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations. | | |
| **5.0** | | **Statistical Techniques** | **06** | |
| | **5.1** | Karl Pearson's Coefficient of correlation (r) and related concepts with problems. | | **CO5** |
| | **5.2** | Spearman's Rank correlation coefficient (R) (Repeated & non repeated ranks with problems). | | |
| | **5.3** | Lines of regression. | | |
| | | **Self-learning Topics:** Covariance. | | |
| **6.0** | | **Probability Theory** | **06** | |
| | **6.1** | Total Probability theorem and Bayes' theorem. | | **CO6** |
| | **6.2** | Discrete and continuous random variable with probability distribution and probability density function. | | |
| | **6.3** | Expectation, Variance, Laws of expectation. | | |
| | **6.4** | Moment generating function, Raw and central moments up to 4th order. | | |
| | | **Self-learning Topics:** Skewness and Kurtosis of distribution (data). | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.

**Reference books:**

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication, 5th edition.
2. Complex Variables and Applications, Brown and Churchill, McGraw-Hill Education, 9th edition.
3. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill Eduction.
4. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series.
5. Advanced Engineering Mathematics – H. K. Dass, S. Chand Publications, 2007.

**Online References:**

1. https://nptel.ac.in/courses
2. https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC302 | Data Structures | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC302 | Data Structures | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. FEC104 – C Programming

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO11: Life-Long Learning

**Course Objectives:**

1. To identify the need and significance of Data structures as a computer Professional.
2. To describe linear and nonlinear data structures.
3. To apply various operations on data structures and select the appropriate one to solve a specific real-world problem.
4. To analyze various techniques for representation of the data in the real world.
5. To understand various graph concepts.
6. To discuss arching and Hashing techniques.

**Course Outcomes: Learners will be able to**

1. Illustrate linear and Non-Linear data structures.
2. Discuss operations on stack and queue.
3. Illustrate linked list data structures.
4. Apply operations like searching, insertion, deletion in the tree.
5. Analyze various operations of graph.
6. Apply various searching and hashing operations.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| 1.0 | | **Introduction to Data Structures** | 02 | |
| | 1.1 | **Introduction to Data Structures,** Concept of ADT, Types of Data | | CO1 |

| | | | | |
|---|---|---|---|---|
| | | Structures-Linear and Nonlinear, Operations on Data Structures, Applications of Data Structures | | |
| **2.0** | | **Stack and Queues** | **08** | |
| | **2.1** | Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix, Conversion and Postfix Evaluation, Recursion. | | **CO2** |
| | **2.2** | Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, introduction of Double Ended Queue, Applications of Queue. | | |
| | | **Self-learning Topics:** Multiple queues. Variants of recursion. Case study on priority management. | | |
| **3.0** | | **Linked List** | **10** | |
| | **3.1** | Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List, Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition, Generalized linked list. | | **CO3** |
| | | **Self-learning Topics:** Case study on linked lists. | | |
| **4.0** | | **Tree** | **11** | |
| | **4.1** | Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree-Expression Tree, Huffman Encoding<br>Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree. | | **CO4** |
| | | **Self-learning Topics**: Case study on trees. Threaded binary trees. | | |
| **5.0** | | **Graphs** | **04** | |
| | **5.1** | Introduction, Graph Terminologies-Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS), Graph Application-Topological Sorting. Applications of graph. | | **CO5** |
| | | **Self-learning Topics:** Data structures for web graph and google map. | | |
| **6.0** | | **Searching Techniques** | **04** | |
| | **6.1** | Linear Search, Binary Search, Hashing-Concept, Hash Functions-division method, multiplication, mid-square and folding. Collision resolution Techniques-open addressing and chaining. | | **CO6** |
| | | **Self-learning Topics:** Case study on hashing and collision. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Data Structures using C, Reema Thareja, 2nd Edition, 2014, Oxford Press.
2. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2nd Edition, 2007, CENGAGE Learning.

3. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education 2nd Edition.
4. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.

**Reference books:**

1. Data Structures using C, E Balagurusamy, 1st Edition, 2013, McGraw-Hill Education India.
2. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.
3. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, 1st Edition, 2019, Pearson Publication.

**Online References:**

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://www.edx.org/course/data-structures-fundamentals
4. https://swayam.gov.in/nd1_noc19_cs67/preview

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

5. Question paper will comprise of 03 questions.
6. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
7. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
8. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
9. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC303 | Discrete Structure and Graph Theory | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC303 | Discrete Structure and Graph Theory | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. Basic Mathematics

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigation of Complex Problems

**Course Objectives:**

1. Cultivate clear thinking and creative problem solving.
2. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.
3. To apply graph theory in solving practical problems.
4. Thoroughly prepare for the mathematical aspects of other Computer Engineering courses.

**Course Outcomes: Learners will be able to**

1. Illustrate the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. Interpret the concept of relations, functions, Diagraph.
3. Identify and analyze chain, antichain and lattice in hasse diagram
4. Analyze a complex computing problem and apply principles of discrete mathematics to identify solutions.
5. Identify the use of groups and codes in Encoding-Decoding.
6. Apply concepts of graph theory in solving real world problems.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| 1.0 | | Logic | 06 | |
| | 1.1 | Propositional Logic, Predicate Logic, Laws of Logic, Quantifiers, Normal Forms, Inference Theory of Predicate Calculus, | | CO1 |

| | | | | |
|---|---|---|---|---|
| | | Mathematical Induction. | | |
| | | **Self-learning Topics:** Truth table, Boolean algebra. | | |
| **2.0** | | **Relations and Functions** | **06** | |
| | **2.1** | Basic concepts of Set Theory, sets, Venn diagram, operation on sets, partition of set. | | **CO2** |
| | **2.2** | Relations: Definition, Types of Relations, Representation of Relations, Closures of Relations, Warshall's algorithm, Equivalence relations and Equivalence Classes. | | |
| | **2.3** | Functions: Definition, Types of functions, Composition of functions, Identity and Inverse function. | | |
| | | **Self-learning Topics:** Operation on relations. | | |
| **3.0** | | **Posets and Lattice** | **05** | |
| | **3.1** | Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattice, Sub lattice. | | **CO3** |
| | | **Self-learning Topics:** Types of Partial order relations. | | |
| **4.0** | | **Permutation, Combination and Discrete Probability** | **08** | |
| | **4.1** | The rules of Sum and Product, Counting principles. | | **CO4** |
| | **4.2** | Recurrence relations, Solving recurrence relations, Random experiment; sample space; events; axioms of probability; conditional probability. Theorem of total probability; Bayes' theorem. Application to information theory and discrete probability, Markov chains and their applications. | | |
| | | **Self-learning Topics:** Permutation and combinations | | |
| **5.0** | | **Algebraic Structures** | **08** | |
| | **5.1** | Algebraic structures with one binary operation: Semi group, Monoid, Groups, Subgroups, Abelian Group, Cyclic group, Isomorphism. | | **CO5** |
| | **5.2** | Algebraic structures with two binary operations: Ring. | | |
| | **5.3** | Coding Theory: Coding, binary information and error detection, decoding and error correction. | | |
| | | **Self-learning Topics:** Types of Rings, cryptography. | | |
| **6.0** | | **Graph Theory** | **06** | |
| | **6.1** | Types of graphs, Graph Representation, Sub graphs, Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components, Homomorphism and Isomorphism of Graphs, Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex, graph coloring, graph traveler's algorithm (BFS, DFS, Dijkstra's algorithm). | | **CO6** |
| | | **Self-learning Topics:** Application of cut vertex and cut set vertex, application of graph theory. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Edition 6,2015, Pearson Education.
2. C. L. Liu "Elements of Discrete Mathematics", Fourth edition 2017, McGraw-Hill Book Company.
3. K. H. Rosen, "Discrete Mathematics and applications", Eighth edition 2021, Tata McGraw Hill Publishing Company.

**Reference books:**

1. Y N Singh, "Discrete Mathematical Structures", First Edition 2016 Reprint, Wiley-India.
2. J. L. Mott, A. Kandel, T. P. Baker, "Discrete Mathematics for Computer Scientists and Mathematicians", Second Edition 1986, Prentice Hall of India.
3. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Seventeenth Edition 2002, Tata McGraw Hill Publishing Company.

**Online References:**

1. https://www.edx.org/learn/discrete-mathematics
2. https://www.coursera.org/specializations/discrete-mathematics
3. https://nptel.ac.in/courses/106106094
4. https://swayam.gov.in/nd1_noc19_cs67/preview

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC304 | Database Management System | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC304 | Database Management System | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. FEC104 C- Programming

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO11: Life-Long Learning

**Course Objectives:**

1. To understand the basics of database systems.
2. To develop an entity-relationship data model and its mapping to a relational model.
3. To learn relational algebra and formulate SQL queries.
4. To apply normalization techniques to normalize the database.
5. To understand the concept of transactions, concurrency control, and recovery techniques.
6. To learn and explore recent databases and their applications.

**Course Outcomes: Learners will be able to**

1. Identify the purpose of the database management system and its operational details.
2. Construct an ER/EER diagram, a relational model, and formulate relational algebra queries.
3. Apply SQL queries to the given database.
4. Apply normalization techniques for relational database design.
5. Illustrate the concepts of transaction management, concurrency control and database recovery.
6. Understand the fundamentals of recent databases and their uses.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| 1.0 | | **Introduction to Database Concepts and Data modeling** | 08 | |
| | 1.1 | Introduction, Characteristics of databases, File system vs. Database system, Data abstraction and data Independence, DBMS system architecture, Applications of databases. | | CO1 |

| | | | | |
|---|---|---|---|---|
| | | The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, entity sets, types of attributes, keys, and relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model: Generalization, Specialization, and Aggregation. | | |
| | | **Self-learning Topics:** Database storage structures | | |
| **2.0** | | **Relational Model and Relational Algebra** | **05** | |
| | **2.1** | Introduction to the Relational Model, relational schema. Mapping the ER and EER models to the relational model.<br>Relational algebra - Operators and algebra queries. | | **CO2** |
| | | **Self-learning Topics:** Relational Calculus | | |
| **3.0** | | **Structured Query Language (SQL)** | **08** | |
| | **3.1** | Overview of SQL, Data Definition Commands, Integrity constraints: key constraints, Domain Constraints, Referential integrity, check Constraints Data Manipulation commands, Data Control commands, Set and string operations, aggregate function-group by, having, Views in SQL, joins, Nested and complex queries, Triggers. | | **CO3** |
| | | **Self-learning Topics:** Stored Procedures, Introduction to PL/SQL | | |
| **4.0** | | **Database Normalization** | **06** | |
| | **4.1** | Pitfalls in relational database designs, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF, 4NF. | | **CO4** |
| | | **Self-learning Topics:**5NF | | |
| **5.0** | | **Transactions Management, Concurrency Control and Recovery** | **08** | |
| | **5.1** | Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log-based recovery, Deadlock handling | | **CO5** |
| | | **Self-learning Topics:** Deadlock handling | | |
| **6.0** | | **Introduction to Emerging databases** | **04** | |
| | **6.1** | Limitations of conventional databases, Multimedia databases: data types, contents of multimedia databases, Cloud databases: Introduction, Design Steps, Distributed databases: types, storage methods | | **CO6** |
| | | **Self-learning Topics:** Object-oriented database, NoSQL databases. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Database System Concepts, Korth, Silberchatz, Sudarshan, 6th Edition, McGraw Hill, 2010.
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education, 2006.
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, TMH (McGraw-Hill), 2002.

**Reference books:**

1. Database Systems: Design, Implementation, and Management, Peter Rob and Carlos Coronel, 9th Edition, Thomson Learning, 2009.
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P.S. Deshpande, Dream Tech Press, 2007.
3. Database Management Systems, G. K. Gupta, McGraw Hill, 2012.

**Online References:**

1. https://swayam.gov.in/nd1_noc19_cs46/preview
2. https://www.coursera.org/learn/database-design-postgresql
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. https://www.mooc-list.com/tags/dbms

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC305 | Computer Organization and Architecture | 02 | - | - | 02 | - | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE[$] | | | |
| | | ISE | MSE | | | | |
| CEC305 | Computer Organization and Architecture | 15 | 15 | 45 | -- | -- | 75 |

**Pre- requisite:**

1. FEC204 – Digital System Design

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Engineering Tool Usage
5. PO6: The Engineer and The World
6. PO11: Life-Long Learning

**Course Objectives:**

The course aims to provide students with:

1. A comprehensive understanding of computer architecture and organization, including functional units and number representations.
2. Knowledge of processor architecture, instruction formats, and control unit design.
3. Insights into memory hierarchy, virtual memory, and cache memory concepts.
4. An understanding of I/O organization, peripheral interfacing, and data transfer mechanisms.
5. Exposure to advanced processor principles, including parallel processing and multi-core architectures.
6. Practical problem-solving skills related to instruction execution, memory management, and system performance optimization.

**Course Outcomes:**

Upon completion of this course, learners will be able to:

1. Describe the basic organization of a computer system, including functional units.
2. Apply data representation techniques and arithmetic algorithms for efficient computation and problem-solving in computer architecture.
3. Analyze processor architectures, instruction formats, addressing modes, arithmetic algorithms, and control unit design for efficient instruction execution.
4. Examine memory hierarchy, virtual memory management techniques, and cache organization for performance optimization.
5. Apply I/O interfacing concepts and peripheral device communication.

6. Differentiate advanced processor concepts, parallel processing, and system bus architectures.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Introduction** | **03** | |
| | **1.1** | Introduction to computer architecture and organization, Basic organization of computer, Block-level description of the functional units. | | **CO1** |
| | | **Self-learning Topics:** Performance measure of computer architecture, Amdahl's law | | |
| **2.0** | | **Data Representation and Arithmetic Algorithms** | **03** | |
| | **2.1** | Booth's algorithm, Division of integers: Restoring and non-restoring division, Floating point representation: IEEE 754 floating point number representation. | | **CO2** |
| | | **Self-learning Topics:** Floating point arithmetic: Addition, Subtraction, Multiplication, Division, ALU and Shifters | | |
| **3.0** | | **Processor Architecture and Organization** | **08** | |
| | **3.1** | Von Neumann model, Harvard architecture, 8086 architecture, Register Organization, instruction formats, addressing modes, instruction cycle, Instruction interpretation and sequencing | | **CO3** |
| | **3.2** | Hardwired control unit design methods: State table, Delay element Microprogrammed control Unit: Microinstruction sequencing and execution. Micro operations, Examples of microprograms | | |
| | | **Self-learning Topics:** Hardwired control unit design method: Sequence Counter | | |
| **4.0** | | **Memory Organization** | **06** | |
| | **4.1** | Memory hierarchy: Cost and performance measurement Virtual Memory: Concept, Segmentation and Paging, Address translation mechanism, Interleaved and Associative memory | | **CO4** |
| | **4.2** | Cache memory concepts, Locality of reference, Design problems based on mapping techniques, Cache coherency, Write policies | | |
| | | **Self-learning Topics:** Virtual memory in modern operating systems | | |
| **5.0** | | **I/O Organization and Peripherals** | **03** | |
| | **5.1** | Input/output systems, I/O module-need & functions, 8255-PPI block diagram, Operating modes | | **CO5** |
| | | **Self-learning Topics:** Direct Memory Access (DMA), Interrupt types | | |
| **6.0** | | **Advanced Processor Principles and Buses** | **03** | |
| | **6.1** | Introduction to parallel processing, Flynn's classification, Instruction pipelining, Introduction to Multi-core processor architecture | | **CO6** |
| | **6.2** | Concept of superscalar architecture | | |
| | | **Self-learning Topics:** Very Long Instruction Word (VLIW) processor, Pipeline hazards | | |
| | | **Total** | **26** | |

**Textbooks:**

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 11th Edition, 2022.
2. John P. Hayes, "Computer Architecture and Organization", 3rd Edition, McGraw-Hill, 2017.
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India), 2017.
4. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI, 1986.
5. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", 3rd Edition, McGraw Hill, 2017.

**Reference books:**

1. Andrew S. Tanenbaum, "Structured Computer Organization", Pearson, Sixth Edition, 2016.
2. Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Publication, 2017.
3. Kai Hwang, FayéAlayé Briggs, "Computer architecture and parallel processing", McGraw Hill, 2017.
4. P. Pal Chaudhuri, "Computer Organization and Design", 3rd Edition, Prentice Hall India, 2008.
5. Dr. M. Usha, T.S. Shrikant, "Computer System Architecture and Organization", Wiley India, 2019.
6. Douglas Hall, "Microprocessor and Interfacing", 3rd Edition, Tata McGraw Hill, 2017.

**Online References:**

1. https://onlinecourses.nptel.ac.in/noc21_cs61/preview
2. https://www.udemy.com/course/computer-organization-and-architecture-j/?couponCode=ST4MT240225A
3. https://www.coursera.org/learn/comparch
4. https://www.udemy.com/course/8086-microprocessor-architecture-programming/?couponCode=ST4MT240225A
5. https://onlinecourses.nptel.ac.in/noc21_ee41/preview

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 10 marks.
- ISE 15 marks = 05 marks for attendance + 10 marks for activities.

**MSE:**

- To be conducted as a written examination for 15 marks (on 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 60 marks and scaled to 45.**

1. Question paper will comprise of 3 questions.
2. Question1(15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.
3. Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.

4. Question3 (15 marks):- Solve any 03 out of 04. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC306 | Engineering Economics | 02 | - | - | 02 | - | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC306 | Engineering Economics | 50 | | -- | -- | -- | 50 |

**Pre- requisite:**

1. Principles of Basic Mathematics

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO10: Project Management and Finance
4. PO11: Life-long Learning

**Course Objectives:**

1. To introduce students to the basic principles of economics and their application to engineering decision-making.
2. To explore the role of trade in a modern economy.
3. To develop student's analytical skills in assessing consumer behavior and the determinants of demand and supply across different market structures, including price elasticity.
4. To enable students to understand cost analysis, pricing, project evaluation.
5. To develop the ability to make informed decisions regarding engineering projects based on economic criteria.
6. To understand the concept of interest rates and their role in the economy.

**Course Outcomes:** Upon completion of this course, learners will be able to…

1. Define the basic concepts of micro and macroeconomics, engineering economics and their application in engineering economics.
2. Define and explain the concept of market in the modern economy.
3. Evaluate the effects of changes in demand and supply on price determination of products and services.
4. Analyze the costs and benefits of various engineering solutions.
5. Develop the ability to account for time value of money using engineering economy factors and formulas.
6. Understand market dynamics and pricing strategies in different industrial sectors.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Introduction to Economics** | **03** | |
| | **1.1** | **Economics** - Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics, The three problems of Economics Organization. Introduction to Engineering Economics. | | **CO1** |
| | | **Self-learning Topics:** Basic Economic Concepts: Cost, Benefit, Profit. | | |
| **2.0** | | **Market and Government in Modern Economy** | **03** | |
| | **2.1** | **Modern Economy** - Market Definition, How market solve three economics problems, Trade, Money & Capital, The economic role of Government. | | **CO2** |
| | | **Self-learning Topics:** Market Economy vs. Planned Economy, The Role of Private vs. Public Sectors | | |
| **3.0** | | **Supply, Demand and Product market** | **06** | |
| | **3.1** | **Basic Elements of Supply and Demand -** The determination of Demand and Supply, The Demand Schedule, The Supply Schedule, Equilibrium of supply and demand. Application of Supply and Demand. | | **CO3** |
| | **3.2** | **Elasticity of Demand and Supply -** Price elasticity of Demand, Elasticity and Revenue, Price elasticity of Supply. | | |
| | **3.3** | **Demand and Consumer behavior** - Choice and utility theory, Equimarginal principle, An alternative approach: substitution effect and income effect, From Individual to market demand. | | |
| | | **Self-learning Topics:** Case Study on demand and supply. | | |
| **4.0** | | **Production and Cost Theory** | **05** | |
| | **4.1** | **Production** - Production function, Laws of returns: Law of variable proportion, Law of returns to scale. | | **CO4** |
| | **4.2** | **Cost and Revenue Concepts** - Total Costs, Fixed cost, Variable cost, Average cost and Marginal cost, The Link between production and costs, Analysis of cost minimization. | | |
| | | **Self-learning Topics:** Read case studies about businesses optimizing their production costs and making strategic production decisions. | | |
| **5.0** | | **Time value and Project evaluation with money** | **04** | |
| | **5.1** | **Time Value of Money -** Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence. | | **CO5** |
| | **5.2** | **Evaluation of Engineering Projects** -Present worth method, Future worth method, Annual worth method, Internal rate of return method. | | |
| | | **Self-learning Topics:** Learn to use financial calculators or Excel functions for quick calculations of TVM. | | |

| | | | | |
|---|---|---|---|---|
| **6.0** | | **Money, Banking and Financial Markets** | **05** | |
| | **6.1** | **Money and Interest Rates -** The Evolution of Money, Functions of Money, Interest rates, Price of Money, Demand for money. | | **CO6** |
| | **6.2** | **Banking and the supply of money** - Banking definition, Types of Banks, Banking as a business, The process of Deposits creations. | | |
| | **6.3** | **Financial Economics** - Financial assets, Risk and return on different assets, The stock market, Personal financial strategies. | | |
| | | **Self-learning Topics:** The evolution of financial market. | | |
| | | **Total** | **26** | |

**Textbooks:**

1. Paul A. Samuelson and William D. Nordhaus, "Economics", Tata McGraw Hill, 20th edition, 2019.
2. L. Blank and A. Tarquin, *Engineering Economy*, 9th ed., McGraw-Hill, 2024.

**Reference books:**

1. J. V. O'Connor, Introduction to Engineering Economics, 5th ed., Pearson, 2013.
2. W S Jawadekar, "Management Information Systems," TMH, 6th edition,2020.
3. C. S. Park, Fundamentals of Engineering Economics, 4th edition, Pearson, 2018.

**Online References:**

1. https://www.mheducation.com/highered/product/Engineering-Economy-Blank.html.
2. https://archive.org/details/engineeringecono0000blan_t5b6.
3. https://www.liberty.edu/online/courses/ENGI220.
4. https://online.stanford.edu/courses/cee146s-engineering-economics-and-sustainability.

**Course Assessment:**
**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 40 marks.
- ISE 50 marks = 10 marks for attendance + 40 marks for activities.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL301 | Data Structure Lab | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL301 | Data Structure Lab | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**

1. FEL103- Knowledge of C programing

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO7: Ethics

**Lab Outcomes:**

**Upon completion of this course, Learners will be able to:**

1. Apply various linear data structures to perform operations like insertion, deletion, searching and traversing on them.
2. Apply various nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them
3. Choose appropriate data structure and apply it in various problems.
4. Select appropriate searching techniques for given problems.
5. Analyze different variations in linear data structures.
6. Analyze different variations in non-linear data structures.

**Suggested List of Experiments:** Students are required to complete at least 10 experiments.

Star (*) marked experiments are compulsory.

| Sr. No. | Title of Experiments | LO |
|---|---|---|
| 1* | Implement Stack ADT using array. | LO1 |
| 2* | Convert an Infix expression to Postfix expression using stack ADT. | LO1 |
| 3* | Evaluate Postfix Expression using Stack ADT. | LO1, LO3 |
| 4 | Applications of Stack ADT. | LO1, LO3 |
| 5* | Implement Linear Queue ADT using array. | LO1 |
| 6* | Implement Circular Queue ADT using array. | LO5 |
| 7 | Implement Priority Queue ADT using array. | LO5 |
| 8 | Implement Singly Linked List ADT. | LO2 |

| | | |
|---|---|---|
| 9* | Implement Circular Linked List ADT. | LO5 |
| 10 | Implement Doubly Linked List ADT. | LO5 |
| 11* | Implement Stack / Linear Queue ADT using Linked List. | LO1, LO2 |
| 12* | Implement Binary Search Tree ADT using Linked List. | LO2, LO6 |
| 13* | Implement Graph Traversal techniques a) Depth First Search b) Breadth First Search | LO2, LO6 |
| 14* | Applications of Binary Search Technique. | LO4 |
| 15 | Quiz on lead code based on above experiments. | LO1-6 |

**Textbooks:**

1. Data Structures using C, Reema Thareja, 2 nd Edition, 2014, Oxford Press.
2. Data Structures Using C, Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, 1 st Edition, 2019, Pearson Publication.
3. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2nd Edition, 2007, CENGAGE Learning.
4. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education 2nd Edition
5. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill

**Reference books:**

1. Data Structures using C, E Balagurusamy, 1st Edition, 2013, McGraw-Hill Education India
2. Data Structures using C and C++, Rajesh K Shukla, 1st Edition, 2009, Wiley-India.

**Online Resources:**

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

**Term Work**:

- Term work should consist of at least 10 experiments.
- Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric, and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

**Term work Marks (CIAP):**

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

**Practical Exam: (2 hours/ 25 Marks)**

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL302 | Database Management System Lab | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL302 | Database Management System Lab | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**

1. FEC104 C- Programming

**Program Outcomes Addressed**

1. PO2: Problem Analysis
2. PO3: Design / Development of Solutions.
3. PO5: Engineering Tool Usage
4. PO7: Ethics
5. PO8: Individual and Collaborative Team Work
6. PO9: Communication
7. PO11: Life-Long Learning

**Lab Objectives:**

1. To explore the design and development of a relational model.
2. To write SQL basic and complex queries.
3. To learn transaction processing and concurrent data access.

**Lab Outcomes:**

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

1. Design an ER/EER diagram and convert it to a relational model for the real-world application.
2. Apply DDL, DML, DCL, and TCL commands.
3. Implement simple and complex queries.
4. Implement triggers and procedures.
5. Demonstrate the concept of concurrent transaction execution.
6. Illustrate the front-end-backend connectivity

**Suggested List of Experiments**

Star (*) marked experiments are compulsory.

| Sr. No. | Title of Experiments | LO |
|---|---|---|
| 1 | Identify the case study and detail the statement of the problem. Design an entity-relationship (ER) / extended entity-relationship model. (Use Lucid chart/Draw. Io/UML tool) | LO 1 |
| 2 | Mapping ER/EER to a relational schema model. | LO 1 |

| | | |
|---|---|---|
| 3 | Design a database using Data Definition Language (DDL) and apply integrity constraints for the specified system. | LO 2 |
| 4 | Apply DML commands for the specified system. | LO 2 |
| 5 | Implement Simple queries, string manipulation operations, and aggregate functions. | LO 3 |
| 6 | Implement various join operations. | LO 3 |
| 7 | Implement Nested and Complex queries. | LO 3 |
| 8 | Implement DCL and TCL commands. | LO 2 |
| 9 | Implement procedures and functions. | LO 4 |
| 10 | Implementation of views and triggers. | LO 4 |
| 11 | Implementation and demonstration of transaction and concurrency control techniques using locks. | LO 5 |
| 12 | Demonstrate database connectivity. | LO 6 |
| 13 | Implementation of Graph Query Language | LO3 |

**Textbooks:**

1. Database System Concepts, Korth, Silberchatz, Sudarshan, 6th Edition, McGraw Hill, 2010.
2. Fundamentals of Database Systems, Elmasri and Navathe, 5th Edition, Pearson Education, 2006.
3. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, TMH (McGraw-Hill), 2002

**Reference books:**

1. Database Systems: Design, Implementation, and Management, Peter Rob and Carlos Coronel, 5th Edition, Thomson Learning, 2002.
2. SQL and PL/SQL for Oracle 10g, Black Book, Dr. P.S. Deshpande, Dream Tech Press, 2007.
3. Database Management Systems, G. K. Gupta, McGraw Hill, 2012.

**Online References:**

1. https://www.w3schools.com/sql/
2. https://www.tutorialspoint.com/sql/index.htm
3. https://learn.microsoft.com/en-us/sql/?view=sql-server-ver16

**Term Work**:

- Term work should consist of at least 10 experiments.
- Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric, and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

**Term work Marks (CIAP):**

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

**Practical Exam: (2 hours/ 25 Marks)**

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL303 | Computer Organization and Architecture Lab | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL303 | Computer Organization and Architecture Lab | -- | -- | -- | 25 | | 25 |

**Pre- requisite:**

1. FEL203 -Digital System Design Lab

**Program Outcomes Addressed:**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO5: Engineering Tool Usage
5. PO7: Ethics
6. PO11: Life-Long Learning

**Lab Objectives:**

1. Understand fundamental arithmetic algorithms, including Booth's algorithm and division algorithms, through implementation.
2. Develop skills in designing and simulating ALU, memory, and cache memory using appropriate simulation tools.
3. Apply assembly programming concepts for arithmetic operations, data transfer, and code conversions using 8086 programming tools (Debug/TASM/MASM/8086kit).
4. Demonstrate proficiency in array manipulation techniques such as sorting, finding the minimum/maximum value, and computing GCD/LCM using 8086 assembly language.
5. Perform data transfer operations and control unit functionalities using 8086 assembly programming.
6. Interface peripheral devices like 8255 for read/write operations and waveform generation.

**Lab Outcomes: Learners will be able to**

1. Apply Booth's multiplication algorithm and restoring/non-restoring division algorithms using assembly language.
2. Design and simulate ALU, memory, and cache memory structures using a simulator.
3. Solve arithmetic operations on 8-bit and 16-bit data using assembly programming tools.
4. Develop assembly programs for code conversion (Hex-BCD, ASCII-BCD), data transfer, and factorial calculation using 8086.

5. Apply array-based algorithms, such as sorting and finding the GCD, LCM, minimum, and maximum values using 8086 assembly language.
6. Illustrate interfacing of 8255 PPI with 8086 to perform read/write operations and square wave generation.

**Suggested List of Experiments**

Star (*) marked experiments are compulsory.

| Sr. No. | Title of Experiments | LO |
|---|---|---|
| 1 | To implement Booth's algorithm. | LO1 |
| 2 | To implement restoring division algorithm. | LO1 |
| 3 | To implement non restoring division algorithm. | LO1 |
| 4 | To implement ALU design using simulator. | LO2 |
| 5 | To implement memory design using simulator. | LO2 |
| 6 | To implement cache memory design using simulator. | LO2 |
| 7 | Use of programming tools (8086kit/ Emulator 8086) to perform basic arithmetic operations on 8-bit data. | LO3 |
| 8 | Use of programming tools (8086kit/ Emulator 8086) to perform basic arithmetic operations on 16-bit data. | LO3 |
| 9 | Code conversion (Hex to BCD and BCD to Hex)/ (ASCII to BCD and BCD to ASCII) using 8086. | LO4 |
| 10 | To transfer a block of data using 8086. | LO4 |
| 11 | Assembly program to find the GCD/ LCM of two numbers. | LO4 |
| 12 | Assembly program to sort numbers in ascending/ descending order. | LO5 |
| 13 | Assembly program to find minimum/ maximum number from a given array. | LO5 |
| 14 | Calculate the factorial of a given number using 8086. | LO4 |
| 15 | Program for interfacing 8255 for Read/Write operation/ Square wave generation. | LO6 |

**Textbooks:**

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Publication, 10th Edition, 2013.
2. John P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1988.
3. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, McGraw-Hill (India).
4. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PHI.
5. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals",
   McGraw Hill

**Reference books:**

1. Andrew S. Tanenbaum "Structured Computer Organization", Pearson, Sixth Edition.
2. Morris Mano. "Computer System Architecture" Pearson Publication, 3rd Edition, 2007.

3. Kai Hwang, FayéAlayé Briggs. "Computer architecture and parallel processing", McGraw Hill.
4. P. Pal Chaudhuri. "Computer Organization and Design" Prentice Hall India, 2004.
5. Dr. M. Usha, T.S. Shrikant. "Computer System Architecture and Organization" Wiley India, 2014.
6. Douglas Hall, "Microprocessor and Interfacing", Tata McGraw Hill.

**Online References:**

1. http://vlabs.iitkgp.ernet.in/coa/#
2. https://emu8086-microprocessor-emulator.en.softonic.com/

**Term Work**:

- Term work should consist of at least 10 experiments. Students must perform **any five experiments** from experiment numbers **1 to 6** and **any four experiments** from experiment numbers **7 to 14**. Additionally, **experiment 15 is compulsory** for all
- Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric, and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

**Term work Marks (CIAP):**

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL304 | Skill Lab (Python Programming) | -- | 2*+2 | -- | -- | 02 | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL304 | Skill Lab (Python Programming) | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**
Programming Languages
1. FEC104: C – Programming
2. FEL205: Object Orien Programming Methodology Lab

**Program Outcomes Addressed**
1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Life-Long Learning

**Lab Objectives:**
1. To provide a comprehensive understanding of Python programming, covering both fundamental and advanced concepts.
2. To solve real-world applications using Data Structure and Multi-threading concept.
3. To introduce OOP principles for efficient coding practices.
4. To enhance knowledge of data analysis and visualization.
5. To prepare students for building Python-based applications involving GUI with database connectivity and networking.
6. To prepare students for analysing and visualizing real time data.

**Lab Outcomes:**
Upon completion of course, learners will be able to:
1. Apply Python fundamentals, including data types, operators, and control structures to develop simple program.
2. Illustrate OOP concepts, files handling, directories, and text processing operations using Python.
3. Analyze different types of data structures such as linked lists, stacks, queues, and dequeues to solve

computational problems effectively.
4. Apply multithreading concepts using Python for efficient concurrent execution.
5. Apply skills in integrating Python with GUI applications, networking, and database systems.
   Apply data analysis and visualization techniques using tools like Pandas, NumPy, Matplotlib, and Seaborn

| Module No. | Unit No. | Topics | Hrs. | LO |
|---|---|---|---|---|
| **0** | | Knowledge of some programming language like C, Java. | **01** | |
| **1** | | **Python basics** | **06** | **LO1** |
| | 1.1 | Introduction, Features, Python Identifiers, Keywords, Variables and Comments Indention, Operators in python, Input and print functions. | | |
| | 1.2 | Control flow statement- Conditional statements (if, if…else, nested if), Looping in Python (while loop, for loop, nested loops), Loop manipulation using continue, pass, break. | | |
| | 1.3 | Data Types in python: Number, Arrays in python, String and Character in python, Functions, Data Structures – List and Tuples, Dictionaries, Sets. | | |
| | 1.4 | Functions- Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Recursion, Scope of variables- Local and global scope, anonymous functions. | | |
| | | **Self-study topics**: Iterators and Generators | | |
| **2** | | **Advanced Python- OOP, File Handling and Exception Handling** | **05** | **LO2** |
| | 2.1 | Introduction to OOP – Classes and Objects: Creating Classes, Creating Instance Objects, Access Modifiers, Inheritance, Polymorphism, Operator Overloading, Abstract Classes, Overriding Methods. | | |
| | 2.2 | Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python. | | |
| | 2.3 | Exception handling: Compile time errors, Runtime errors, exceptions, types of exception, try statement, except block, raise statement, User -Defined Exceptions. | | |
| | | **Self-study topics:** Experiment to **Build a Personal Notes App (File-Based Storage), Automate Daily Tasks with Python.** | | |
| **3** | | **Data Structure in Python** | **02** | **LO3** |
| | 3.1 | Linked List, Stack, Queue, Dequeue. | | |
| | | **Self-study topics:** polynomial representation and operations using linked list, Task Queues in Web Servers. | | |
| **4** | | **Python Integration Primer** | **04** | **LO4** |
| | 4.1 | Graphical User interface, Python database connectivity, Introduction to APIs: Fetching Data from Web Services.<br>Django web application Framework. | | |
| | | **Self-study topics:** Fetch weather data from a public API and display it. | | |
| **5** | | **Multithreading** | **03** | **LO5** |
| | 5.1 | Thread and Process, starting a thread, threading module, Synchronizing | | |

| | | | | |
|---|---|---|---|---|
| | | threads. | | |
| | 5.2 | Socket Programming. | | |
| | | **Self-study topics:** Multithreaded Priority Queue. | | |
| **6** | | **Data Analysis and Visualization libraries** | **05** | **LO6** |
| | 6.1 | NumPy - Creating NumPy arrays, Indexing and slicing in NumPy, Dimensions of Arrays, Attribute of array, manipulating array shapes, working with multi-dimensional arrays, Indexing and slicing in multi-dimensional arrays, Matrices in NumPy, Mathematical Functions of NumPy. | | |
| | 6.2 | Pandas - Creating Data Frame from an Excel Spreadsheet, .csv File, Python Dictionary and Python List of Tuples, Operations on Data Frames, Series and Data Frames. | | |
| | 6.3 | Matplotlib, Seaborn - Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn. Bar Graph, Histogram, Pie Chart, Line Graph. | | |
| | | **Self-study topics:** Creating array views copies, Aggregating, Merge Data Frames, Interactive Visualization with Plotly . | | |
| | | **Total** | **26** | |

**Suggested List of Experiments**

Star (*) marked experiments are compulsory.

| Sr. No. | Title of Experiments | LO |
|---|---|---|
| 1 | Exploring basics of pythonlike datatypes(strings, list, array, dictionaries, set, tuples) and control statements. | LO1 |
| 2 | Creating functions, classes and objects using python. Demonstrate exception handling and inheritance. | LO1, LO2 |
| 3 | Exploring Files and directories<br>a) Python program to append data to existing file and then display the entire file<br>b) Python program to count number of lines, words and characters in a file.<br>c) Python program to display file available in current directory | LO2 |
| 4 | Menu driven program for data structure using built in function for linked list, stack and queue. | LO3 |
| 5 | a) Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.<br>b) Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/My SQL) using python. | LO4 |
| 6 | To learn how to make API requests in Python using the requests module and fetch data from a public web service. | LO4 |
| 7 | Programs on Threading using python. | LO5 |
| 8 | To implement client server communication using socket programming | LO5 |
| 9 | To explore the basics of NumPy methods and demonstrate the use of NumPy array objects for performing efficient numerical computations, including array creation, operations, and manipulations. | LO6 |

| | | |
|---|---|---|
| 10 | To explore and understand the functionalities of Pandas Series and Data Frames, including their creation, manipulation, and grouping using the group by () function in Python. | LO6 |
| 11 | Program to demonstrate Data Series and Data Frames using Pandas. | LO6 |
| 12 | Graphical representation and analysis of the data using python to analyze and visualize a given dataset using Python by applying various graphical techniques. | LO6 |
| 13* | Program to send email and read content of URL. | LO5 |

**Textbooks:**

1. Dr. R. Nageswara Rao, "Core Python Programming", Dreamtech Press,2021.
2. James Payne, "Beginning Python: Using Python 2.6 and Python 3.1", Wrox Publication, 2011.
3. Anurag Gupta, G. P. Biswas, "Python Programming", McGraw-Hill, 2019
4. E. Balagurusamy, "Introduction to computing and problem-solving using Python," McGraw Hill Education, 2017.

**Reference books:**

1. Zed A. Shaw, "Learn Python the Hard Way", Addison-Wesley Professional 2024.
2. Laura Cassell, Alan Gauld, "Python Projects", Wrox Publication, 2015.

**Online Resources:**

1. https://docs.python.org/release/3.0.1/tutorial/
2. https://www.perl.org/books/beginning-perl/
3. https://spoken-tutorial.org/
4. https://starcertification.org/Certifications/Certificate/python
5. https://onlinecourses.nptel.ac.in/noc22_cs32/preview

**Software Tools:**

1. Python IDLE
2. PyCharm,
3. Visual Studio Code (VS Code)
4. Jupyter Notebook
5. Google Colab
6. Notepad++

**Online Repository:**

1. Google Drive
2. GitHub
3. Code Guru

**Term Work**:

- Term work should consist of at least 12 experiments and 13$^{th}$ Experiment is optional
- Journal must include at least 2 assignments.

The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. The assignments should be students' centric, and an attempt should be made to make assignments more meaningful,

interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

**Term work Marks (CIAP):**

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05 Marks (Attendance)
- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

**Practical Exam: (2 hours/ 25 Marks)**

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

# SIES Graduate School of Technology
## Department of Computer Engineering
### Bachelor of Engineering

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEM301 | Mini Project 1 A | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEM301 | Mini Project 1 A | -- | -- | -- | 25 | 25 | 50 |

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Life-Long Learning

**Course Objectives:**

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

**Course Outcomes: Upon completion of this course, learners will be able to**

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Deduce the proper inferences from available results through theoretical/ experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Apply standard norms of engineering practices.
7. Develop skills in written and oral communication.
8. Illustrate capabilities of self-learning in a group, which leads to life long learning.
9. Explain project management principles during project work.

**Guidelines for Mini Project**

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed for less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisors may give input to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group should understand problems effectively, propose multiple solutions and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

**Guidelines for Assessment of Mini Project: Term Work**

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below.
  1. Marks awarded by guide/supervisor based on logbook: 10
  2. Marks awarded by review committee 10
  3. Quality of Project report 05

The review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

**One-year project:**

- In the first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the students' group.

- First shall be for finalization of problem
- Second shall be on finalization of proposed solution of problem.

- In the second semester the expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - The first review is based on the readiness of building a working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

**Half-year project:**

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalization of problem and proposed solution
- Second shall be for implementation and testing of solution.

**Assessment criteria of Mini Project**

**Mini Project** shall be assessed based on the following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In the case of **half year project** all criteria in generic may be considered for evaluation of performance of students in mini project.

**Guidelines for Assessment of Mini Project Practical/Oral Examination:**

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by head of Institution.

- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

**Mini Project** shall be assessed based on the following points.

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC401 | Applied Mathematics-IV | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC401 | Applied Mathematics-IV | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:** Knowledge of
1. FEC101- Applied Mathematics-I
2. FEC102- Applied Mathematics-II
3. CEC301- Applied Mathematics-III

**Program Outcomes Addressed**
1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigations of Complex Problems

**Course Objectives:**
1. To evaluate eigenvalues and eigenvectors and apply them to solve systems of linear equations and matrix diagonalization.
2. To evaluate line and contour integrals and construct the power series expansion of a complex-valued function.
3. To understand the concepts of probability distributions and sampling theory for small samples.
4. To apply the sampling theory on small dataset for analysis.
5. To understand the concepts of non-parametric and analysis of variance for testing.
6. To optimize the Linear and Non-linear programming problems.

**Course Outcomes:**
After successful completion of the course student will be able to
1. Evaluate eigenvalues and eigenvectors, analyze their properties, and apply them in engineering problem-solving.
2. Apply the concepts of Complex Integration to evaluate integrals, analyze and compute residues, and solve various contour integrals.
3. Design conclusions on population-based data science problems and interpret the hypotheses.
4. Analyze nonparametric test and perform Analysis of Variance on the population to analyze data.
5. Apply the concept of optimization on Linear Programming Problems.
6. Examine Non-Linear Programming Problems to engineering problems of optimization.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Linear Algebra (Theory of Matrices)** | **06** | |
| | **1.1** | Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof). Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials. | | **CO1** |
| | **1.2** | Similarity of matrices, diagonalizable and non-diagonalizable matrices. | | |
| | **1.3** | Functions of Square Matrix, Derogatory and non-derogatory matrices. | | |
| | | **Self-learning Topics:** Coding and encoding of matrices | | |
| **2.0** | | **Complex Integration** | **07** | |
| | **2.1** | Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof). | | **CO2** |
| | **2.2** | Taylor's and Laurent's series (without proof). | | |
| | **2.3** | Definition of Singularity, Zeroes, poles of f(z), Residues, Cauchy's Residue Theorem (without proof). | | |
| | | **Self-learning Topics:** Application of Residue Theorem to evaluate real integrations | | |
| **3.0** | | **Probability Distribution and Sampling Theory** | **07** | |
| | **3.1** | Probability Distribution: Poisson and Normal distribution. | | **CO3** |
| | **3.2** | Sampling distribution, Testing of Hypothesis, Level of Significance, Critical region, One-tailed, and two-tailed test, Degree of freedom. | | |
| | **3.3** | Large Sampling with test of single mean and difference of means. | | |
| | **3.4** | Students't-distribution (Small sample). Test the significance of mean and Difference between the means of two samples. | | |
| | | **Self-learning Topics:** Large sampling with testing for parameters. | | |
| **4.0** | | **Test of Hypothesis- Chi square Distribution and ANOVA** | **07** | |
| | **4.1** | Chi-Square Test: Test of goodness of fit. | | **CO4** |
| | **4.2** | Independence of attributes, Contingency table. | | |
| | **4.3** | Analysis of Variance (F-Test): One way classification, Two-way classification (short-cut method). | | |
| | | **Self-learning Topics:** Other types of non-parametric tests. | | |
| **5.0** | | **Linear Programming Problems** | **06** | |
| | **5.1** | Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method. | | **CO5** |
| | **5.2** | Artificial variables, Big-M method (Method of penalty). | | |
| | **5.3** | Dual Simplex Method. | | |
| | | **Self-learning Topics:** Principle of Duality, Dual of LPP. | | |
| **6.0** | | **Nonlinear Programming Problems** | **06** | |

| | | | | |
|---|---|---|---|---|
| | **6.1** | NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers. | | **CO6** |
| | **6.2** | NLPP with **One** inequality constraint: Kuhn-Tucker conditions. | | |
| | **6.3** | NLPP with two inequality constraint: Kuhn-Tucker conditions. | | |
| | | **Self-learning Topics:** NLPP with two equality constraints. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication, 45th edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited, 10th Edition 2023-24.
3. Higher Engineering Mathematics: B V Ramna; Tata McGraw Hill Publication
4. Fundamentals of Mathematical Statistics – S. C. Gupta & V. K. Kapoor, 12th edition, 2020.

**Reference books:**

1. **Matrices** – Shanti Narayan, S. Chand Publications, Revised edition.
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa Publications.
3. **Advanced Engineering Mathematics** – H. K. Dass, S. Chand Publications, 2007.
4. J. K. Sharma, "Operation Research", S. Chand Publications, 6th edition 2017.
5. T. Veerarjan, "Engineering Mathematics", Tata McGraw Hill Publication 2007.

**Online References:**
**Course on Advanced Engineering Mathematics**

1. https://nptel.ac.in/courses
2. https://www.coursera.org/courses?query=advanced%20engineering%20mathematics

**Course Assessment:**
**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 50% syllabus)

**End Semester Examination**:
**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC402 | Operating System | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC402 | Operating System | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. CEC305- Computer Organization and Architecture

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis

**Course Objectives:**

1. To understand the basic concepts of Operating System, its functions and services.
2. To introduce the concept of a process and its management like transition, scheduling, etc.
3. To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4. To understand the concepts and implementation of memory management policies and virtual memory.
5. To understand the functions of Operating System for storage management and device management.
6. To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.

**Course Outcomes:** Upon completion of this course, learners will be able to…

1. Identify the importance of operating system, its functions and services.
2. Compare process scheduling algorithms to ensure efficient execution of processes.
3. Apply concept of process synchronization and deadlocks.
4. Analyse memory management algorithms in effective allocation of main memory usage.
5. Discuss various File management methods and analyse I/O management algorithms for performance and quality criterion.
6. Compare the functions of various special-purpose Operating Systems.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Operating system Overview** | **03** | |
| | **1.1** | Introduction, Objectives, Functions and Evolution of Operating System | | **CO1** |
| | **1.2** | Operating system structures: Layered, Monolithic and Microkernel | | |
| | **1.3** | Linux Kernel, Shell and System Calls | | |
| | | **Self-learning Topics:** Resource Manager view, process view, Virtual Machine. | | |
| **2.0** | | **Process Management and Scheduling** | **07** | |
| | **2.1** | **Process:** Basic Concepts of Process; Process State Model and Transition; Operation on Process; Process Control Block, Context switching | | **CO2** |
| | **2.2** | **Threads:** Introduction to Threads; Types of Threads | | |
| | **2.3** | **Uniprocessor Scheduling:** Basic Concepts of Scheduling; Types of Schedulers scheduling algorithms. | | |
| | | **Self-learning Topics:** Multithreading Models, Thread libraries, Performance comparison of Scheduling Algorithms | | |
| **3.0** | | **Process Synchronization and Deadlock** | **10** | |
| | **3.1** | **Process Synchronization:** Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Classic Problems of Synchronization; Message Passing | | **CO3** |
| | **3.2** | **Deadlocks Management**: System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance. | | |
| | | **Self-learning Topics:** Barber's shop problem , real time case study for Deadlock detection and recovery | | |
| **4.0** | | **Memory Management** | **09** | |
| | **4.1** | **Memory Management:** Basic Concepts of Memory Management; Swapping; Contiguous Memory Allocation; Paging; Structure of Page Table; Segmentation. | | **CO4** |
| | **4.2** | **Virtual Memory:** Basic Concepts of Virtual Memory; Demand Paging, Copy-on Write; Page Replacement Algorithms; Thrashing | | |
| | | **Self-learning Topics:** Concept of memory management in Linux & Windows NT/XP | | |
| **5.0** | | **File and I/O Management** | **06** | |
| | **5.1** | **File Management:** Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass-Storage Structure | | **CO5** |
| | **5.2** | **I/O Management:** I/O devices, Organization of the I/O Function, Disk Organization, I/O Management and Disk Scheduling: FCFS, SSTF, | | |

| | | | | |
|---|---|---|---|---|
| | | SCAN, CSCAN, LOOK, C-LOOK. | | |
| | | **Self-learning Topics:** NTFS File system, RAID structure | | |
| **6.0** | | **Operating Systems Security** | **04** | |
| | **6.1** | **Overview of Security and Protection:** Goals of Security and Protection, Security and Protection Threats. | | **CO6** |
| | **6.2** | **Protection Structure:** Granularity of Protection, Access control Matrix, Access Control Lists (ACLs), Capability Lists(C-Lists), Protection Domain | | |
| | | **Self-learning Topics:** Classification of Computer Security, Security Attacks. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. A.Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, 4th ed., Pearson, 2015.
4. D. M. Dhamdhere, Operating Systems: A Concept-Based Approach, McGraw Hill, 2009.

**Reference books:**

1. Achyut Godbole and Atul Kahate, Operating Systems, 3rd ed., McGraw Hill Education, 2011.
2. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
3. A.Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson, 2006.
4. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, 1st ed., CreateSpace Independent Publishing Platform, 2018.

**Online References:**

1. https://www.nptel.ac.in
2. https://archive.nptel.ac.in/courses/106/105/106105214/
3. https://archive.nptel.ac.in/courses/106/105/106105172/

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1 (20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

# SIES Graduate School of Technology
## Department of Computer Engineering
### Bachelor of Engineering

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC403 | Analysis of Algorithm | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC403 | Analysis of Algorithm | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**
Basic knowledge of programming and data structure.

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO8: Individual and Collaborative Teamwork
5. PO9: Communication
6. PO11: Life-Long Learning

**Course Objectives:**

1. To provide mathematical approaches for analysis of algorithms.
2. To understand and solve problems using various algorithmic approaches.
3. To analyze algorithms using various methods.
4. To develop a technique for analyzing and computing the performance of an algorithm.
5. To understand computational complexity classes and their significance in problem-solving.
6. To apply algorithmic techniques to solve real-world computational problems.

**Course Outcomes:**

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

1. Analyze the running time and space complexity of the algorithms.
2. Describe, apply, and analyze the complexity of the divide and conquer strategy.
3. Solve optimization problems using greedy strategy and analyze the complexity.
4. Illustrate and analyze the complexity of dynamic programming strategy.
5. Explain and apply backtracking, branch, and bound.
6. Apply string matching techniques and understand various complexity classes.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Introduction** | **07** | |
| | **1.1** | **Introduction:** Performance analysis, space and time complexity, Growth of function, Big-Oh, Omega Theta notation Mathematical background for algorithm analysis. Analysis of selection sort, insertion sort. | | **CO1** |
| | **1.2** | **Recurrences:** The substitution method, Recursion tree method, Master method. | | |
| | | **Self-learning Topics:** Bubble Sort, Randomized Algorithms | | |
| **2.0** | | **Divide and Conquer Approach** | **06** | |
| | **2.1** | General method, Merge sort, Quicksort, Finding minimum and maximum algorithms and their Analysis, Analysis of Binary search | | **CO2** |
| | | **Self-learning Topics:** Implementation of Linear search, Strassen's Matrix Multiplication | | |
| **3.0** | | **Greedy Method Approach** | **06** | |
| | **3.1** | General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms | | **CO3** |
| | | **Self-learning Topics:** Graph representations: adjacency matrix and adjacency list, Optimal storage on tape algorithm. | | |
| **4.0** | | **Dynamic Programming Approach** | **09** | |
| | **4.1** | General Method, Multistage graphs, Single source shortest path Bellman ford Algorithm, All pair shortest path: Floyd Warshall Algorithm, 0/1 knapsack Problem, Travelling Sales person problem, longest common subsequence | | **CO4** |
| | | **Self-learning Topics:** Matrix operations, Assembly-line scheduling Problem | | |
| **5.0** | | **Back tracking and Branch and bound** | **06** | |
| | **5.1** | General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring. | | **CO5** |
| | **5.2** | Branch and Bound: Travelling Sales person Problem,15 Puzzle problem | | |
| | | **Self-learning Topics:** Basics of graph theory and set theory, Hamiltonian cycle. | | |
| **6.0** | | **String Matching Algorithms** | **05** | |
| | **6.1** | The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm | | **CO6** |
| | **6.2** | **Complexity class:** Definition of P, NP, NP-Hard, NP-Complete | | |
| | | **Self-learning Topics:** Modular arithmetic, Boyer Moore algorithm | | |
| | | **Total** | **39** | |

**Textbooks:**

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, PHI Publication, 2005.
2. Ellis Horowitz, Sartaj Sahni, and Sangu thevar Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Orient Black Swan, 2008.

**Reference books:**

1. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, Algorithms, McGraw-Hill Education, 2006.
2. S. K. Basu, Design Methods and Analysis of Algorithms, PHI Learning Pvt. Ltd., 2005.

**Online References:**

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEC404 | Critical Thinking and Design | 02 | - | - | 02 | - | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| CEC404 | Critical Thinking and Design | 15 | 15 | 45 | -- | -- | 75 |

**Pre- requisite:** None

**Program Outcomes Addressed**

1. PO2: Problem Analysis
2. PO3: Design/Development of Solutions
3. PO5: Engineering Tool Usage
4. PO6: The Engineer and The World
5. PO7: Ethics
6. PO8: Individual and Collaborative Team Work
7. PO9: Communication
8. PO10: Project Management and Finance
9. PO11: Life-Long Learning

**Course Objectives:**

1. To describe the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. To differentiate personal thinking stages and implement structured strategies for continuous cognitive growth.
3. To analyze key elements of thought and intellectual standards to enhance logical reasoning.
4. To examine the principles of design thinking and apply them to solve real-world problems through an iterative, user-centered approach.
5. To demonstrate hands-on experience with idea generation, customer insights, and problem framing to drive innovation.
6. To employ creative problem-solving techniques such as brainstorming, prototyping, and hypothesis validation to design user-centric solutions.

**Course Outcomes:** Learners will be able to

1. Interpret the fundamentals of critical thinking and fair-minded reasoning for effective decision-making.
2. Identify their cognitive development stage and implement structured strategies to progress as a critical thinker.
3. Apply intellectual standards like clarity, accuracy, and logic to improve reasoning and problem-solving skills.
4. Integrate design thinking principles to create innovative, balanced, and user-centered solutions.
5. Develop a broad perspective in understanding customer needs and effectively define problem

statements using diverse methodologies.
6. Implement creative solutions and enhance ideas through iterative prototyping and user feedback using brainstorming techniques.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Introduction to Critical Thinking** | **04** | |
| | **1.1** | **Introduction:** Start-up definition of Critical Thinking how skilled are you as a Thinker? Hard Work, Concept of Critical Thinking, establish new habits of thoughts, Develop confidence | | **CO1** |
| | **1.2** | **Fair-minded Thinker:** Weak Vs Strong Critical Thinking Requirement of Fair-mindedness Intellectual: Humility, Courage, Empathy, Integrity, Perseverance, Autonomy Interdependence of Intellectual Virtues | | |
| | | **Self-learning Topics:** Role of Intellectual Humility in Decision-Making | | |
| **2.0** | | **Four Stages of Development, Game Plan** | **03** | |
| | **2.1** | **Four Stages of Development:** Stage 1: Unreflective thinker, Stage 2: Challenged thinker, Stage 3: Beginning thinker, Stage 4: Practicing thinker | | **CO2** |
| | **2.2** | **Game Plan:** Purpose & Key Components of Game Plan, Integrating of Game Plan Strategies | | |
| | | **Self-learning Topics:** Case Study: Explores how a student progresses through four stages using self-reflection& discipline. | | |
| **3.0** | | **Self-Understanding, Parts & Universal Standards** | **03** | |
| | **3.1** | **Three Distinctive Functions:** Recognize the Mind's Three Distinctive Functions; Special Relationship | | **CO3** |
| | **3.2** | **Thoughts & Intellectual Standards:** Fundamental structures of thought, The elements of thought, Universal Intellectual Standards: Clarity, Accuracy, Precision, Relevance, Depth, Breadth, Logic, Significance, Fairness | | |
| | | **Self-learning Topics:** Recognizing biases and promoting ethical decision-making. | | |
| **4.0** | | **Design Thinking & its Key Tenets** | **05** | |
| | **4.1** | **Design Thinking Basics:** Traditional Model vs. Design Thinking, Five Stages: Inspire, Empathize, Define, Ideate, Prototype & Test Scale Thinking: Lean Thinking, Critical Thinking, Lateral Thinking, Design Thinking | | **CO4** |
| | **4.2** | **Key Tenets:**Customer-Centric Approach, Thinking Beyond Products, Balancing Desirability, Feasibility & Viability, Broad & Compartmentalized Thinking, Visual Thinking & Hands-on Approach | | |
| | | **Self-learning Topics:** Case Study: How a global brand used design thinking to enhance customer experience and increase engagement. | | |

| | | | | |
|---|---|---|---|---|
| **5.0** | | **Inspire, Empathize and Define** | **05** | |
| | **5.1** | **Generating & Broadening Ideas:** Creating Stretch Goals, Power of Metaphors & Widening Perspectives, Importance of Diversity in Ideation | | **CO5** |
| | **5.2** | **Empathize & Define:** New Channels for Customer Insights, Deep Customer Empathy & Stakeholder Analysis, Leveraging Technology for Insights, Mind Mapping: Stakeholders, Journey Mapping, Problem Framing | | |
| | | **Self-learning Topics:** Case Study: How Airbnb used empathy mapping and customer insights to redefine its business model. | | |
| **6.0** | | **Ideate, Prototype and Test** | **06** | |
| | **6.1** | Ideate: Brainstorming & Hybrid Ideation Techniques, Challenging Assumptions & Breaking Patterns, Cross-Industry Inspiration (Analogous Design), Designing for Extreme Users & Ideation Triggers | | **CO6** |
| | **6.2** | Prototype & Test: Rapid Prototyping & Hypothesis Validation, Storyboarding & Scenario Visualization, Collecting Feedback & Managing Failed Prototypes | | |
| | | **Self-learning Topics:** Case Study: Explore Apple's iterative prototyping process in designing user-friendly products. | | |
| | | **Total** | **26** | |

**Textbooks:**

1. Richard Paul, Linda Elder, “Critical Thinking: Tools for Taking Charge of Your Learning and Your Life”,Fourth Edition, 2022,Pearson Education
2. Pavan Soni, “Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving”,2020, Penguin Random House India Private Limited

**Reference books:**

1. Roger L. Martin,“The Design of Business: Why Design Thinking is the Next Competitive Advantage”,2009,Harvard Business Press
2. Richard Paul, Robert Niewoehner, Linda Elde,”The Thinker's Guide to Engineering Reasoning, 2019, Rowman & Littlefield Publishers, **ISBN-13:** 978-1538133798
3. Tilmann Lindberg, Christoph Meinel, Ralf Wagner, Christo, “Design Thinking: Creating a Culture of Innovation”,Springer
4. Brooke Noel Moore & Richard Parker,”Critical Thinking”13th Edition,2020,McGraw-Hill Education.

**Online References:**

1. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
2. https://onlinecourses.nptel.ac.in/noc20_de03/preview
3. https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
4. https://www.coursera.org/learn/uva-darden-design-thinking-innovation

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 10 marks.
- ISE 15 marks = 05 marks for attendance + 10 marks for activities.

**MSE:**

- To be conducted as written examination for 15 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 2 hours are of 60 marks and scaled to 45.**

1. Question paper will comprise of 3 questions.
2. Question1(15 marks): - Solve any 03 out of 04. All questions carry 05 marks each.
3. Question 2 (30 marks): - Solve any 03 out of 05. All questions carry 10 marks each.
4. Question3 (15 marks):- Solve any 03 out of 04. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| MDM C4021 | Statistical Foundation for Data Science | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| MDM C4021 | Statistical Foundation for Data Science | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:** Knowledge of
1. CSC301- Applied Mathematics-III

**Program Outcomes Addressed**
1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigation of Complex Problems
5. PO11: Life-Long Learning

**Course Objectives:**
1. To build an intuitive understanding of Mathematics and relate it to Artificial Intelligence, Machine Learning and Data Science.
2. To provide a strong foundation for probabilistic and statistical analysis mostly used in varied applications in Engineering.
3. Tofocusonexploringthedatawiththehelpofgraphicalrepresentationanddrawingconclusions.
4. To explore optimization and dimensionality reduction techniques.

**Course Outcomes:**
After successful completion of the course student will be able to
1. Use linear algebra concepts to model, solve, and analyze real-world problems.
2. Apply probability distributions and sampling distributions to various business problems.
3. Select an appropriate graph representation for the given data.
4. Apply exploratory data analysis to some real datasets and provide interpretations via relevant visualization
5. Analyze various optimization techniques.
6. Describe Dimension Reduction Algorithms

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **Linear Algebra** | **05** | |
| | **1.1** | Vectors and Matrices, Solving Linear equations, The four Fundamental Subspaces, Eigen values and Eigen Vectors, The Singular Value Decomposition (SVD). | | **CO1** |
| | | **Self-learning Topics:** Applications of Eigenvalues and Eigenvectors in Machine Learning | | |
| **2.0** | | **Probability and Statistics** | **07** | |
| | **2.1** | Introduction, Random Variables and their probability Distribution, Random Sampling, Sample Characteristics and their Distributions, Chi-Square, t-, and F-Distributions: Exact Sampling Distributions, Sampling from a Bivariate Normal Distribution, The Central Limit Theorem. | | **CO2** |
| | | **Self-learning Topics:** Bayesian Statistics and its Applications | | |
| **3.0** | | **Introduction to Graphs** | **05** | |
| | **3.1** | Quantitative vs. Qualitative data, Types of Quantitative data: Continuous data, Discrete data, Types of Qualitative data: Categorical data, Binary data, Ordinary data, plotting data using Bar graph, Piechart, Histogram, Stem and Leaf plot, Dot plot, Scatter plot, Time-series graph, Exponential graph, Logarithmic graph, Trigonometric graph, Frequency distribution graph. | | **CO3** |
| | | **Self-learning Topics:** Graph-Based Data Structures in Python | | |
| **4.0** | | **Exploratory Data Analysis** | **08** | |
| | **4.1** | Need of exploratory data analysis, cleaning and preparing data, Feature engineering, Missing values, understanding dataset through various plots and graphs, draw conclusions, deciding appropriate machine learning models. | | **CO4** |
| | | **Self-learning Topics:** Handling Imbalanced Datasets in Machine Learning | | |
| **5.0** | | **Optimization Techniques** | **07** | |
| | **5.1** | Types of optimization-Constrained and Unconstrained optimization, Methods of Optimization-Numerical Optimization, Bracketing Methods-Bisection Method, False Position Method, Newton's Method, Steepest Descent Method, Penalty Function Method. | | **CO5** |
| | | **Self-learning Topics:** Hyperparameter Tuning in Machine Learning Models | | |
| **6.0** | | **Dimension Reduction Algorithm** | **07** | |
| | **6.1** | Introduction to Dimension Reduction Algorithms, Linear Dimensionality Reduction: Principal component analysis, Factor Analysis, Linear discriminant analysis. | | **CO6** |
| | **6.2** | Non-Linear Dimensionality Reduction: Multidimensional Scaling, Isometric Feature Mapping. Minimal polynomial. | | |
| | | **Self-learning Topics:** Principal Component Analysis (PCA) vs. | | |

| | | | | |
|---|---|---|---|---|
| | | Linear Discriminant Analysis (LDA) | | |
| | | **Total** | **39** | |

**Textbooks:**

1. Linear Algebra for Everyone, Gilbert Strang, Wellesley-Cambridge Press, 2020.
2. An Introduction to Probability and Statistics, Vijay K. Rohatgi & A. K. Md. Ehsanes Saleh, Wiley, 3rd Edition, 2015.
3. An Introduction to Optimization, Edwin K. P. Chong & Stanislaw H. Zak, Wiley, 2nd Edition, 2004.
4. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
5. Exploratory Data Analysis Using R,Pearson, Ronald K, CRC Press, 1st Edition, 2018.

**Reference books:**

1. Introduction to Linear Algebra – Gilbert Strang, Wellesley-Cambridge Press, 5th Edition, 2016.
2. Advanced Engineering Mathematics – Erwin Kreyszig, Wiley, 10th Edition, 2011.
3. Foundations of Machine Learning – Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, MIT Press, 2nd Edition, 2018.
4. Understanding Machine Learning: From Theory to Algorithms – Shai Shalev-Shwartz
5. 
6. and Shai Ben-David, Cambridge University Press, 2014.
7. Mathematics and Programming for Machine Learning with R – William B. Claster, CRC Press, 1st Edition, 2020.

**Online References:**

1. https://math.mit.edu/gs/Iinearalgebra/
2. https://www.coursera.org/learn/probability-theory-statistics
3. https://nptel.ac.in/courses/111/105/111105090/
4. https://onlinecourses.nptel.ac.in/noc21_ma01/preview
5. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| MDM C4031 | Microprocessor and Microcontrollers | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| MDM C4031 | Microprocessor and Microcontrollers | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. Digital system design

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solution
4. PO4: Conduct Investigation of Complex Problems

**Course Objectives:**

1. To equip students with the fundamental knowledge and basic technical competence in the field of Microprocessors.
2. To emphasize instruction set and logic to build assembly language programs.
3. To prepare students for higher processor / Controller architectures.
4. To understand architecture of 8051 and ARM7 core.

**Course Outcomes:**

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

1. Describe core concepts of 8086 microprocessor.
2. Interpret the instructions of 8086 and write assembly and Mixed language programs.
3. Appraise the architecture of advanced processors
4. Describe core concepts of 8051 microcontroller.
5. Interpret the instructions of 8051 and write assembly language programs.
6. Appraise the architecture of advanced controllers.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | | **The Intel Microprocessors 8086 Architecture** | **08** | |
| | **1.1** | 8086 CPU Architecture, Functional Pin Diagram | | **CO1** |
| | **1.2** | Programmer's Model | | |
| | **1.3** | Memory Segmentation, Banking in 8086 | | |
| | **1.4** | Demultiplexing of Address/Data bus | | |
| | **1.5** | Functioning of 8086 in Minimum mode and Maximum mode | | |
| | **1.6** | Interrupt structure and its servicing | | |
| | | **Self-learning Topics:** Timing diagram of minimum and maximum mode | | |
| **2.0** | | **Instruction Set and Programming of 8086** | **05** | |
| | **2.1** | Addressing Modes, Instruction set | | **CO2** |
| | **2.2** | Program related -Data Transfer Instructions, String Instructions, Logical Instructions, Arithmetic Instructions, Transfer of Control Instructions, Processor Control Instructions | | |
| | | **Self-learning Topics:** 8255,8259 ,8257 | | |
| **3.0** | | **Pentium Processor** | **06** | |
| | **3.1** | Comparison of 8086 and Pentium, Pentium Architecture, Superscalar Operation, Integer &Floating-Point Pipeline Stages | | **CO3** |
| | **3.2** | Branch Prediction Logic, Cache Organization, MESI Protocol | | |
| | | **Self-learning Topics:** 80386 Processor | | |
| **4.0** | | **8051 Microcontroller** | **08** | |
| | **4.1** | Comparison between Microprocessor and Microcontroller | | **CO4** |
| | **4.2** | Features, architecture and pin configuration of 8051 | | |
| | **4.3** | CPU timing and machine cycle | | |
| | **4.4** | Memory organization | | |
| | **4.5** | Counters and timers | | |
| | **4.6** | Interrupts | | |
| | **4.7** | Serial data input and output | | |
| | | **Self-learning Topics:** Input output ports | | |
| **5.0** | | **8051 Assembly Language Programming and Interfacing** | **06** | |
| | **5.1** | Addressing modes, Instruction set | | **CO5** |
| | **5.2** | Programs related to :arithmetic, logical, delay subroutine, input, output, timer, counters, port, serial communication, and interrupts Interfacing with LEDs | | |
| | | **Self-learning Topics:** Need of Assembler & Cross Assemble, Assembler Directives | | |
| **6.0** | | **ARM7** | **06** | |
| | **6.1** | Introduction & Features of ARM 7, Concept of Cortex-A, Cortex-R | | **CO6** |

| | | | | |
|---|---|---|---|---|
| | | and Cortex-M Architectural inheritance, Pipelining Programmer's model | | |
| | **6.2** | Brief introduction to exceptions and interrupts handling Instruction set: Data processing, Data Transfer, Control flow | | |
| | | **Self-learning Topics:** Programming of ARM7 | | |
| | | **Total** | **39** | |

**Textbooks:**

1. K. M. Bhurchandani and A. K. Ray, "Advanced Microprocessors and Peripherals", McGraw Hill
2. Douglas V Hall, SSSP Rao "Microprocessors & Interfacing", McGraw Hill
3. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications
4. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning
5. Steve Furber, "ARM System on chip Architecture", Pearson

**Reference books:**

1. John Uffenbeck, "8086/8088 family: Design Programming and Interfacing", PH

**Online References:**

1. https://swayam.gov.in/nd1_noc20_ee11/preview
2. https://nptel.ac.in/courses/108/105/108105102/
3. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
4. https://www.mooc-list.com/tags/microprocessors

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3 (20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| MDM C4061 | Cost Management | 03 | - | - | 03 | - | - | 03 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE$ | | | |
| | | ISE | MSE | | | | |
| MDM C4061 | Cost Management | 20 | 20 | 60 | -- | -- | 100 |

**Pre- requisite:**

1. Basic Accounting principles, Quantitative skills etc.

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO11: Life-Long Learning

**Course Objectives:**

1. To acquire knowledge and understanding of the concepts, techniques, and practices of cost and management accounting and to develop skills for decision making.

**Course Outcomes: Learners will be able to**

1. To understand and analyze different cost concept and methods.
2. To understand the Elements of Cost & Cost classification.
3. To apply various material concepts & classifications for preparation of cost sheet.
4. To analyze various techniques of costing and its application in Finance, budgets and budgetary control.
5. To develop requisite data for cost control and cost reduction.
6. To evaluate marginal costing techniques for decision making.

| Module No. | Unit No. | Topics | Hrs. | Mapped to Course Outcome |
|---|---|---|---|---|
| **1.0** | **1** | **Module 1: Introduction to Cost Accounting** | **04** | |
| | | Meaning of Cost, Cost Accounting & its Objectives, Comparison between Cost accounting and Financial Accounting, Comparison between Cost Accounting and Management Accounting, Types of cost, Methods of costing & Techniques of costing. | | **CO1** |
| | | **Self-learning Topics:**Basic accounting concepts, Journal entry and ledgers. | | |
| **2.0** | **2** | **Classification of Costs and Cost Sheet** | **05** | |
| | | Elements of Cost, Classification of Costs, Cost center and cost unit, Preparation of Cost Sheet & Estimated Cost Sheet. | | **CO2** |
| | | **Self-learning Topics:** Purpose and importance of cost sheet. | | |
| **3.0** | | **Material Management and Accounting for materials** | **06** | |
| | | Managing Purchase Functions, Cost of Material, Storing of materials – Inventory control methods, Costs associated with storing and ordering material, Economic Order Quantity, Fixation of levels and calculation of the same, Issue control-Pricing issues (LIFO, FIFO, Weighted Average), Material control -Objectives in Material Control, Stock Turnover, Material losses wastage, scrap, spoilage, defectives. | | **CO3** |
| | | **Self-learning Topics:** Basic flowchart for material flow in a company. | | |
| **4.0** | | **Accounting for labour and Overheads** | **08** | |
| | | Accounting for labour: Types of Labour Cost, Methods of Remuneration, Treatment of overtime, fringe benefits, idle time etc. Accounting for overheads: Production overheads – Collection, Distribution to Production and service departments, Computation of Overheads Rate based on Machine Hour Rate method, Allocations and Apportionment, Absorption of overheads. | | **CO4** |
| | | **Self-learning Topics:** Types of labour, classification of overheads. | | |
| **5.0** | | **Cost Control and Cost Reduction** | **10** | |
| | | Introduction, Comparison between cost control & cost reduction, Budgets and Budgetary Control, Meaning and Purpose of Budget, Objectives of Budgetary Control, Dangers of budget, Types of Budgets- Flexible Budget Standard Costing, Concept and development of standard costing,Variance analysis for cost, Direct Material variance- Cost, Price, usage, mix and yield variance Direct Labour Variance- Cost, Efficiency, usage, mix, yield and idle-time variance, Overhead Variance – Variable & Fixed Overhead variance, Sales variances – Value, rate, volume and mix variance. | | **CO5** |
| | | **Self-learning Topics:** Differences and Interplay Between Cost Control and Cost Reduction. | | |
| **6.0** | | Marginal Costing & CVP Analysis | **06** | |

| | | | | |
|---|---|---|---|---|
| | | Nature and scope of Marginal Costing, Marginal Cost equation, Cost Profit volume analysis, Break Even point and Break-Even Analysis, Relevant cost analysis for decision making. | | **CO6** |
| | | **Self-learning Topics:** Applications of Marginal Costing in Decision Making. | | |
| | | **Total** | **39** | |

**Textbooks:**

1. B. Banerjee, Cost Accounting: Theory and Practice, 14th ed. New Delhi, India: PHI Learning Pvt. Ltd., 2021.
2. M. Y. Khan and P. K. Jain, Management Accounting, 8th ed. New Delhi, India: McGraw-Hill Education, 2021

**Reference books:**

1. P. Shah, Management Accounting, 6th ed. New Delhi, India: Oxford University Press, 2015.
2. C. Drury, Management and Cost Accounting, 12th ed. Andover, U.K.: Cengage Learning, 2024.

**Online References:**

1. https://dynamicstudyhub.com/cost-management.
2. https://www.wallstreetmojo.com/cost-management

**Course Assessment:**

**ISE:**

- To be conducted in any of these forms - Assignment/ Quiz/ Presentation/ Class Test/ Case study etc. of 20 marks.
- ISE 20 marks = 05 marks for attendance + 15 marks for activities.

**MSE:**

- To be conducted as written examination for 20 marks (on 40% - 50% syllabus)

**End Semester Examination**:

**$ ESE of duration 03 hours are of 80 marks and scaled to 60.**

1. Question paper will comprise of 03 questions.
2. Question1(20 marks): - Solve any 04 out of 06. All questions carry 05 marks each.
3. Question 2 (40 marks): - Solve any 04 out of 06. All questions carry 10 marks each.
4. Question3(20 marks):- Solve any 04 out of 06. All questions carry 05 marks each.
5. All COs should be mapped as per the weightage in the syllabus.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL401 | Operating System Lab | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL401 | Operating System Lab | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**

1. Knowledge on Operating system principles.

**Program Outcomes addressed:**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct Investigations of Complex Problems
5. PO5: Engineering Tool Usage
6. PO8: Individual And Collaborative Team Work
7. PO9: Communication

**Lab Objectives:**

1. To gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.
2. To familiarize students with the architecture of Linux OS.
3. To provide necessary skills for developing and debugging programs in Linux environment.
4. To learn programmatically to implement simple operation system mechanisms.

**Course Outcomes:**

Upon completion of this course, learners will be able to…

1. Illustrate basic Operating system Commands, Shell scripts, System Calls.
2. Simulate and implement various processes, scheduling algorithms and evaluate their performance.
3. Analyze and experiment various methods of synchronization and deadlocks.
4. Show various Memory Management techniques and evaluate their performance.
5. Illustrate and analyze concepts of virtual memory.
6. Implement and analyze concepts of file management and I/O management techniques.

| Suggested List of Experiments | | | |
|---|---|---|---|
| **Sr. No.** | | **Content** | **LO** |
| **1** | | **Explore Linux Commands** | **LO1** |
| | **1.1** | Explore usage of basic Linux Commands and system calls for file, directory and process management.<br>For eg:(mkdir, chdir, cat, ls, chown, chmod, chgrp, ps.<br>System calls: open, read, write, close, get pid, set pid, get uid, get gid, get e gid, get euid. sort.) | |
| | **1.2** | Implement any one basic commands of linux like ls, cp, mv and others using kernel APIs. | |
| **2** | | **Linux shell script** | **LO1** |
| | **2.1** | To write shell script<br>a. Write a grep/egrep script to find the number of words character, words and lines in a file.<br>b. Write an awk script to develop a Fibonacci series.<br>c. Write an awk script to display the pattern of given string or number.<br>d. Write an egrep script to display list of files in directory | |
| | **2.2** | Write shell scripts to do the following:<br>a. Display OS version, release number, kernel version<br>b. Display top10 processes in descending order<br>c. Display processes with highest memory usage.<br>d. Display current logged in user and logname.<br>e. Display current shell, home directory, operating system type, current path setting, current working directory. | |
| **3** | | **Linux-Process** | **LO1** |
| | **3.1** | a. Create a child process in Linux using the fork system call. From the child process obtain the process ID of both child and parent by using get pid and get ppid system call.<br>b. Explore wait and wait pid before termination of process. | |
| **4** | | **Process Management: Scheduling** | **LO2** |
| | **4.1** | a. Write a program to demonstrate the concept of non-preemptive scheduling algorithms.<br>b. Write a program to demonstrate the concept of preemptive scheduling algorithms | |
| **5** | | **CPU-OS simulator** | **LO2** |
| | **5.1** | Using the **CPU-OS simulator** analyze and synthesize the following:<br>a. Process Scheduling algorithms.<br>b. Thread creation and synchronization.<br>c. Deadlock prevention and avoidance. | |
| **6** | | **Process Management: Synchronization** | **LO3** |
| | **6.1** | Write a C program to implement solution of Producer consume problem through Semaphore | |
| **7** | | **Process Management: Deadlock** | **LO3** |
| | **7.1** | a. Write a program to demonstrate the concept of deadlock avoidance through | |

| | | | |
|---|---|---|---|
| | | Banker's Algorithm<br>b. Write a program demonstrate the concept of Dining Philospher's Problem | |
| **8** | | **Memory Management** | **LO4** |
| | **8.1** | a. Write a program to demonstrate the concept of MVT and MFT memory management techniques<br>b. Write a program to demonstrate the concept of dynamic partitioning placement algorithms i.e. Best Fit, First Fit, Worst-Fit etc. | |
| **9** | | **Memory Management: Virtual Memory** | **LO5** |
| | **9.1** | a. Write a program to demonstrate the concept of demand paging for simulation of Virtual Memory implementation<br>b. Write a program in C demonstrate the concept of page replacement policies for handling page faults eg: FIFO, LRU etc. | |
| **10** | | **File Management & I/O Management** | **LO6** |
| | **10.1** | a. Write a C program to simulate File allocation strategies typically sequential, indexed and linked files<br>b. Write a C program to simulate file organization of multi-level directory structure.<br>c. Write a program into do disk scheduling-FCFS,SCAN, C-SCAN | |

**Textbooks:**

1. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley &Sons, Inc., 9thEdition, 2016.
3. Linux Kernel Book, by Remy Card, Eric Dumas, Frank Mevel, Wiley India.
4. Unix Concepts and Applications, Sumitabha Das, McGraw Hill.

**Reference books:**

1. Practicing Hand Book for Operating System Laboratory by Sathish Kumar Ravichandran, Archana Sasi.
2. Operating System Lab Programs: Guide to Shell and OS lab programs by S.Sydhani Begum
3. Maurice J. Bach, "Design of UNIX Operating System", PHI

**Online References:**

1. OS Simulator: Downloads – CPU-OS Simulator

**Term Work** will be assessed as **Continuous Internal Assessment Practical (CIAP).**

1. Term work should consist of 10 experiments covering all modules.
2. Journal must include at least 2 assignments on content of theory and practical of "Operating System"
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks)

**Practical Exam: (2 hours/ 25 Marks)**

End-semester Practical and oral exam will be held based on the above syllabus and will be assessed as **End Semester Examination Practical (ESEP).**

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL402 | Analysis of Algorithm Lab | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL402 | Analysis of Algorithm Lab | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**

1. Basic knowledge of programming and data structure Lab

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO4: Conduct Investigations of Complex Problems
4. PO8: Individual And Collaborative Teamwork
5. PO9: Communication
6. PO11: Life-Long Learning

**Lab Objectives:**

1. To introduce the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply a suitable algorithm for the given real-world problem.
4. Analyze the worst-case running time of algorithms and understand fundamental algorithmic problems.

**Course Outcomes: Learners will be able to**

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

1. Implement the algorithms using different approaches.
2. Analyze the complexities of various algorithms.
3. Compare the complexity of the algorithms for specific problems.
4. Apply appropriate algorithms to solve computational problems.
5. Implement advanced problem-solving techniques like backtracking and branch & bound.
6. Understand complexity classes through implementation and case studies.

**Suggested List of Experiments**

Star (*) marked experiments are compulsory.

| Sr. No. | Title of Experiments | LO |
|---|---|---|
| 1 | A library management system needs to arrange books by their ID numbers in ascending order. Implement sorting techniques to efficiently organize the books. | LO1, LO2 |
| 2 | Implementation of merge sort and quick sort. | LO1, LO2 |

| | | |
|---|---|---|
| 3 | A student records system allows users to search for a student's record by ID number. Implement an efficient search algorithm to find a student's details quickly. | LO1, LO3 |
| 4 | A GPS navigation system needs to provide users with the shortest path between their current location and a given destination. Implement Dijkstra's algorithm to compute the optimal route. | LO1, LO3 |
| 5 | Implementation of Prim's Algorithm for Minimum Spanning Tree (MST). | LO1, LO4 |
| 6 | Implementation of the 0/1 Knapsack Problem using Dynamic Programming. | LO1, LO3 |
| 7 | Implementation of the Floyd-Warshall algorithm all-pair shortest path. | LO1, LO3 |
| 8 | A DNA sequencing research project aims to find the longest common subsequence between two DNA strands. Implement an LCS algorithm to compare genetic sequences efficiently. | LO1, LO4 |
| 9 | A chess tournament system is testing possible arrangements of N queens on an N×N board such that no two queens attack each other. Implement the N-Queens problem using backtracking to generate valid placements. | LO1, LO5 |
| 10 | Implementation of the Rabin- Karp String Matching Algorithm. | LO1, LO4 |
| 11 | A university needs to schedule exams such that no two exams for the same student are scheduled at the same time. Implement the graph coloring algorithm to minimize the number of time slots required. | LO1, LO5 |
| 12 | Write a case study on Complexity Classes: P, NP, NP-Hard, NP-Complete. | LO6 |

**Textbooks:**

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, PHI Publication, 2005.
2. Ellis Horowitz, Sartaj Sahni, and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Orient BlackSwan, 2008.

**Reference books:**

1. Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, Algorithms, McGraw-Hill Education, 2006.
2. S. K. Basu, *Design Methods and Analysis of Algorithms*, PHI Learning Pvt. Ltd., 2005.

**Online References:**

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://swayam.gov.in/nd1_noc19_cs47/preview
3. https://www.coursera.org/specializations/algorithms

**Term Work**:

The term work should include 10 experiments. At least 02 assignments covering the entire syllabus must be given on the content of theory of "Analysis of Algorithms". The assignments should be students' centric and an attempt should be made to make assignments more meaningful, interesting and innovative. Term work will be assessed as Continuous Internal Assessment Practical (CIAP).

**Term work Marks:**

- 25 Marks (Total Marks) =15 Marks (Experiment) + 05 Marks (Assignments) + 05

Marks (Attendance)

- The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

**Practical Exam: (2 hours/ 25 Marks)**

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL403 | Skill Lab (Web Technology) | -- | 2*+2 | -- | -- | 02 | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL403 | Skill Lab (Web Technology) | -- | -- | -- | 25 | 25 | 50 |

**Pre- requisite:**

1. Data Structures, C, Java, Python

**Program Outcomes Addressed**

1. PO1: Engineering knowledge
2. PO2: Problem analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigations of complex problems
5. PO5: Modern tool usage
6. PO7: Environment & Sustainability
7. PO8: Ethics
8. PO9: Individual and team work
9. PO10: Communication
10. PO12: Life Long Learning

**Lab Objectives:**

The course aims to enable students:

1. To get familiar with the basics of Internet Programming and GIT functionality.
2. To facilitate in developing a responsive web application using JavaScript for enhanced user experience across devices.
3. To acquire knowledge and skills for creation of web site considering both client and server-side programming
4. Demonstrate Rich Internet Application using Ajax and demonstrate and differentiate between various Web Extensions.
5. To build a web application with ReactJS and NoSQL database MongoDB
6. To use MERN stack for web application development

**Lab Outcomes:**

Upon completion of this course, Learners will be able to:

1. Installing GIT and understanding its functionalities
2. Develop interactive web pages using HTML and CSS to engage users dynamically
3. Design and create a responsive web application using JavaScript and interactive web application powered by AJAX using JavaScript and jQuery for seamless data retrieval and dynamic updates
4. Construct an Demonstrate the integration of PHP and MySQL to facilitate data storage, retrieval, and manipulation in web applications
5. Build a web application using ReactJS, Mongoose Library, ExpressJS and NodeJS
6. Develop mini projects using above technologies

| Module | | Detailed Content | Hours | LO mapped |
|---|---|---|---|---|
| **1.0** | | **Foundations of Web Development with Git** | 6 | **LO1 LO2** |
| | 1.1 | WWW, Basic Internet Protocols, HTTP request and HTTP response message, HTML – Introduction, history and versions. | | |
| | 1.2 | HTML elements: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Logical and physical tags in HTML5 | | |
| | 1.3 | Concept of **CSS**, Creating Style Sheet, CSS Properties, CSS Styling 4 (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties) CSS Advanced: (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector).<br>**Basics of Bootstrap**: The Grid System, CSS Foundations, Navigation Systems, JavaScript Effects | | |
| | 1.4 | Introduction to Git and Github, Benefits of using Github, Pushing the source code into github, Collaborating with others by creating Pull Requests ,Working on parallel branches | | |
| | | **Self-Learning topic**: Create a game using HTML, CSS and Javascript where random shapes (circle, squares, rectangles) of random sizes and random color will appear and disappear on the screen for random time durations (0.5 sec to 3 sec). Clicking on the shape before it disappears will increment your score. | | |
| **2.0** | | **Javascript with AJAX** | **4** | **LO3** |
| | 2.1 | Introduction to JavaScript, DOM Manipulation, Data types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Scripting CSS, Handling Events | | |
| | 2.2 | Introduction to AJAX, AJAX Components, AJAX with Javascript, AJAX with JQuery, AJAX and JSON,AJAX with Forms and API Integration | | |
| | | **Self-Learning topic**: Implement a search bar with live suggestions (like Google Search). | | |
| **3.0** | | **Back End Development** | **5** | **LO4** |
| | 3.1 | **Introduction** to PHP- Data types, control structures, built in functions, building web applications using PHP- Session handling Mechanisms, PHP and MySQL database connectivity . | | |
| | | **Self-Learning topic**:Build a webpage for Image or document file upload . | | |
| **4.0** | | **ReactJS (Frontend Layer for Full Stack Development)** | **5** | **LO5** |
| | 4.1 | **ReactJS**: Introduction, JSX, Components, Props, State, Hooks (use State, use Effect), React Router, Axios, VirtualDOM, API integration and Form Handling | | |
| | | **Self-Learning topic**: Simple React App like Random Joke Generator | | |
| **5.0** | | **MONGODB(Data Storage) and EXPRESS JS(Backend Layer for Full stack Development)** | **4** | **LO5** |
| | 5.1 | MongoDB: NoSQL basics, Collections/Documents, CRUD operations, Mongoose setup(ODM ie Object Data Modeling library), schema design. | | |

| | | | | |
|---|---|---|---|---|
| | | **Express.js(Node.js framework) : Building** REST API , Routing, Middleware, MongoDB integration, JWT authentication, and backend for the React app. | | |
| | | **Self-Learning topic**: Web Application CRUD To-Do app. | | |
| **6.0** | | **Mini project** | **2** | **LO6** |
| | 6.1 | Selection of problem statements and implementing end to end solutions. | | |
| | | Total | 26 | |

**Textbooks:**

1. Web Technology Black Book, Kogent Learning Sol., First Edition, Dreamtech Press, 2009
2. Ralph Moseley, M.T. Savliya , “Developing Web Applications”, Willy India, Second Edition.
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition,O'REILLY,2014
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd,
   Edward Benson, Wiley publications First Edition.
5. Schwarz, D. (Year). *The Designer's Guide to Figma*. Perlego, First edition.
6. Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux, O’Reilly, First Edition.
7. Krishna Chodorow, MongoDB The Definite Guide, O’Reilly, 2nd Edition.
8. Shelly Powers, Learning Node,O’Reilly, 2nd Edition.

**Reference books:**

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011
2. Achyut S Godbole and Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill,2012.
3. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, TataMcGraw Hill, 2013.
4. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012,Second Edition.
5. Masse, M. (2011). REST API Design Rulebook. Germany: O'Reilly Media,First Edition.
6. Steven Holzner ―The Complete Reference - PHP, Tata McGraw Hill, 2008, First Edition.

**Software Tools:**

1. Figma Downloads | Web Design App for Desktops & Mobile

**Online References:**

1. Home | spoken-tutorial.org
2. Course: React JS for Web Development: React with Node JS, MongoDB | Udemy
3. W3Schools Online Web Tutorials

| Suggested List of Programming Assignments / Laboratory Work: | | |
|---|---|---|
| **Sr.No.** | **Name of the Experiment** | **LO mapped** |
| 1 | Installation of Git, Creating new GIT repository and understanding functionality like Add, ommit, Modify, View. | LO1 |
| 1 | Develop a straightforward blog page using HTML, CSS, and Bootstrap. The blog page hould incorporate images, embedded videos, and a contact form. | LO2 |
| 2 | Create a portfolio landing page using Html, CSS and JavaScript. Enhance it with features ke dark mode and light mode, and incorporate animations to elevate the website's aesthetic ppeal. | LO3 |
| 3 | Design a static HTML page that contains a selection box with a list of 5 countries. When the ser selects a country, its capital should be printed next to the list. Add CSS to customize the roperties of the font of the capital (color, bold and font size). | LO3 |
| 4 | Validate the fields of registration page created in the first experiment using regular xpressions in JavaScript and also Validate login credentials without refreshing the age.(AJAX and JSON). | LO3 |
| 5 | Build a web page enabling users to retrieve and display real-time weather information for a pecific city using AJAX. Students should explore free API providers offering weather data. | LO3 |
| 6 | Create interactive web pages that fetch, display, and update data from MySQL databases ynamically based on user interactions using PhP. | LO4 |
| 7 | Create a react application and make use of at least 4 hooks available in react. (Eg: Simple ounter application in react which uses State Hooks). | LO5 |
| 8 | Design and implement a basic CRUD (Create, Read, Update, Delete) operations system sing MongoDB. | LO5 |
| 9 | A **blog platform** where users can create, edit, and delete posts, and view others' posts using xpress Js. | LO5 |
| 10 | Mini Project based on the content of the syllabus (Group of 2-3 students). | LO6 |

**Term Work(CIAP):**

1. Term work should consist of 10 experiments and Journal submission.
2. Mini Project based on the content of the syllabus (Group of 2-3students).
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
4. Total 25 – Marks (Experiments: 10 - marks, Attendance: 05 - marks, Mini Project:-5 marks, Participation or wining in Web based competition: 05-marks).

**Practical Exam: (2 hours/ 25 Marks)**

- End-semester Practical and oral exam will be held based on the above syllabus and will be conducted as End Semester Examination Practical (ESEP).

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEL404 | Value Education Course (UHV) | -- | 04 | -- | -- | 02 | - | 02 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEL404 | Value Education Course (UHV) | -- | -- | -- | 50 | -- | 50 |

**Program Outcomes Addressed**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of
4. PO4: Investigation of Complex
5. PO5: Engineering Tool
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Collaborative Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Lifelong Learning

**Course Objectives:**

1. **To introduce the fundamental concepts of human values**, including intrinsic and extrinsic values, and their relevance to personal and professional development in the context of IT engineering.
2. **To explore the principles of Universal Human Values (UHV)**, emphasizing self-awareness, self-exploration, and the application of tools like the JOHARI window and SWOT analysis in the IT profession.
3. **To study the different levels of harmony**—within oneself, in the family, society, and nature—and apply these concepts to achieve a balanced and fulfilling life, especially in the fast-paced IT industry.
4. **To comprehend the key aspects of professional ethics in IT**, including ethical standards, work ethics, and moral issues such as data privacy, cybersecurity, and AI ethics.
5. **To develop foundational values** such as integrity, impartiality, nonpartisanship, and objectivity, and cultivate empathy, tolerance, and compassion in both personal and professional contexts, particularly in IT-related decision-making.
6. **To integrate human values into IT practices**, focusing on ethical decision-making, sustainable technology development, and responsible innovation.

**Course Outcomes: Learners will be able to**

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

1. **Understand and Explain** (*Understand*) the basic concepts of human values and their significance in personal and professional contexts, particularly in the IT industry.
2. **Explore and Internalize** (*Apply*) human values to guide personal behavior and professional conduct in IT roles such as software development, data analysis, and cyber security.
3. **Analyze and Apply** (*Analyze & Apply*) the concept of harmony at various levels of existence to achieve a balanced life, even in high-pressure IT environments.
4. **Identify and Evaluate** (*Analyze & Evaluate*) ethical issues in the IT profession, including data privacy, cyber security, AI ethics, and intellectual property rights, using appropriate ethical theories and standards.
5. **Demonstrate and Uphold** (*Apply & Evaluate*) integrity and ethical principles in professional and public service contexts, fostering empathy and compassion in IT projects that impact society.
6. **Integrate and Implement** (*Create & Apply*) human values into IT practices, ensuring that technology development aligns with ethical, social, and environmental considerations.

| Module No. | Unit No. | Topics | Mapped Learning Outcome (LO) |
|---|---|---|---|
| **1.0** | | **Introduction to Human Values and Their Relevance in IT** | |
| | **1.1** | Definition, Intrinsic & Extrinsic values, Shalom Schwartz's Theory of Basic Human Values, Value education: Need, Basic Guidelines and Scope, Self-exploration, Happiness and Prosperity, Harmony, Self-awareness: JOHARI window and SWOT analysis | **LO1** |
| | **1.2** | Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights | **LO4** |
| **2.0** | | **Understanding Human Beings and Harmony at Various Levels of Existence** | |
| | **2.1** | Human beings as a combination of the conscious 'I' and material body, Abraham Maslow's Hierarchy of Needs, Classification between I & Body, Co-existence, Harmony in Self: Swasthya and Sanyama | **LO3** |
| | **2.2** | Harmony in the Family -- Understanding Values in Human Relationships, Differentiation in relationships, Values in relationships | **LO3** |
| | **2.3** | Harmony in the Society -- From Family order to World Family Order, Comprehensive Human Goal, Harmony in Nature -- Understanding the Interconnectedness and Mutual Fulfilment, Understanding the Four Orders of Nature | **LO3, LO6** |
| **3.0** | | Professional Ethics in IT | |

| Module No. | Unit No. | Topics | Mapped Learning Outcome (LO) |
|---|---|---|---|
| | **3.1** | Definition, Characteristics, Profession, Professionalism, Morality, Moral issues in the IT profession, Understanding Ethics, Ethical Standards, Work Ethics, Engineering Ethics | **LO4** |
| | **3.2** | Types of Inquiries, Kohlberg's Theory, Heinz Dilemma, Gilligan's Theory, and Ethical Theories | **LO4** |
| | **3.3** | Ethical Challenges in IT: Data privacy, cybersecurity, AI ethics, and intellectual property rights | **LO4** |
| **4.0** | | **Ethics, Integrity, and Aptitude in IT** | |
| | **4.1** | Essence, determinants, and consequences of ethics in human actions, Dimensions of ethics, Ethics in private and public relationships | **LO5** |
| | **4.2** | Key contributions from Indian and global moral thinkers and philosophers, emphasizing integrity, impartiality, and non-partisanship in professional settings | **LO5** |
| | **4.3** | Upholding objectivity and dedication to public service, Cultivating empathy, tolerance, and compassion, with a focus on their application in IT and public welfare | **LO5** |
| **5.0** | | **Understanding Harmony in Nature and Sustainable IT Practices** | |
| | **5.1** | Concept of harmony in Nature: Meaning of harmony in nature, Disharmony with Nature -- causes, Implications of disharmony with nature | **LO6** |
| | **5.2** | Maintaining harmony with nature: Harmony through mutual fulfilment of the four orders in nature, Harmony through symbiotic relationship with nature, Achieving competence in maintaining harmony with nature in professional life | **LO6** |
| | **5.3** | Sustainable IT Practices: Green computing, energy-efficient algorithms, and eco-friendly technology development | **LO6** |
| **6.0** | | **Practicum Project -- Community Engagement and IT for Social Good** | |
| | **6.1** | Students carry out a community engagement project to benefit the local community through IT-based initiatives (e.g., developing apps for social causes, organizing digital literacy camps, or creating awareness about cybersecurity). | **LO2, LO5, LO6** |
| | **6.2** | Students write a reflective report on how the understanding of universal human values has been integrated into their IT project. | **LO5, LO6** |

**Textbooks:**

1. **Naagarazan, R. S.** *A Textbook on Professional Ethics and Human Values*. 4th Edition. New Age International Publishers, 2021.
2. **Gaur, R.R., Sangal, R., &Bagaria, G.P.** *A Foundation Course in Human Values and Professional Ethics*. 3rd Edition. Excel Books, 2019.
3. **Khosla, Vaishali R., & Bhagat, Kavita.** *Human Values and Professional Ethics*. 2nd Edition. Macmillan Education, 2020.
4. **Harris, C.E., Pritchard, M.S., & Rabins, M.J.** *Engineering Ethics: Concepts and Cases*. 6th Edition. CENGAGE Learning, 2019.
5. **Murthy, PSR.** *Indian Culture, Values and Professional Ethics*. 4th Edition. BS Publications, 2022.

**Reference books:**

1. **Kumar, Niraj.** *Lexicon for Ethics, Integrity & Aptitude for IAS General Studies Paper IV*. 2nd Edition. McGraw Hill Education, 2023.
2. **Subba Rao, G., & Roy Chowdhury, P. N.** *Ethics, Integrity & Aptitude*. 3rd Edition. McGraw Hill Education, 2020.

**Online References:**

1. https://fdp-si.aicte-india.org/index.php
2. https://example.com/

**Course Assessment:**
**Internal Assessment Method (With Rubrics)**
The internal assessment will consist of **Continuous Internal Assessment (CIAP) = 50 marks** based on **Assignments, Case Studies, Presentations, and Practicum Projects**.

| Assessment Component | Weightage (%) | Evaluation Criteria (Rubrics) |
|---|---|---|
| **Assignment on Human Values** | 20% | - Excellent (5): Demonstrates deep understanding with real-life examples<br>- Good (4): Good understanding with relevant examples<br>- Satisfactory (3): Basic understanding with minimal examples<br>- Needs Improvement (2): Partial understanding with errors<br>- Poor (1): Little to no understanding |
| **Case Study on Ethical Issues in IT** | 20% | - Excellent (5): In-depth analysis with ethical theories and solutions<br>- Good (4): Covers major ethical aspects with examples<br>- Satisfactory (3): Identifies ethical concerns with some analysis<br>- Needs Improvement (2): Limited understanding with minor errors<br>- Poor (1): Lacks analysis and ethical reasoning |
| **Presentation on** | 20% | - Excellent (5): Well-structured, engaging, innovative ideas |

| | | |
|---|---|---|
| **Sustainability in IT** | | - Good (4): Clear and logical presentation with good insights<br>- Satisfactory (3): Covers major points but lacks depth<br>- Needs Improvement (2): Some points missing, lacks clarity<br>- Poor (1): Unstructured, lacks coherence |
| **Reflection Report on Practicum Project** | 20% | - Excellent (5): Thoughtful reflection, well-articulated impact<br>- Good (4): Covers personal learning and impact clearly<br>- Satisfactory (3): General reflection with limited depth<br>- Needs Improvement (2): Superficial understanding<br>- Poor (1): Minimal effort, lacks insight |
| **Participation in Discussion & Engagement** | 20% | - Excellent (5): Actively participates, provides insightful contributions<br>- Good (4): Engaged, contributes relevant thoughts<br>- Satisfactory (3): Participates but with limited contribution<br>- Needs Improvement (2): Rarely participates, minimal effort<br>- Poor (1): No participation |

**Examples of Practicum Projects for Community Engagement and IT for Social Good**

The practicum project aims to encourage students to apply **Universal Human Values (UHV)** and **Ethics in IT** to solve real-world societal challenges. Below are some project ideas along with explanations of how they integrate **human values and ethics**:

**Digital Literacy Program for Underprivileged Communities**
**Objective:** Create and conduct workshops to educate marginalized communities about basic computer skills, cybersecurity awareness, and digital payments.
**Implementation:**

- Design an easy-to-understand curriculum on digital literacy.
- Conduct workshops/webinars in rural schools or community centers.
- Develop a simple mobile/web application for learning digital skills.
- Educate participants about data privacy, cyber threats, and ethical internet use.

**Human Values & Ethics Integration:**

- **Empathy & Compassion** – Address digital divide and empower underprivileged individuals.
- **Integrity & Responsibility** – Teach ethical use of technology and responsible online behavior.
- **Public Welfare** – Ensure safe digital access for vulnerable communities.

**AI-Based Cyberbullying Detection for Schools & Colleges**
**Objective:** Develop an AI model to identify cyberbullying in chat messages and social media posts, ensuring a safer digital environment.
**Implementation:**

- Collect and train data on cyberbullying-related words & phrases.
- Implement a Natural Language Processing (NLP)-based chatbot to detect abusive content.
- Educate students on ethical social media behavior and reporting mechanisms.
- Partner with schools/colleges to deploy the model in their IT systems.

**Human Values & Ethics Integration:**

- **Respect & Non-Partisanship** – Encourage online respectful interactions.
- **Fairness & Objectivity** – Ensure non-biased AI in content moderation.
- **Safety & Privacy** – Protect users' personal data and identity.

**Green Computing Awareness & E-Waste Management App**

**Objective:** Develop an app to educate users on sustainable IT practices and provide an e-waste collection service.

**Implementation:**

- Create an app that guides users on green computing practices.
- Provide nearby e-waste collection centers and reward users for recycling.
- Conduct IT industry awareness campaigns on energy-efficient computing.
- Promote the use of renewable energy in data centers.

**Human Values & Ethics Integration:**

- **Environmental Sustainability** – Encourage eco-friendly IT solutions.
- **Social Responsibility** – Spread awareness about ethical e-waste disposal.
- **Harmony in Nature** – Minimize IT sector's negative impact on nature.

**Cybersecurity Awareness Chatbot for Senior Citizens**

**Objective:** Build a WhatsApp or Telegram chatbot that assists senior citizens in identifying and avoiding online scams, phishing, and frauds.

**Implementation:**

- Develop an AI chatbot that explains common online scams.
- Create step-by-step tutorials on safe internet banking and social media usage.
- Partner with local community centers and NGOs to spread awareness.
- Ensure chatbot provides real-time support and automated alerts.

**Human Values & Ethics Integration:**

- **Compassion & Empathy** – Assist vulnerable groups in safe internet use.
- **Integrity & Awareness** – Promote honest and secure online transactions.
- **Public Welfare** – Reduce cyber frauds targeting elderly people.

**AI Ethics Awareness in IT Companies & Colleges**

**Objective:** Develop an interactive website or mobile app to educate IT professionals and students on ethical AI usage and biases in AI systems.

**Implementation:**

- Provide interactive case studies on AI bias, privacy, and ethical dilemmas.
- Conduct quiz-based learning to test AI ethical understanding.
- Collaborate with IT professionals and faculty to design real-world scenarios.
- Ensure alignment with global AI ethics standards (e.g., IEEE, EU AI Act).

**Human Values & Ethics Integration:**

- **Integrity & Fairness** – Ensure unbiased AI algorithms.
- **Public Interest** – Educate developers on responsible AI implementation.
- **Transparency** – Promote explainable and fair AI decision-making.

**Mobile App for Volunteer & Donation Matching**

**Objective:** Develop a volunteer-matching platform that connects IT professionals and students with social organizations in need of technical assistance.

**Implementation:**

- Allow users to register their skills (app development, cybersecurity, etc.).
- Connect them with NGOs or community projects that require IT support.
- Enable secure crowdfunding and donation tracking for transparency.
- Promote projects focused on digital inclusion and education.

**Human Values & Ethics Integration:**

- **Social Responsibility** – Encourage IT professionals to give back to society.
- **Transparency & Trust** – Maintain fair donation tracking.
- **Empathy & Compassion** – Align IT skills with community development.

**Ethical Hacking & Cybersecurity Training for Students**

**Objective:** Conduct a hands-on ethical hacking workshop to educate students on ethical penetration testing and cybersecurity best practices.

**Implementation:**

- Develop training modules on ethical hacking, cryptography, and network security.
- Conduct capture-the-flag (CTF) cybersecurity challenges for hands-on learning.
- Educate students on responsible disclosure of vulnerabilities.
- Partner with cybersecurity firms for internships and projects.

**Human Values & Ethics Integration:**

- **Ethical Responsibility** – Train IT students to prevent cybercrimes.
- **Accountability** – Promote responsible ethical hacking practices.
- **Public Safety** – Improve cybersecurity awareness in college networks.

**AI-Powered Sign Language Recognition System**

**Objective:** Develop an AI-based sign language recognition system to help hearing-impaired individuals communicate using real-time gesture recognition.

**Implementation:**

- Train a machine learning model on Indian Sign Language (ISL).
- Develop a mobile/web app that converts sign language gestures into text/speech.
- Partner with special education institutes and NGOs for deployment.
- Ensure open-source availability for future development.

**Human Values & Ethics Integration:**

- **Inclusion & Accessibility** – Bridge communication gaps for disabled individuals.
- **Fairness & Transparency** – Ensure AI is unbiased across different sign languages.
- **Social Welfare** – Enhance digital accessibility for differently-abled people.

- **Project Submission & Reflection Report**

After completing the practicum project, students will submit a reflective report covering:

1. **Project Objective & Problem Statement**
2. **Implementation Details & Challenges Faced**
3. **Human Values & Ethics Integrated**
4. **Impact Assessment & Learning Outcomes**
5. **Future Improvements & Scalability**

**Evaluation Rubric:**

- **Excellent (5):** Clear objectives, strong ethical integration, significant social impact.
- **Good (4):** Good ethical integration, minor improvement areas.
- **Satisfactory (3):** Basic implementation lacks depth in ethical application.
- **Needs Improvement (2):** Minimal social impact, weak ethical connection.
- **Poor (1):** Unclear project execution, little relevance to human values.

| Course Code | Course Name | Teaching Scheme (Hrs.) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Theory | Practical | Tutorial | Total |
| CEM401 | Mini Project 1 B | -- | 02 | -- | -- | 01 | - | 01 |

| Course Code | Course Name | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|
| | | Theory Marks | | | CIAP | ESEP | Total |
| | | Course Assessment | | ESE | | | |
| | | ISE | MSE | | | | |
| CEM401 | Mini Project 1 B | -- | -- | -- | 25 | 25 | 50 |

**Program Outcomes addressed:**

1. PO1: Engineering Knowledge
2. PO2: Problem Analysis
3. PO3: Design/Development of Solutions
4. PO4: Conduct investigation of complex problems
5. PO5: Engineering Tool Usage
6. PO6: The Engineer and The World
7. PO7: Ethics
8. PO8: Individual and Team Work
9. PO9: Communication
10. PO10: Project Management and Finance
11. PO11: Lifelong Learning

**Objectives**

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

**Outcome:** Upon completion of this course, learners will be able to

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Deduce the proper inferences from available results through theoretical/ experimental /simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Apply standard norms of engineering practices.
7. Develop skills in written and oral communication.
8. Illustrate capabilities of self-learning in a group, which leads to life-long learning.
9. Explain project management principles during project work.

**Guidelines for Mini Project**

1. Students shall form a group of 3 to 4 students, while forming a group shall not be allowed for less than three or more than four students, as it is a group activity.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
3. Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
4. A logbook to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5. Faculty supervisors may give input to students during mini project activity; however, focus shall be on self-learning.
6. Students in a group should understand problems effectively, propose multiple solutions and select best possible solution in consultation with guide/ supervisor.
7. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
9. With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
10. However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

**Guidelines for Assessment of Mini Project: Term Work**

- Term work will be assessed as Continuous Internal Assessment Practical (CIAP).
- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below.
    1. Marks awarded by guide/supervisor based on logbook: 10
    2. Marks awarded by review committee 10
    3. Quality of Project report 05

The review/progress monitoring committee may consider the following points for assessment based on either one year or half year project as mentioned in general guidelines.

**One-year project:**

- In the first semester the entire theoretical solution shall be ready, including

components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the students' group.

- First shall be for finalization of problem
- Second shall be on finalization of proposed solution of problem.

- In the second semester the expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
  - The first review is based on the readiness of building a working prototype to be conducted.
  - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

**Half-year project:**

In this case in one semester students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

Two reviews will be conducted for continuous assessment,

- First shall be for finalization of problem and proposed solution
- Second shall be for implementation and testing of solution.

**Assessment criteria of Mini Project**

**Mini Project** shall be assessed based on the following criteria;

1. Quality of survey/ need identification.
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions.
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness.
6. Societal impact.
7. Innovativeness.
8. Cost effectiveness and Societal impact.
9. Full functioning of working model as per stated requirements.
10. Effective use of skill sets.
11. Effective use of standard engineering norms.
12. Contribution of an individual's as member or leader.
13. Clarity in written and oral communication.

- In **one year, project**, first semester evaluation may be based on the first six criteria's and the remaining may be used for second semester evaluation of performance of students in mini project.
- In the case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

**Guidelines for Assessment of Mini Project Practical/Oral Examination:**

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of

working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organization's having experience of more than five years approved by head of Institution.

- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

**Mini Project** shall be assessed based on the following points.

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

**Oral & Practical exam (ESEP)**

Based on the entire syllabus of CEM401 Mini Project End Semester Examination Practical (ESEP) will be conducted.

**Internal Assessment:**

**For 03 credit - 80 marks subject**

Assessment consists of one Mid Semester Examination (MSE) of 20 marks and In Semester Examination (ISE) of 20 marks. The MSE to be conducted based on 50 %syllabus with duration of one hour.

**For 02 credit - 60 marks subject**

Assessment consists of one Mid Semester Examination (MSE) of 15 marks and In Semester Examination (ISE) of 15 marks. The MSE to be conducted based on 50 %syllabus with duration of one hour.

**In Semester Examination (ISE)**

**SE 20 marks = 05 marks attendance +15 marks for Activities.**

**ISE 15 marks = 05 marks attendance +10 marks for Activities.**

The Rubrics for activities are as follows. The activities will be decided by course in charge and approved by HoD.

| Sr.No | Rubrics | Marks |
|---|---|---|
| 1 | Multiple Choice Questions(Quiz) | 05Marks |
| 2 | Literature review of papers/journals | 05Marks |
| 3 | Participation in event/ workshop/ talk / competition followed by small report and certificate of participation relevant to the subject | 05Marks |
| 4 | Extra Experiments/Virtual Lab | 05 marks |
| 5 | Content beyond syllabus presentation | 05 marks |
| 6 | Wins in the event/competition/hackathon pertaining to the course | 10Marks |
| 7 | Case study, Presentation, group discussion, technical debate on recent trends in the said course | 10Marks |
| 8 | NPTEL/ Coursera/ Udemy/ any MOOC Certificate course for 4 weeks or more | 10Marks |
| 9 | Creating Proof of Concept | 10Marks |
| 10 | Mini Project/ | 10Marks |
| 11 | GATE Based Assignment test/Tutorials etc | 10Marks |

*For sr.no.8, the date of certification exam should be with in the term and in case a student is unable complete the certification, the grading has to be done accordingly.