The Bombay Salesian Society's

# DON BOSCO
## Institute of Technology

ISO 9001:2015 & NAAC Accredited

# CURRICULUM STRUCTURE

## FIRST YEAR ENGINEERING (FE)

Semester I and II

Scheme: DB25–V1

Academic Year: 2025–2026

**Department of Basic Science and Humanities**

(Common Curriculum for First Year Engineering)

## The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

**Department of Basic Science and Humanities**

**CURRICULUM STRUCTURE FOR FIRST YEAR ENGINEERING**

**SEM I and II**

**(As Per NEP 2020)**

## ( Scheme: DB25-V1 )
## Effective from Academic Year 2025-2026

The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

( An Autonomous Institute affiliated to University of Mumbai )

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AC: 01/02
Item no. 02

# The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

## Department of Basic Science and Humanities

## CURRICULUM STRUCTURE FOR FIRST YEAR ENGINEERING SEM I

**(As Per NEP 2020)**

## (Scheme: DB25-V1)
## Effective from Academic Year 2025-2026

# 1. Preamble

Don Bosco Institute of Technology, Kurla, Mumbai, proudly celebrates the achievement of autonomous status—an academic milestone that reaffirms our steadfast commitment to excellence, holistic development, and student-centric learning. This autonomy empowers us to craft and implement a curriculum that is forward-looking, contextually relevant, and deeply rooted in our institutional values and the aspirations of our nation.

As an autonomous institution affiliated with the University of Mumbai, DBIT embraces the opportunity to restructure its academic framework in alignment with the University Grants Commission (UGC) guidelines and the National Education Policy (NEP) 2020. This curriculum framework outlines the undergraduate engineering programs for the EXTC, COMP, IT, and MECH branches. It reflects NEP's emphasis on multidisciplinary learning, flexibility, and outcome-based education, while staying true to the Don Bosco educational philosophy.

The curriculum adopts a top-down approach, beginning with the institutional Vision and Mission, which guides the definition of Program Educational Objectives (PEOs) and Program Outcomes (POs). These outcomes are used to shape Course Outcomes (COs) and the content and assessment methods of each course. This ensures that all academic efforts remain aligned with the broader goals of transforming learners into technically sound, ethically responsible and socially aware citizens. Importantly, this curriculum has been shaped through extensive consultations with stakeholders, including industry experts, academic peers, alumni, and students—to ensure that it remains aligned with contemporary industry requirements and societal expectations. Their inputs have been instrumental in designing a framework that bridges the gap between academic learning and practical applicability.

**Key Objectives in developing syllabus are:**

1. **Develop Strong Technical Foundations:** Equip students with robust knowledge and skills in core engineering domains to solve real-world problems through design, analysis, and innovation.

2. **Foster Research, Innovation, and Entrepreneurship:** Cultivate a spirit of inquiry, critical thinking, and entrepreneurial mind-set to promote research-based problem-solving and start-up culture.

3. **Enhance Interdisciplinary and Industry-Ready Competencies:** Integrate emerging technologies, multidisciplinary learning, and practical exposure to prepare

Students for dynamic industry requirements and lifelong learning.

4. **Promote Ethical, Sustainable, and Socially Responsible Engineering Practice:** Inculcate ethics, human values, and environmental consciousness to enable students to contribute meaningfully to society and sustainable development.

5. **Empower Communication, Leadership, and Teamwork Abilities:** Strengthen students' soft skills, collaboration, and leadership to perform effectively in diverse professional and global environments.

**Academic design includes:**

- A Choice-Based Credit System (CBCS) for flexibility
- A range of Minor and Honors options to encourage specialization and research
- Opportunities for field engagement, internships, and experiential learning
- Emphasis on skill enhancement and future workforce needs
- Integration of ethical reasoning, social awareness, and environmental consciousness

As an institution inspired by the values of Saint John Bosco, we strive to create a joyful and inclusive learning environment that fosters creativity, curiosity, and compassion. Through this curriculum framework, we renew our pledge to produce graduates who are not only professionally competent but also committed to the greater good of society.

## 2. Vision and Mission

**Vision:**

DBIT will be known to have an innovative, enjoyable, and holistic learning environment that transforms individuals into socially conscious citizens the Don Bosco way, and will lead in research and entrepreneurship in the area of sustainable technologies.

**Mission:**

1. To create future engineers who work with honesty and integrity and excel in the use of technology for the benefit of the underprivileged.

2. To train engineers to be innovative problem-solvers and entrepreneurs who engage in research and lifelong learning.

3. To provide a diverse and stimulating environment for staff and students to grow holistically.

## 3. Curriculum Design Philosophy

The curriculum is structured in alignment with the National Education Policy (NEP) 2020 and UGC guidelines. It follows a top-down approach wherein the institutional Vision and Mission guide the Program Educational Objectives (PEOs) and Program Outcomes (POs). These shapes the Course Outcomes (COs) and form the foundation for the course structure, the delivery, and the assessments.

**Key design principles include:**

- Emphasis on Outcome-Based Education (OBE) with clear mappings of COs to POs
- Integration of core technical knowledge with interdisciplinary electives
- Inclusion of vocational skills, internships, and community engagement
- Development of entrepreneurship and research aptitude through minor and honors pathways
- Encouragement of ethical, sustainable, and socially responsible engineering practices

This approach ensures that the curriculum remains academically rigorous, industry-relevant, and value-driven.

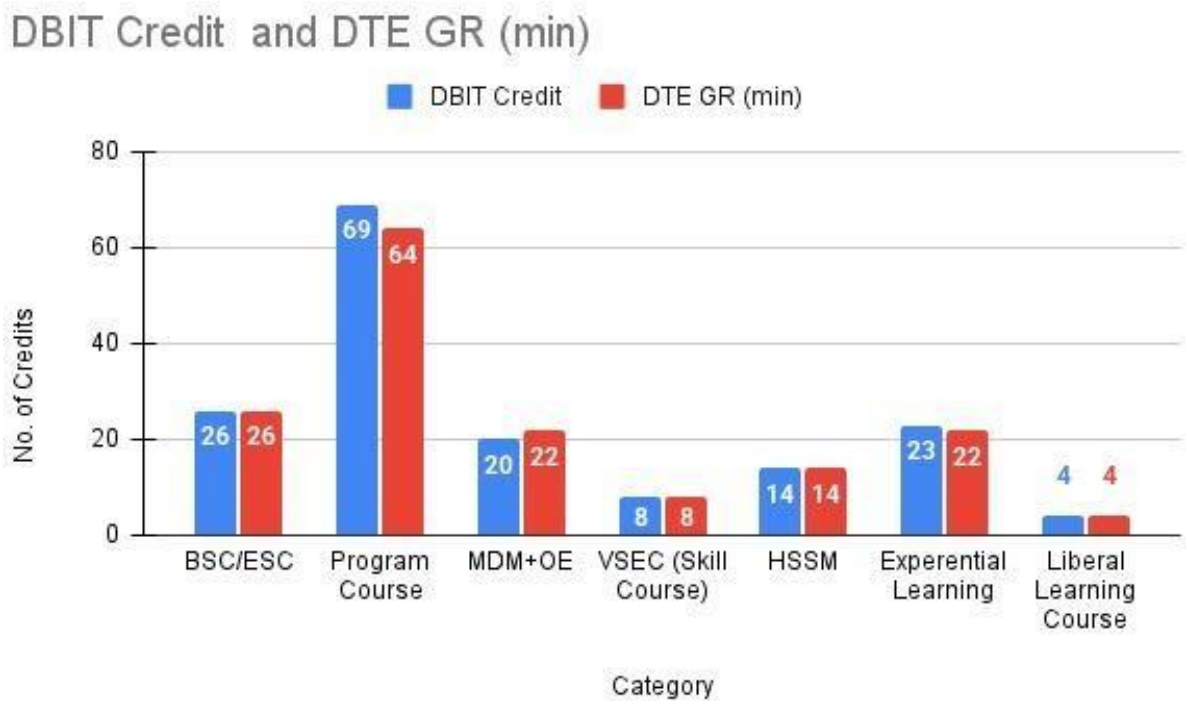
## 4. Credit Guidelines and Allocation

The curriculum is delivered through a structured credit system as follows:

| Activity Type | Credit Definition |
|---|---|
| Theory Course | 1 Credit = 15 Contact Hours |
| Laboratory / Studio / Workshop | 1 Credit = 30 Contact Hours |
| Internship / Field Work | 1 Credit = 40 Hours or 02 weeks |
| Seminar / Group Discussions | 1 Credit = 15 Hours |
| Community Engagement / Field Project | 1 Credit = 30 Hours |

## DBIT Overall Curriculum Credit Structure

| Semester | | I | II | III | IV | V | VI | VII | VIII | Total Credits | DTE Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course | BSC/ESC | 9 | 6 | | | | | | | 15 | 14-18 |
| Engineering Science Course | | 7 | 4 | | | | | | | 11 | 12 - 16 |
| Programme Core Course (PCC) | Program Courses | | 3 | 16 | 14 | 6 | 6 | 6 | | 51 | 44-56 |
| Programme Elective Course (PEC) | | | | | | 3 | 3 | 6 | 6 | 18 | 20 |
| Multidisciplinary Minor (MD M) | Multidisciplinary Courses | | | | 3 | 4 | 4 | 3 | | 14 | 14 |
| Open Elective (OE) Other than a particular program | | | | | 2 | 2 | | 2 | | 6 | 8 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 3 | 3 | 2 | | | | | | 8 | 8 |
| Ability Enhancement Course (AEC -01, AEC-02) | Humanities Social Science and Management (HSSM) | | 2 | | | 2 | | | | 4 | 4 |
| Entrepreneurship/Economics/ Management Courses | | | | | 2 | | 2 | | | 4 | 4 |
| Indian Knowledge System (IKS) | | | 2 | | | | | | | 2 | 2 |
| Value Education Course (VEC) | | 2 | | 2 | | | | | | 4 | 4 |
| Research Methodology | Experiential Learning Courses | | | | | 2 | | | | 2 | 4 |
| Community. Engagement. Project (CEP)/ Field Project (FP) (Mini - Project) | | | | 1 | 1 | 1 | | | | 3 | 2 |
| Project | | | | | | | 3 | 3 | | 6 | 4 |
| Internship/ OJT | | | | | | | | | 12 | 12 | 12 |
| Co-curricular Courses (CC) | Liberal Learning Courses | | 1 | | 1 | | 1 | | 1 | 4 | 4 |
| **Total Credits (Major)** | | **21** | **21** | **21** | **23** | **20** | **19** | **20** | **19** | **164** | **160- 176** |



## 5. Degree Options and Exit Pathways

Students are offered flexible learning pathways through the following options:

**Undergraduate Degree Options:**

- B.E with MDM – Minimum 164 credits
- B.E with Double Minor/ Honors – 182 credits
- B.E Research with Research – 182 credits

**Multiple Entry-Exit Options (Aligned with NEP 2020):**

| Exit Options | Credits Structure |
|---|---|
| Certificate after Year 1: | 42 Credits + 08 credits (04 credit Exit Course + 04 Summer internship). |
| Diploma after Year 2: | 86 credits + 08 credits (04 credit Exit Course + 04 Summer internship). |
| B. Vocational Degree after Year 3: | 125 credits + 08 credits (04 credit Exit Course + 04 Summer internship). |

Credits earned are banked in the Academic Bank of Credits (ABC) for lifelong learning flexibility.

## Abbreviations Used:

| | |
|---|---|
| AEC | Ability Enhancement Course |
| AEL | Ability Enhancement Laboratory |
| BSC | Basic Science Course |
| BSL | Basic Science Laboratory |
| CEP | Community Engagement Project |
| CC | Co-curricular Courses |
| CIE | Continuous Internal Evaluation |
| EEM | Entrepreneurship, Economics and Management |
| ELC | Experiential Learning Courses |
| ESC | Engineering Science Course |
| ESE | End Semester Examination |
| ESL | Engineering Science Laboratory |
| FP | Field Project |
| HSSM | Humanities Social Science and Management |
| IKS | Indian Knowledge System |
| L | Lecture |
| LLC | Liberal Learning Courses |
| MDM | Multidisciplinary Minor |
| MSE | Mid Semester Exam |
| OE | Open Elective |

| | |
|---|---|
| OJT | On Job Training |
| P | Practical |
| PCC | Program Core Course |
| PCL | Program Core Laboratory |
| PEC | Program Elective Course |
| T | Tutorial |
| VEC | Value Education Course |
| VSEC | Vocational and Skill Enhancement Course |

# Curriculum Scheme and Structure: Semester I

| Semester I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Vertical** | **Course Name** | **Teaching Scheme (Contact Hours)** | | | **Credits Assigned** | | |
| | | | **L** | **P** | **T** | **L** | **P** | **T** | **TOTAL** |
| 25FE1BSC01 | BSC | Fundamentals of Engineering Mathematics –I | 3 | - | 1 | 3 | - | 1 | **4** |
| 25FE1BSC02 | BSC | Applied Physics | 2 | 1 | - | 2 | 0.5 | - | **2.5** |
| 25FE1BSC03 | BSC | Engineering Chemistry | 2 | 1 | - | 2 | 0.5 | - | **2.5** |
| 25FE1ESC01 | ESC | Engineering Graphics | 2 | 2 | - | 2 | 1 | - | **3** |
| 25FE1ESC02 | ESC | Basic Electrical and Digital Electronics | 3 | 2 | - | 3 | 1 | - | **4** |
| 25FE1VSEC01 | VSEC | Workshop – I | - | 2 | - | - | 1 | - | **1** |
| 25FE1VSEC02 | VSEC | Problem Solving using C programming | - | 2*+ 2 | - | - | 2 | - | **2** |
| 25FE1VEC01 | VEC | Universal Human Values | 2 | - | - | 2 | - | - | **2** |
| | | **Total** | **14** | **12** | **1** | **14** | **6** | **1** | **21** |

* Two hours of demo/discussion for entire class

# Examination Marking Scheme: Semester I

| Semester I | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Vertical** | **Course Name** | **Examination Mark** | | | | | |
| | | | **CA** | **MSE** | **ESE** | **TW** | **OR/PR** | **Total** |
| 25FE1BSC01 | BSC | Fundamentals of Engineering Mathematics –I | 20 | 30 | 50 | 25 | - | **125** |
| 25FE1BSC02 | BSC | Applied Physics | 20 | 30 | 50 | 25 | - | **125** |
| 25FE1BSC03 | BSC | Engineering Chemistry | 20 | 30 | 50 | 25 | - | **125** |
| 25FE1ESC01 | ESC | Engineering Graphics | 20 | 30 | 50 | 25 | - | **125** |
| 25FE1ESC02 | ESC | Basic Electrical and Digital Electronics | 20 | 30 | 50 | 25 | 25 | **150** |
| 25FE1VSEC01 | VSEC | Workshop-I | 50 | - | - | - | - | **50** |
| 25FE1VSEC02 | VSEC | Problem Solving using C Programming | 25 | - | - | - | 25 | **50** |
| 25FE1VEC01 | VEC | Universal Human Values | 50 | - | - | - | - | **50** |
| **Total** | | | **225** | **150** | **250** | **125** | **50** | **800** |

# Assessment Methodology

| Types of Courses | Assessment Tools | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>Any two Pedagogies (10 marks each)<br>MCQ /Class Test<br>Case study/Assignment<br>GATE based Tutorial<br>MOOCs Certification (Approved by instructor)<br>Open Book Test<br>Working model/simulation of a course-based concept. |
| **Theory** | **CA-25** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>Active Participation and Timely Submission of Laboratory and Programming Assignments ( 5 Marks)<br>OR<br>Any two Pedagogies (10 marks each) and Active Participation and Timely Submission of Laboratory and Programming Assignments (5 Marks)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model / simulation of a course-based concept. |
| **Theory (VEC)** | **CA-50** | • Active Participation = 5 marks<br>• MCQ /Class Test= 10 marks<br>• Instructor Assessment of the Activity carried out by student for 25 marks<br>• Assignment = 10 marks |
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

| | | |
|---|---|---|
| **Liberal Learning Courses (LLC)** | **CA-50** | • Active Participation = 5 marks<br>• Assessment of the Activity carried out by student = 25 marks<br>• Cultural Event Participation = 10 marks<br>• Technical Event Participation = 10 marks |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Laboratory Report = 10 marks<br>• Laboratory performance = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work |
| **Tutorial** | **TW-25** | Active Participation = 5 marks<br>Tutorial Submission = 20 marks<br>• Tutorial based on the entire Syllabus |
| **Laboratory** | **OR-25** | Oral examination will be based on the entire syllabus. |
| **Laboratory** | **PR-25** | Practical examination will be based on the experiments performed by the students during laboratory sessions. |
| | | |

## Weightage of COs across all Assessments:

| Course Outcomes | Percentage |
|---|---|
| **CO-1, CO-2** | **20-30** |
| **CO-3, CO-4** | **40-50** |
| **CO-5, CO-6** | **20-30** |

*Note: Total Weightage of All CO's should be 100%

## Heads of Passing

a. Passing Criteria for Theory Course: 40% maximum marks in CA, MSE, ESE taken together
b. Passing Criteria for Laboratory/Tutorial (Term Work): 40% of maximum marks
c. Passing Criteria for Oral/Practical (Term Work): 40% of maximum marks

1. **Course Vertical-BSC-Fundamentals of Engineering Mathematics-I**

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | **L** | **P** | **T** | **L** | **P** | **T** | **Total** |
| 25FE1BSC01 | Fundamentals of Engineering Mathematics -I | 3 | - | 1 | 3 | - | 1 | 4 |
| | | **Examination Scheme** | | | | | | |
| | | **CA** | **MSE** | **ESE** | **TW** | **OR** | **PR** | **Total** |
| | | **Theory** | 20 | 30 | 50 | - | - | - | 100 |
| | | **Lab/Tut** | **-** | **-** | **-** | **25** | **-** | **-** | **25** |
| | | **Total** | **125** | | | | | |

**Course Objectives:**

1. To develop a strong foundation in complex numbers and successive differentiation for engineering applications.

2. To be able to apply the principles of partial differentiation & vector calculus for modelling physical phenomena

3. To use matrix algebra for solving systems of linear equations and understand their applications in engineering.

4. To evaluate and implement numerical methods for obtaining more precise approximate solutions to equations and systems.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, the students will be able to | |
| | CO1 | Recall key definitions and properties of complex numbers, functions, matrices, and differentiation, scalar and vector fields. |
| | CO2 | Explain the physical meaning of complex functions, partial and higher derivatives, and gradients, system of Linear Equations, divergence and curl. |
| | CO3 | Use De Moivre's for roots, Chain Rule for partials, Leibnitz for nth derivatives, separation of real & imaginary parts for deductions, irrational fields for work, Taylor for expansions, partials for extrema, matrix forms for rank and numerical methods.(Applying) |
| | CO4 | Analyze Euler's Theorem for deductions, higher-derivative patterns, solutions of linear systems, and polynomial roots via De Moivre's theorem. (Analyzing) |
| | CO5 | Assess, Compare and Identify methods for nth derivatives, matrix inverses, numerical algorithms (bisection, Newton–Raphson, Regula–Falsi, Gauss–Seidel, and Gauss–Jacobi) for convergence, accuracy and efficiency (Evaluating). |
| | CO6 | Design and implement mathematical models and numerical algorithms in SCILAB/Python/ C to simulate and validate engineering solutions. |

**Syllabus:**

| Module | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Complex Numbers and its Functions** | |
| | 1.1 | Review of Complex Numbers-Algebra of Complex Numbers, Cartesian, polar and exponential form of complex number, Statement of De Moivre's Theorem. | 12 |
| | 1.2 | Expansion of sin ^n θ, cos^n θ in terms of sines and cosines of multiples of θ and Expansion of sin(nθ), cos(nθ) in powers of sin(θ), cos(θ). | |
| | 1.3 | Powers and Roots of a complex number. | |
| | 1.4 | Complex functions: Circular, Hyperbolic, Inverse Hyperbolic Functions, Logarithm of Complex Number. Separation of real and imaginary parts of all types of Functions | |
| | Self-Learning Topics | Representing roots of complex numbers on Argand's plane | |
| **2** | | **Successive differentiation and Expansion of functions** | |
| | 2.1 | Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem | 6 |
| | 2.2 | Taylor's Theorem and Taylor's series, Maclaurin's series.<br>Expansion of exp(x), sin(x), cos(x), tan(x), sinh(x), cosh(x),tanh(x), log(1+x). | |
| | Self-Learning Topics | Indeterminate forms, L- Hospital Rule. | |
| **3** | | **Partial Differentiation and its Application** | |
| | 3.1 | Partial Differentiation: Functions of two and three variables, Partial derivatives of first and higher orders. Differentiation of composite functions (Chain rule) | 8 |
| | 3.2 | Euler's Theorem on Homogeneous functions for 2 and 3 variables (without proof); Deductions from Euler's Theorem (without proof) | |
| | 3.3 | Maxima and Minima of a function of two independent variables | |
| | Self-Learning Topics | Applications of partial differentiation in weather modeling, wave equation, sensitivity analysis | |
| **4** | | **Matrices** | |
| | 4.1 | Types of Matrices (Hermitian, Skew Hermitian, Unitary, Orthogonal Matrices) | 8 |

| | | | |
|---|---|---|---|
| | 4.2 | Rank of a Matrix: using Echelon form, reduction to normal form, and PAQ form | |
| | 4.3 | System of homogeneous and non - homogeneous equations, their consistency, and solutions | |
| | 4.4 | Solutions of Systems of Linear Equations using Gauss elimination and Gauss-Jordan methods | |
| | Self-Learning Topics | Properties of matrices, Applications of matrices in Coding theory, Circuit analysis, signal processing, computer graphics, data transformation | |
| **5** | | **Introduction to Vector Calculus**<br>**Prerequisite:** Dot and Cross products of vectors | |
| | 5.1 | Scalar and Vector Fields; Gradient of a scalar field | 6 |
| | 5.2 | Directional Derivative of a scalar point function and its maximum rate of change | |
| | 5.3 | Divergence and Curl of a vector field, Solenoidal and irrotational (conservative) vector fields. | |
| | 5.4 | Physical significance of vector calculus in Engineering | |
| | Self-Learning Topics | Applications in Fluid flow, Electromagnetic waves, Control systems, Signal Processing and Machine Learning | |
| **6** | | **Numerical Methods** | |
| | 6.1 | Solution of Transcendental Equations: Solutions by Bisection, Newton Raphson and Regula –Falsi methods | 5 |
| | 6.2 | Gauss Jacobi and Gauss Seidel methods to solve System of Linear Equations | |
| | 6.3 | Engineering Applications of numerical methods | |
| | Self-Learning Topics | Applications in structural engineering, work done and energy calculations | |
| | | **TOTAL** | 45 |

**Text Books:**


1. B S Grewal [2017] *Higher Engineering Mathematics*, Khanna Publishers.
2. B V Ramana [2009] *Higher Engineering Mathematics*, Mc Graw Hill Publications
3. N.P. Bali [2007] *Engineering Mathematics*, Laxmi Publication 8th edition.

**Reference Books:**

1. Kreyszig, Erwin 10thEd [2011] *Advanced Engineering Mathematics,* New Delhi Wiley Eastern Limited.

2. D.G. Zill and M.R. Cullen, III ed. 3rd reprint [2009] *Advanced Engineering Mathematics*, Narosa Publications

3. Spiegel, Murray R [C1974] *Theory And Problems Of Vector Analysis And An Introduction to Tensor Analysis*, McGraw-Hill Book Company

**Useful Links:**

1. **https:**//nptel.ac.in/courses/111105121 (**Engineering Mathematics - I, IIT Kharagpur**)
2. https://nptel.ac.in/courses/111105167 (**Advanced Engineering Mathematics, IIT Kharagpur**)

**Tutorials:** Students are expected to complete a minimum of 08 to 12 tutorials conducted batch-wise. Active participation, initiative, and creative engagement in all tutorials are expected.

| **Tut. No.** | **Suggested Tutorial Topics** |
|---|---|
| 1 | Complex Numbers |
| 2 | Hyperbolic and circular Functions |
| 3 | Logarithmic and Inverse Functions |
| 4 | Successive Differentiation & Taylor's Series |
| 5 | Partial Differentiation |
| 6 | Euler's Theorem and application of Partial differentiation |
| 7 | Rank of a Matrix using Echelon form, reduction to Normal form, and PAQ form |
| 8 | Solving System of Linear Equations using Matrices |
| 9 | Directional Derivative, Solenoidal and irrotational fields |
| 10 | Solving System of Linear Equations using Numerical Methods |
| 11 | **SCILAB/Python/C**:<br>(i) Basic operations and in-built functions on matrices, defining functions and understanding loops<br>(ii) Gauss Elimination Method<br>(iii) Gauss Seidal Iteration method<br>(iv) Gauss Jacobi Iteration Method |
| 12 | **SCILAB/Python/C**:<br>(i)Newton Raphson Method<br>(ii) Regula –Falsi method |

| | |
|---|---|
| | (iii) Bisection Method. |

**Assessment Methodology:**

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>Any two Pedagogies (10 marks each)<br>MCQ /Class Test<br>Case study/Assignment<br>GATE based Tutorial<br>MOOCs Certification (Approved by instructor)<br>Open Book Test<br>Working model/simulation of a course-based concept. |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Tutorial** | **TW-25** | • Active Participation = 5 marks<br>• Tutorial Submission = 20 marks<br>Tutorial based on the entire syllabus |

## 2. Course Vertical -BSC- Applied Physics

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="5">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="7">25FE1BSC02</td><td rowspan="7">Applied Physics</td><td colspan="2">L</td><td>P</td><td>T</td><td colspan="2">L</td><td>P</td><td>T</td><td>TOTAL</td></tr>
<tr><td colspan="2">2</td><td>1</td><td>-</td><td colspan="2">2</td><td>0.5</td><td>-</td><td>2.5</td></tr>
<tr><td colspan="9">Evaluation Scheme</td></tr>
<tr><td></td><td>CA</td><td>MSE</td><td>ESE</td><td>TW</td><td>OR</td><td>PR</td><td colspan="2">Total</td></tr>
<tr><td>Theory</td><td>20</td><td>30</td><td>50</td><td>-</td><td>-</td><td>-</td><td colspan="2">100</td></tr>
<tr><td>Lab/Tut</td><td>-</td><td>-</td><td>-</td><td>25</td><td>-</td><td>-</td><td colspan="2">25</td></tr>
<tr><td>Total</td><td colspan="8">125</td></tr>
</table>

**Course Objectives:**

1. To introduce the principles of modern optics, including lasers and optical fibers, and their applications in communication and sensing technologies.
2. To develop an understanding of wave optics and quantum physics concepts, enabling analysis of interference, diffraction, and quantum behavior of particles.
3. To provide knowledge of semiconductor physics and the operation of basic electronic devices such as diodes and transistors, essential for electronics and instrumentation.
4. To familiarize students with electromagnetic theory using vector calculus and Maxwell's equations, and to explore the fundamentals and applications of various sensors in real-world systems.

| **Course Outcomes** | **After successful completion, the students will be able to** |
|---|---|
| | CO1 Identify and describe fundamental principles of wave optics, lasers & fiber optics, quantum, semiconductor, sensors and electrodynamics. (Remembering) |
| | CO2 Explain the physical laws and mechanisms governing wave optics, lasers & fiber optics, quantum, semiconductor, sensors and electrodynamics. (Understanding) |
| | CO3 Use physics to calculate solutions for engineering problems in optics, quantum mechanics, and semiconductors. (Applying) |
| | CO4 Analyze physical systems, identifying key components, relationships, in the context of wave optics, lasers, fiber optics, quantum mechanics, semiconductor physics, sensors, and electrodynamics. (Analyzing) |
| | CO5 Assess and justify the best physics-based solutions for engineering problems, considering their limitations and impacts within optics, quantum mechanics, semiconductors, and sensing. (Evaluating) |
| | CO6 Design a simple experiment or model to demonstrate a basic physics principle related to optics, quantum mechanics, or sensors. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Lasers & Fiber optics** | |
| | 1.1 | Laser: Einstein's coefficients, spontaneous and stimulated emission, types of pumping, population inversion. | 5 |
| | 1.2 | Resonant cavity and amplification of light, 3 & 4 level lasers. | |
| | 1.3 | Helium Neon (He-Ne) laser. | |
| | 1.4 | Optical fiber: Types of fibres and materials used, modes in fiber, expression for acceptance angle and numerical aperture. | |
| | 1.5 | Normalized frequency (‘V’ number), optical communication system. | |
| | Self-Learning Topics: Properties of laser, applications of laser, semiconductor laser, total internal reflection (TIR), and construction of an optical fiber. | | |
| **2** | | **Wave Optics** | |
| | 2.1 | Interference: Parallel thin film (reflected system). | 5 |
| | 2.2 | Fringe width by wedge shaped film. | |
| | 2.3 | Newton’s rings and applications, anti-reflection coating. | |
| | 2.4 | Diffraction: Fraunhofer diffraction at single slit. | |
| | 2.5 | Resolving power of a grating, determination of wavelength of laser light using plane transmission grating. | |
| | Self-Learning Topics: Parallel thin film (transmitted system), polarization, Fresnel & Fraunhofer diffraction, diffraction grating. | | |
| **3** | | **Quantum Physics** | |
| | 3.1 | Concept of wave function and probability density, physical significance of wave function. | 5 |
| | 3.2 | Eigenfunction and Eigenvalue, Heisenberg’s Uncertainty Principle (HUP). | |
| | 3.3 | Schrodinger’s wave equation in 1D: Time dependent equation (TDSWE) and time independent equation (TISWE). | |
| | 3.4 | Particle in a 1D potential well (rigid box). | |
| | 3.5 | Basics of quantum computing. | |
| | Self-Learning Topics: Wave particle duality, de Broglie wavelength, matter waves. | | |
| **4** | | **Semiconductor Physics** | |
| | 4.1 | Fermi Dirac statistics, Fermi level in intrinsic & extrinsic semiconductors, variation of Fermi level with doping (concentration) and temperature. | 6 |
| | 4.2 | Hall Effect and its applications. | |
| | 4.3 | Fermi Level in P-N Junction in biased and unbiased conditions, Zener diode and its application as voltage regulator. | |
| | 4.4 | BJT, common emitter configuration and characteristics. | |
| | 4.5 | Transistor as a switch, introduction to FET & MOSFET. | |

| | | | |
|---|---|---|---|
| | Self-Learning Topics: Types of semiconductors, P-N Junction diode, LED, solar cell, diodes. | | |
| **5** | | **Electrodynamics** | |
| | 5.1 | Operator 'del', Physical significance of gradient & divergence in Cartesian coordinate system. | |
| | 5.2 | Physical significance of Curl. | |
| | 5.3 | Fundamental theorems for gradient & divergence. | 5 |
| | 5.4 | Fundamental theorems for curl (Stoke's theorem), displacement current, continuity equation. | |
| | 5.5 | Maxwell's equations in free space (differential and integral forms). | |
| | Self-Learning Topics: Scalar and Vector fields, Gauss's law for electrostatics, Faraday's Law and Ampere's law. | | |
| **6** | | **Physics of Sensors** | |
| | 6.1 | Resistive sensors: PT100 (temperature), strain gauge (deformation); | 4 |
| | 6.2 | Temperature sensor: Thermocouple (J-type and K-type); Humidity sensor (hygrometer). | |
| | 6.3 | Pressure sensor: Concept of pressure sensing by capacitive, flex (bending) and inductive method. Piezoelectric transducers and its use as ultrasonic generators. | |
| | 6.4 | Optical sensor: Photodiode; Pyroelectric sensor for IR; Thermal radiation sensor: Bolometer. | |
| | Self-Learning Topics: Principle of sensors, application of different types of sensors, ultrasonic transducer for distance measurement (in liquid or air) velocity measurement, concept of photodiode. | | |
| | | **TOTAL** | **30** |

**List of Experiments of which minimum of 5 experiments should be completed.**

| Sr. No | Module | Experiment |
|---|---|---|
| 1 | Wave Optics | Measurement of wavelength of sodium light using a wedge shaped film. |
| 2 | Wave Optics | Determination of radius of curvature of a plano convex lens using Newton's rings. |
| 3 | Laser | Determination of Laser wavelength using diffraction grating. |
| 4 | Fiber optics | Determination of numerical aperture & acceptance angle of an optical fiber. |
| 5 | Semiconductor Physics | Estimation of the energy band gap of a semiconductor material. |
| 6 | Semiconductor Physics | Measurement of hall voltage using Hall Effect apparatus. |
| 7 | Semiconductor Physics | Analysis of the forward & reverse biased characteristics of a P-N junction diode. |

| | | |
|---|---|---|
| 8 | Semiconductor Physics | Study of the I-V characteristics of a photodiode. |
| 9 | Quantum Physics | Determination of planck's constant using a photocell setup. |
| 10 | Physics of Sensors | Calibration and Use of a PT100 Sensor for temperature measurement. |
| 11 | Physics of Sensors | Measurement of the distance between two surfaces using an ultrasonic distance metre. |

**Text Books:**


1. A Textbook of Engineering Physics – Avadhanulu & Kshirsagar (S. Chand)
2. Engineering Physics – R. K,. Gaur, S.L. Gupta, Dhanpatrai Publications.
3. Engineering Physics - Uma Mukherji - Alpha Science International Ltd.
4. Engineering Physics Laboratory Manual - Jayaraman et al, Pearson Education India.


**Reference Books:**


1. Optics - Ajay Ghatak, Tata McGraw Hill.
2. Handbook of Modern Sensors Physics design and application- Jacob Fraden, Springer, AIP press.
3. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication.


**Useful Links:**

1. https://nptel.ac.in/courses/115102124
2. https://nptel.ac.in/courses/122106034
3. https://nptel.ac.in/courses/104104082

## Assessment Methodology

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | • Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>• Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model/simulation of a course-based concept. |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory. |

| | | |
|---|---|---|
| | | • Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Laboratory Report = 10 marks<br>• Laboratory performance = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work |

## 1. Course Vertical -BSC- Engineering Chemistry

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="6">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="6">25FE1BSC03</td><td rowspan="6">Engineering Chemistry</td><td colspan="3">L</td><td colspan="2">P</td><td>T</td><td>L</td><td>P</td><td>T</td><td>TOTAL</td></tr>
<tr><td colspan="3">2</td><td colspan="2">1</td><td>-</td><td>2</td><td>0.5</td><td>-</td><td>2.5</td></tr>
<tr><td colspan="10">Evaluation Scheme</td></tr>
<tr><td></td><td>CA</td><td>MSE</td><td>ESE</td><td>TW</td><td>OR</td><td>PR</td><td colspan="3">Total</td></tr>
<tr><td>Theory</td><td>20</td><td>30</td><td>50</td><td>-</td><td>-</td><td>-</td><td colspan="3">100</td></tr>
<tr><td>Lab/Tut</td><td>-</td><td>-</td><td>-</td><td>25</td><td>-</td><td>-</td><td colspan="3">25</td></tr>
<tr><td>Total</td><td colspan="9">125</td></tr>
</table>

**Course Objectives:**

1. To build a strong understanding of chemistry concepts to help students solve practical problems in various engineering areas.
2. To explore the essential principles governing material properties, chemical reactions, and environmental factors that influence engineering systems.
3. To apply chemical knowledge and analytical thinking to address challenges involving materials, energy sources, environmental processes, and system performance.
4. To develop data interpretation skills for recognizing trends and insights across various chemical and engineering applications.
5. To foster creativity in designing effective and sustainable solutions by integrating interdisciplinary knowledge from chemistry and engineering.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, students will be able to | |
| | CO1 | Recall core concepts in alloys, nanomaterial's, ceramics, and composites, water quality parameters, fuel properties, corrosion mechanisms, electrochemical principles, and the relevant chemistry used in engineering applications. |
| | CO2 | Explain the role and significance of advanced and high performance materials, water treatment processes, fuel combustion behaviour, corrosion control methods, electrochemical reactions, and the chemical principles that govern their behaviour and performance. |
| | CO3 | Apply chemistry knowledge to address challenges in selecting advanced materials, water purification, fuel efficiency, and corrosion prevention for industrial use. |
| | CO4 | Analyze chemical data and solve problems related to material properties, water chemistry, fuel characteristics, and corrosion behavior to infer their suitability and performance in engineering applications. |

| | | |
|---|---|---|
| | CO5 | Evaluate the chemical properties, performance reliability of engineering materials, water treatment technologies, fuel types, and corrosion protection methods in various engineering applications. |
| | CO6 | Design sustainable engineering solutions by applying concepts from materials, water, fuels, and corrosion and present them through reports, models, or simulations |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Water** | |
| | 1.1 | Water Quality Assessment Parameter- Types of Hardness: Temporary and Permanent hardness. Disadvantages of using Hard water in industries | 5 |
| | 1.2 | Numerical on Total hardness. Introduction to Hardness Measurement Technique - EDTA titration method-Principle and Reactions. | |
| | 1.3 | Softening Techniques: Ion exchange method - Principle and Reactions, Advantages and Applications. Numerical on Ion exchange method. | |
| | 1.4 | Water Purification Technologies: Reverse Osmosis (RO) - Working Principle, Advantages and Applications. | |
| | **Self-Learning Topics:** General Water Quality Assessment Parameters, Methods of Water Disinfection: Ultraviolet Treatment. | | |
| **2** | | **Corrosion** | |
| | 2.1 | Introduction to Corrosion: Definition and significance.<br>Types of Corrosion: a) Dry (chemical) Corrosion-Concept of stability of oxide films, b) Wet (electrochemical) Corrosion-Mechanism of Electrochemical Corrosion | 6 |
| | 2.2 | Factors affecting Corrosion Rate: Humidity, Position of metal in Galvanic series, pH, Temperature, Relative area of cathode to anode, Presence of Impurities.<br>Factors contributing to corrosion in electronic devices. | |
| | 2.3 | Different forms of Corrosion: Galvanic corrosion, Differential Aeration corrosion, Intergranular Corrosion. | |
| | 2.4 | Corrosion Prevention:<br>Non-Metallic Coatings-Acrylic, Epoxy.<br>Anti-Rust Lubricant- Definition of Lubricant and Acid Value of Oil and Its Significance, Numerical on Acid Value, Corrosion Inhibitors in Engine Oils.<br>Metallic Protective Coatings: Differences Between Galvanization and Tinning. Surface Treatment- Anodizing. | |
| | 2.5 | Cathodic Protection: Principle and Application of Sacrificial anode and Impressed Current Systems | |

| | | | |
|---|---|---|---|
| | **Self-Learning Topics:** Introduction to Electrochemistry, Corrosion Control Techniques based on Design considerations, Material selection and modification | | |
| **3** | | **Polymers** | |
| | 3.1 | Introduction to Polymers, Important properties of Polymers: Average Molecular Weight, Numerical on Average Molecular Weight. | 6 |
| | 3.2 | Important Properties of Polymers: Glass Transition Temperature (Tg), Viscoelasticity, Factors Affecting Glass Transition Temperature and Melting Temperature (Tm). Significance | |
| | 3.3 | Advanced Polymers: Types, Properties, Applications of a) Smart Polymers, b) Conducting Polymers c) Biopolymers | |
| | 3.4 | Classification of Polymers as Thermosetting and Thermoplastic Polymers Introduction to the Compounding of Polymers, Fabrication and Molding Techniques of Polymers: Injection, Compression. | |
| | **Self-Learning Topics**: Overview of Polymer Classification, Fabrication Methods - Extrusion Process | | |
| **4** | | **Alloys and Application of Spectroscopy in Metal Analysis.** | |
| | 4.1 | Introduction to Alloys, Different types of Ferrous alloys - Plain Carbon Steels-Composition, Properties and Applications<br>Special effects of alloying elements on steel - Cr, Ni, W, Co, V. | 4 |
| | 4.2 | Introduction To Shape Memory Alloys and Its Applications. | |
| | 4.3 | Spectroscopic Determination of Metals from Metal Ion Solutions- Definition of spectroscopy, Principle of Atomic Absorption Spectroscopy (AAS) and Colorimetric methods- Beer-Lambert's Law, Numerical on Beer-Lambert's Law | |
| | **Self-Learning Topics**. Purpose of making alloys, Composition, properties and uses of Duralumin, German silver. | | |
| **5** | | **Fuels and Energy Storage Technologies** | |
| | 5.1 | Solid Fuels: Concept Of Calorific Value and Its Significance. Introduction to Proximate and Ultimate Analysis. Numerical On Calorific Value and Proximate Analysis | 5 |
| | 5.2 | Numerical on Combustion Analysis of Solid Fuel. | |
| | 5.3 | Liquid Fuels: Octane Number, Cetane Number, Knocking and Anti-Knocking Agents.,Unleaded Petrol and Oxygenates. | |
| | 5.4 | Use of Catalytic converter. Bio diesel-Definition, Properties and Uses. | |
| | 5.5 | Introduction to Lithium-Ion Batteries, Lithium-Polymer Batteries, their Advantages and Applications. | |
| | **Self-Learning Topics:** Fuel - Definition, Types And Characteristics Of Good Fuel, Hydrogen as a Fuel – Advantages, Limitations | | |
| **6** | | **High Performance Materials: Nanomaterials, Composites, Ceramics.** | |

| | | | |
|---|---|---|---|
| | 6.1 | Nanomaterials: Definition, Specific Properties- Surface-to-Volume Ratio, Quantum Size Effects, Optical Properties, Chemical Reactivity, Applications. Types of Nanostructured Materials.<br>Graphene: Structure and Properties | 4 |
| | 6.2 | Carbon Nanotubes: Types (SWCNTs and MWCNTs), Properties and Applications. Synthesis using Chemical Vapor Deposition (CVD). | |
| | 6.3 | Composites: Definition, Classification with Examples and Advantages. Properties and Important Application of Polymer Composites | |
| | 6.4 | Ceramics: Definition of Ceramics, Properties and Important Applications of commonly used Engineering Ceramics - Alumina, Silicon Carbide, Zirconia | |
| | **Self-Learning Topics:** Properties and Important Applications of Plywood, Concept of Bio-Composites. | | |
| | | **TOTAL** | **30** |

**Text Books:**


1. A Text book of Engineering Chemistry, 12th edition S.S Dara & Dr. S.S Umare, S Chand & Company Ltd., 2011.
2. A Text Book of Engineering Chemistry, 17th edition, P. C. Jain and Monica Jain, Dhanapat Rai Publications, New Delhi, 2018.
3. A Text Book of Engineering Chemistry, 4th edition, Shashi Chawla, Dhanpat Rai & Co. (P) Ltd. 2016.
4. Wiley's Engineering Chemistry, 2nd Edition, Dr. Shubha Ramesh et al., (Wiley India), 2013.


**Reference Books:**


1. Gowariker, V. R., Viswanathan, N. V., & Sreedhar, J.,3rd edition. *Polymer Science*. New Age International (P) Limited, 2019.
2. Callister, W. D., & Rethwisch, D. G. (2020). *Materials Science and Engineering: An Introduction*, 10th edition. Wiley
3. Text Book of Polymer Science, 4th edition, F.W. Billmeyer, John Wiley & Sons, 2007
4. Vogel's Quantitative Chemical Analysis by: J. Mendham, R.C. Denney, J.D. Barnes, Edition: 6th edition (2009) Publisher: Pearson Education


**Web Resources:**

1. https://onlinecourses.nptel.ac.in/noc24_mm42/preview
2. http://digimat.in/nptel/courses/video/113106093/L01.html
3. https://www.coursera.org/learn/corrosion
4. https://edu.rsc.org/exhibition-chemistry/nailing-corrosion-demonstrations/2000054.article

**List of Experiments**

A minimum of five experiments from the following list must be successfully completed**.**

| Sr. No. | Module | Experiment Name |
|---|---|---|
| 1 | Water | Determination of Water Hardness by using EDTA method |
| 2 | Corrosion | Corrosion Investigation of Iron Nail in Various Media |
| 3 | Fuel | Determination of Moisture in Coal |
| 4 | Alloys | Estimation of Copper by Colorimetric method |
| 5 | Polymers | Preparation of Urea Formaldehyde Resin |
| 6 | Fuel | Determination of Flash Point of Oil |
| 7 | Corrosion and Electrochemistry. | Measurement of EMF of Daniel Cell |
| 8 | Alloys | Estimation of Iron using Potentiometric Titrations |
| 9 | Water | Determination of Efficiency of Ion Exchange Resin |
| 10 | Corrosion and Fuel | Determination of Acid Value of Oil |
| 11 | Polymers | Synthesis of Biopolymer from Banana Peels |

## Assessment Methodology

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | • Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>• Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model/simulation of a course-based concept. |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes) |

| | | |
|---|---|---|
| | | • Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Laboratory Report = 10 marks<br>• Laboratory performance = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work |

## 1. Course Vertical - ESC- Engineering Graphics

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25ESC1C01 | Engineering Graphics | **L** | **P** | **T** | **L** | **P** | **T** | **TOTAL** |
| | | 2 | 2 | - | 2 | 1 | - | 3 |
| | | **Examination Scheme** | | | | | | |
| | | | **CA** | **MSE** | **ESE** | **TW** | **OR** | **PR** | **Total** |
| | | **Theory** | 20 | 30 | 50 | - | - | - | 100 |
| | | **Lab/Tut** | - | - | - | 25 | - | - | 25 |
| | | **Total** | **125** | | | | | | |

**Course Objectives:**

1. To impart and inculcate understanding of the theory of projection.

2. To enable students to improve their visualization skill, understand and interpret drawings.

3. To apply the principles of projection to represent three-dimensional objects on a two- dimensional surface.

4. To enable students to represent the internal features of a 3D object using sections that clearly depict their internal arrangement.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, students will be able to | |
| | CO1 | Recall and recognize standard drawing conventions, symbols, line types, dimensioning practices, and projection methods (orthographic, isometric) used in engineering drawings.(Remembering) |
| | CO2 | Interpreting principles of orthographic and isometric projection, sectional views, and the relationship between 2D representations and 3D objects (Understanding). |
| | CO3 | Construct engineering drawings of points, lines, planes, and solids, including orthographic projections, sectional views, and isometric representations, using appropriate tools. (Applying) |
| | CO4 | Analyze engineering drawings to identify geometric features, view relationships, and the logical sequence used in multi-view and sectional representations. (Analyzing) |
| | CO5 | Evaluate technical drawings for correctness, completeness, and clarity by verifying projections, dimensions, and adherence to BIS/ISO standards. (Evaluating) |
| | CO6 | Generate complete and accurate engineering drawings, integrating orthographic, sectional, and isometric views, to effectively communicate design intent and represent complex 3D engineering components. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Introduction to Engineering Drawing** | |
| | 1.1 | Introduction to Engineering Graphics and its significance in the Engineering domain. Types of Lines, Dimensioning Systems as per IS conventions. | 3 |
| | 1.2 | Introduction to plain and diagonal scales. | |
| | 1.3 | Engineering Curves: Basic construction of Cycloid, Involutes and Helix (cylinder only). | |
| | **Self-Learning Topics:** Problems based on Application of line & curves. | | |
| **2** | | **Projections of Points, Lines and Planes** | |
| | 2.1 | Projections of Points<br>Projections of points in any quadrants as well as resting on planes. | 6 |
| | 2.2 | Projections of Lines<br>Projections of lines inclined to both the reference planes. | |
| | | Projections of Planes<br>Projections of planes (Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular) inclined to both the Reference Planes. | |
| | **Self-Learning Topics:** Problems based on line in two different quadrants. | | |
| **3** | | **Projections of Solids** | |
| | 3.1 | Projections of solids with the axis inclined to one and both reference planes. (prism, pyramid, cylinder and cone only). Triangular, square, pentagonal & hexagonal prism and pyramids to be considered. | 6 |
| | **Self-Learning Topics:** Problems based on hollow solids | | |
| **4** | | **Sections of Solids** | |
| | 4.1 | Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to at least one reference plane (Exclude Curved Section Plane). Use change of position or Auxiliary plane method. | 4 |
| **5** | | **Orthographic Projections** | |
| | 5.1 | Orthographic Projections<br>Fundamentals of orthographic projections like concept of quadrants, observer position, horizontal, vertical and profile plane, symbol etc. Different orthographic views, First and Third angle method of projection.<br>Views of a simple machine part as per the first angle projection method recommended by I.S. | 7 |

| | | | |
|---|---|---|---|
| | 5.2 | Sectional Orthographic Projections: Fundamentals of sectional projections like concept of section plane, its representation, section lines and its features, need of sectional views, rib and web in section. Types of section and its representation. Different views of a simple machine part as per the first angle projection. | |
| | **Self-Learning Topics:** Completion of three orthographic views from any other two given views. (Missing view) | | |
| **6** | | **Isometric Views** | |
| | 6.1 | Basic concept of isometric projection like why it is called isometric, what does it represents, its need, isometric and non-isometric lines, isometric axis and isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views (Excluding sphere). | 4 |
| | **Self-Learning Topics:** Isometric view for Spherical shape objects. | | |
| **TOTAL** | | | **30** |

**List of Term-Sheets /Assignments**

| Sr. No. | List of Term-Sheets | Hours |
|---|---|---|
| 01 | Prerequisite Test<br>To draw basic geometric shapes like pentagon, hexagon and square (in different orientation). Divide a line into equal number of parts. Divide a circle into equal number of parts. (Prerequisite syllabus should not be considered for paper setting) | 02 |
| 02 | Two problems on Projection of Lines and two problems on Projection of Planes to be drawn on drawing sheet. | 02 |
| 03 | A minimum of two problems on the Projection of Solids to be drawn on the drawing sheet. Out of two problems, one should be on the prism category (includes cylinder) and other should be on the pyramid category (includes cone). | 03 |
| 04 | Minimum of two problems on Sections of Solids to be drawn on drawing sheet. Out of two problems one should be on the prism category (includes cylinder) and other should be on the pyramid category (includes cone). | 04 |
| 05 | Two problems on Isometric Projections to be drawn on drawing sheet. | 04 |

| | | |
|---|---|---|
| 06 | **Overview of Computer Graphics Covering:**<br><br>Basic information about the drafting software (CAD). Demonstrating knowledge of the theory of CAD software such as: Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.<br><br>**Customization & CAD Drawing:**<br><br>Consisting of set up of the drawing page and the printer including scale settings, setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning.<br><br>**Annotations, layering & other Functions Covering:**<br><br>Applying dimensions to objects, applying annotations to drawings, setting up and use of layers, layers to create drawings, Create, edit and use customized layers, changing line lengths through modifying existing lines (extend/lengthen). | 06 |
| 07 | Two problems on Orthographic Projections (without section) using drafting software. | 03 |
| 08 | Two problems on Orthographic Projections (with section) using drafting software. | 03 |
| 09 | Minimum two problems on Isometric Projections using drafting software. | 03 |

Students must solve a minimum of fifteen (15) questions from the problems mentioned above for the successful completion of term work.

**Text Books:**


1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd Edition: 54th Edition, 2023.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd. 51st Edition 2022.


**Reference Books:**


1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).
3. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.


**Useful Links:**

1. https://archive.nptel.ac.in/courses/112/105/112105294/
2. https://nptel.ac.in/courses/112103019
3. https://archive.nptel.ac.in/courses/112/102/112102304/

**Assessment Methodology**

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | • Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>• Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model/simulation of a course-based concept. |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO. |

| | | |
|---|---|---|
| | | • ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Drawing hall Term sheets = 10 marks<br>• Auto-cad lab Term sheets = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work |

**1. Course Vertical - ESC- Basic Electrical and Digital Electronics**

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25FE1ESC02 | Basic Electrical and Digital Electronics | L | P | T | | L | P | T | TOTAL |
| | | 3 | 2 | - | | 3 | 1 | - | 4 |
| | | Evaluation Scheme | | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| | | Theory | 20 | 30 | 50 | - | - | - | 100 |
| | | Lab | - | - | - | 25 | 25 | - | 50 |
| | | Total | 150 | | | | | | |

**Course Objectives:**

1. To teach fundamental electrical concepts, laws, and network theorems applicable to DC and AC circuits.
2. To explain the operation of single-phase and three-phase systems, electrical machines, and power backup devices.
3. To introduce number systems, binary arithmetic, logic gates, and Boolean algebra for digital circuit analysis.
4. To implement digital circuits for real-world applications.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, the students will be able to | |
| | CO1 | Recall fundamental concepts of electric circuits, machines, power systems, and digital electronics. (Remembering) |
| | CO2 | Explain the working principles of DC and AC circuits, electrical machines, batteries and logic circuits. (Understanding) |
| | CO3 | Apply network theorems, circuit laws and logic principles to solve problems in electrical and digital circuits. (Applying) |
| | CO4 | Analyze the performance of electrical circuits, machines, and digital logic systems under different input and loading conditions. (Analyzing) |
| | CO5 | Evaluate and choose the most efficient electrical circuits/devices and logic circuits for specific practical applications. (Evaluating) |
| | CO6 | Design basic electrical and digital systems for real world implementations. (Creating) |

**Syllabus**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | **DC Circuits and Network Theorems** | | **10** |
| | 1.1 | Kirchhoff's Laws, Series and Parallel DC Circuits, Voltage/Current Division Rule, Ideal and Practical Sources, Source Transformation. | |
| | 1.2 | Mesh analysis, nodal analysis | |
| | 1.3 | Network Theorems: Superposition, Thevenin, Norton, Maximum Power Transfer theorems. | |
| | **Self-Learning Topics:** Study the conversion between star and delta networks and their practical use in simplification of electrical networks. | | |
| **2** | **AC Circuits and Power Systems** | | **9** |
| | 2.1 | Sinusoidal Waveforms: RMS, Average, Peak, Phase, Frequency | |
| | 2.2 | Concept of Single-phase and Three-phase Supply | |
| | 2.3 | Effect of AC signal on R, L, C, RL, RC, RLC series and parallel circuits. | |
| | 2.4 | AC Power: Active, Reactive, Apparent Power | |
| | 2.5 | Resonance in series circuit | |
| | **Self-Learning Topics:** Resonance in parallel circuits, comparison and applications. | | |
| **3** | **Electrical Machines and Power Backup Systems** | | **5** |
| | 3.1 | DC Motors: Brushed and Brushless – Principle, Construction, Applications | |
| | 3.2 | Single-phase Induction Motors – Construction, working and Applications | |
| | 3.3 | Power Backup Systems: Inverter, UPS, SMPS – Block Diagram & Principle. | |
| | 3.4 | Batteries: Lead-acid and Lithium-ion – Construction & Characteristics | |
| | **Self-Learning Topics:** Comparison of DC Motor, Induction Motor, Inverter, UPS, Battery (Lead-acid and Li-ion) | | |
| **4** | **Number Systems and Binary Arithmetic** | | **6** |
| | 4.1 | Number Systems: Decimal, Binary, Octal, Hexadecimal | |
| | 4.2 | Conversions between Number Systems | |
| | 4.3 | Binary Arithmetic: Addition and Subtraction (Using 1's and 2's complement) | |
| | 4.4 | Introduction to Binary code, BCD Code, Gray Code and its code conversions. | |
| | **Self-Learning Topics**: Practice and understand the process of code conversion through more examples. | | |
| **5** | **Logic Gates and Boolean Algebra** | | **8** |
| | 5.1 | Logic Gates: AND, OR, NOT, NAND, NOR, XOR – Symbols and Truth Tables | |

| | | | |
|---|---|---|---|
| | 5.2 | Universal Gates: Realization of basic gates using NAND/NOR | |
| | 5.3 | Boolean Algebra – Laws, Identities, Minimization of Boolean Expressions. | |
| | 5.4 | Sum of Product (SOP) and Product of Sum(POS), K-Map Simplification (up to 4 variables), realization of circuits using logic gates. | |
| | **Self-Learning Topics**: Implement XOR, XNOR using universal gates | | |
| **6** | **Combinational Circuits and Applications** | | **7** |
| | 6.1 | Introduction to Combinational and Sequential circuits, Performance parameters of digital circuits. | |
| | 6.2 | Half Adder , Full Adder, Half Subtractor, Full Subtractor, realization of adders and subtractors using logic gates. | |
| | 6.3 | Multiplexer, Demultiplexer, Encoder, Decoder and Comparator | |
| | 6.4 | Realization of real world applications using combinational circuits. | |
| | **Self-Learning Topics**: Explore more real-life applications of combinational circuits | | |
| | | **TOTAL** | **45** |

**Suggested List of Experiments**

| Experiment Number | Title of the Experiment |
|---|---|
| 1 | Verify Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) |
| 2 | Mesh and Nodal Analysis in a resistive circuit |
| 3 | Superposition Theorem using two independent sources in resistive networks. |
| 4 | Verification of Thevenin's Theorem |
| 5 | Study of phase relationship between voltage, current and power in an RL series circuit |
| 6 | Resonance in an RLC series circuit |
| 7 | Verify truth tables of basic logic gates (AND, OR, NOT) using digital ICs |
| 8 | Realize basic gates using universal gates (NAND and NOR) |
| 9 | Implement a logic expression using universal gates (NAND/NOR) on a breadboard or simulator |
| 10 | Design and verify a Half Adder and Full Adder using logic gates |
| 11 | Study of DC Motor |
| 12 | Study of Single-phase Induction Motor |
| 13 | Perform Decimal to Binary, Octal, and Hexadecimal conversions, and vice versa |
| 14 | Perform Binary addition and subtraction using 1's and 2's complement methods |
| 15 | Multiplexer (MUX) or Decoder circuit using ICs or digital simulation |

**Text Books:**

1. D. P. Kothari and I. J. Nagrath, Basic Electrical and Electronics Engineering, 2nd edition, New Delhi, India, McGraw Hill Education.
2. R. P. Jain, Modern Digital Electronics, 4th edition, New Delhi, India, McGraw Hill Education.
3. B.L. Theraja, A Textbook of Electrical Technology, Vol. I & II, S. Chand Publication.

**Reference Books:**

1. R. Prasad, Fundamentals of Electrical Engineering, New Delhi, India: PHI Learning Pvt. Ltd.
2. D. P. Leach, A. P. Malvino, and G. Saha, Digital Principles and Applications, 8th edition, New Delhi, India: McGraw Hill Education.

**Useful Links:**

1. https://onlinecourses.nptel.ac.in/noc22_ee113/
2. https://onlinecourses.nptel.ac.in/noc25_ee45/

## Assessment Methodology:

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | • Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>• Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model/simulation of a course-based concept. |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus. |

| | | |
|---|---|---|
| | | • Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Drawing hall Term sheets = 10 marks<br>• Auto-cad lab Term sheets = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work |
| | **OR-25** | Oral examination will be based on the entire syllabus. |

## Branch: Mechanical

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="7">25FE1VSE01</td><td rowspan="7">Engineering Skills Workshop-I</td><td>L</td><td>T</td><td>P</td><td>L</td><td>T</td><td>P</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>2</td><td>-</td><td>-</td><td>1</td><td>1</td></tr>
<tr><td colspan="7">Examination Scheme</td></tr>
<tr><td></td><td>CA1</td><td>CA2</td><td>MSE</td><td>ESE</td><td colspan="2">Total</td></tr>
<tr><td>Theory</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td></tr>
<tr><td></td><td>Trade 1</td><td>Trade 2</td><td>Trade 3</td><td>Att</td><td colspan="2">Total</td></tr>
<tr><td>Lab</td><td>15</td><td>15</td><td>15</td><td>05</td><td colspan="2">50</td></tr>
</table>

**Course Objectives:**

1. To familiarize students with basic mechanical, electrical, and electronic measuring instruments and their applications in Engineering.
2. To develop practical skills in handling tools, workshop operations, assembling desktop computer systems, and executing electrical wiring projects.
3. To inculcate safety awareness and systematic procedures for installing, testing, and troubleshooting electrical and electronic systems in real-world environments.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, students will be able to | |
| | CO1 | Recall the names, functions, and safety procedures for common mechanical, electrical, and electronic tools and measuring instruments used in engineering workshops.(Remembering) |
| | CO2 | Explain the principles of operation and application of linear measuring instruments, electronic instruments (DMM, Function Generator, CRO, Power Supply), wiring accessories, and earthing/protection systems.(Understanding) |
| | CO3 | Use hand tools, measuring instruments (Vernier caliper, micrometer, DMM, CRO), wiring tools, and testing equipment to perform basic mechanical measurements, assemble a PC, and construct/test electrical wiring circuits safely.(Applying) |
| | CO4 | Analyze electrical circuits and PC hardware configurations to identify faults, troubleshoot wiring problems, and diagnose system issues using appropriate testing methods and instruments.(Analyzing) |
| | CO5 | Select appropriate tools, instruments, wiring components, and PC hardware based on technical specifications, operational requirements, and safety standards for specific workshop tasks.(Evaluating) |

| | | |
|---|---|---|
| | CO6 | Assemble a functional desktop PC, construct basic electrical wiring installations conforming to safety standards, and develop solutions for troubleshooting.(Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Trade 1: Mechanical, Electrical & Electronics Measurements** | **10** |
| | 1.1 | Measurement of linear dimensions using linear measurement tools like Vernier caliper, micrometer,Vernier height gauge. | |
| | 1.2 | Measurement of small dimensions by Optical Profile Projector | |
| | 1.3 | Setting of dimensions using precision gauge blocks (slip gauges) by Wringing process, Measurement of components deviations w.r.t. standard using mechanical comparator | |
| | 1.4 | Spirit Level for Alignment test, Feeler Gauges for Gap measurement, Thread Gauges for thread measurement | |
| | 1.5 | Introduction to Electronic Measurement Instruments<br>Basics of Measurement Instruments and concepts<br>Overview of Key Instruments | |
| | 1.6 | Power Supply<br>Types of Power Supplies, Block diagram and Functionality<br>Applications and Hands-On Exercise | |
| | 1.7 | Digital Multi-meter (DMM)<br>Introduction to DMM<br>Modes of Operation and functionality<br>Applications and Hands-On Exercise | |
| | 1.8 | Function Generator, Cathode Ray Oscilloscope (CRO)<br>Overview of Function Generators and CRO<br>Types of Function generators & its signals, CRO functions,<br>Applications and Hands-On Exercise | |
| **2** | | **Trade 2: PC Assembly** | |
| | 2.1 | Desktop Basics: Identifying components-motherboard, CPU, RAM, storage, etc. | **10** |
| | 2.2 | Assembling a PC | |
| | 2.3 | BIOS/UEFI overview and settings Hands-on: Build and boot a desktop system | |
| | 2.4 | Preparing bootable media (USB) BIOS boot settings | |
| | 2.5 | Installing Windows/Linux OS, Initial OS configuration and activation, Hands-on: OS installation practice on 2–3 different hardware configurations | |
| **3** | | **Trade 3: Electrical Wiring** | |
| | 3.1 | Introduction to Electrical Tools and Accessories | **10** |

| | | | |
|---|---|---|---|
| | | Electrical Systems and Safety Protocols: Ohm's Law and its applications, AC vs. DC systems, Personal Protective Equipment (PPE), Electrical hazards and safety measures, First aid and emergency<br>Hand Tools and Equipment: Identification and use of screwdrivers, pliers, wire cutters, etc., Drilling machines and bits, Insulation resistance testers. | |
| | 3.2 | Electrical Wiring<br>Wiring Accessories, Types of switches, sockets, MCBs, ELCBs, and distribution board, Selection criteria and installation<br>Types of Wiring Systems and wiring practices for Single-phase and three-phase circuits, Installation and techniques and Cables | |
| | 3.3 | Earthing and Protection Systems<br>Earthing Methods<br>Copper Plate earthing, pipe earthing, and rod earthing<br>Protection Devices<br>MCBs, ELCBs, RCCBs<br>Electrical Testing and Troubleshooting, Testing Procedures, Polarity, continuity, insulation, and earthing tests, Use of testing instruments: Multimeter, Megger.<br>Identifying and rectifying faults in circuits, Electrical Installations in Residential and Commercial, Industry Standards and Regulations, Regulatory Bodies and Codes | |
| | 3.4 | Practical Sessions and Hands-On Training<br>Circuit Construction, Building and testing basic circuits, installation Projects, Residential and commercial wiring installations<br>Fault Simulation, Creating and diagnosing faults in circuits, Safety Drills, Emergency response and safety protocol exercises<br>Tools and Equipment, Multi-meter, Meggers, Insulation testers. Cable cutters, strippers, crimping | |
| | 3.5 | Electrical Networks<br>House Wiring, Stair Case and Go down wiring<br>Series bulb and Extension Board wiring<br>Electrical Gadgets, Repairing of appliances like Table fan/Ceiling fan<br>Emergency extension Board and Electrical fan | |
| | | **TOTAL** | **30** |

**Text Books:**


1. "Practical Electronics for Inventors" by Paul Scherz and Simon Monk (4th Edition, McGraw-Hill Education, 2016)
2. Engineering Metrology and Measurements, Authors: N.V. Raghavendra, L. Krishnamurthy, Publisher: Oxford University Press
3. "Computer Hardware and Networking" Author: K. L. James, Publisher: Scitech Publications
4. "Electrical Wiring, Estimating and Costing", Author: S.L. Uppal and G.C. Garg, Publisher: Khanna Publishers

**Reference Books:**


1. "Fundamentals of Electrical Engineering and Technology" by BL Theraja (S. Chand Publishing)
2. PC Hardware: The Complete Reference", Author: Craig Zacker and John Rourke, Publisher: McGraw Hill Education
3. "Electrical Wiring, Maintenance and Estimating", Author: B.L. Theraja, Publisher: S. Chand Publishing


**Term Work:**
Students are expected to complete all Three trades conducted individually and batch-wise in laboratory settings.

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

## Branch: Electronics and Telecommunication

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="7">25FE1VSE01</td><td rowspan="7">Engineering Skills Workshop-I</td><td>L</td><td>T</td><td>P</td><td>L</td><td>T</td><td>P</td><td>Total</td></tr>
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<tr><td>Lab</td><td>15</td><td>15</td><td>15</td><td>05</td><td colspan="2">50</td></tr>
</table>

**Course Objectives:**

1. To familiarize students with basic mechanical, electrical, and electronic measuring instruments and their applications in Engineering.
2. To develop practical skills in handling tools, workshop operations, assembling desktop computer systems, and executing electrical wiring projects.
3. To inculcate safety awareness and systematic procedures for installing, testing, and troubleshooting electrical and electronic systems in real-world environments.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, students will be able to | |
| | CO1 | Recall the names, functions, and safety procedures for common mechanical, electrical, and electronic tools and measuring instruments used in engineering workshops.(Remembering) |
| | CO2 | Explain the principles of operation and application of linear measuring instruments, electronic instruments (DMM, Function Generator, CRO, Power Supply), wiring accessories, and earthing/protection systems.(Understanding) |
| | CO3 | Use hand tools, measuring instruments (Vernier caliper, micrometer, DMM, CRO), wiring tools, and testing equipment to perform basic mechanical measurements, assemble a PC, and construct/test electrical wiring circuits safely.(Applying) |
| | CO4 | Analyze electrical circuits and PC hardware configurations to identify faults, troubleshoot wiring problems, and diagnose system issues using appropriate testing methods and instruments.(Analyzing) |
| | CO5 | Select appropriate tools, instruments, wiring components, and PC hardware based on technical specifications, operational requirements, and safety standards for specific workshop tasks.(Evaluating) |

| | | |
|---|---|---|
| | CO6 | Assemble a functional desktop PC, construct basic electrical wiring installations conforming to safety standards, and develop solutions for troubleshooting.(Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Trade 1: Mechanical, Electrical & Electronics Measurements** | **10** |
| | 1.1 | Measurement of linear dimensions using linear measurement tools like Vernier caliper, micrometer,Vernier height gauge. | |
| | 1.2 | Measurement of small dimensions by Optical Profile Projector | |
| | 1.3 | Setting of dimensions using precision gauge blocks (slip gauges) by Wringing process, Measurement of components deviations w.r.t. standard using mechanical comparator | |
| | 1.4 | Spirit Level for Alignment test, Feeler Gauges for Gap measurement, Thread Gauges for thread measurement | |
| | 1.5 | Introduction to Electronic Measurement Instruments<br>Basics of Measurement Instruments and concepts<br>Overview of Key Instruments | |
| | 1.6 | Power Supply:<br>Types of Power Supplies, Block diagram and Functionality<br>Applications and Hands-On Exercise | |
| | 1.7 | Digital Multi-meter (DMM)<br>Introduction to DMM<br>Modes of Operation and functionality<br>Applications and Hands-On Exercise | |
| | 1.8 | Function Generator, Cathode Ray Oscilloscope (CRO)<br>Overview of Function Generators and CRO<br>Types of Function generators & its signals, CRO functions,<br>Applications and Hands-On Exercise | |
| **2** | | **Trade 2: PC Assembly** | |
| | 2.1 | Desktop Basics: Identifying components-motherboard, CPU, RAM, storage, etc. | **10** |
| | 2.2 | Assembling a PC | |
| | 2.3 | BIOS/UEFI overview and settings Hands-on: Build and boot a desktop system | |
| | 2.4 | Preparing bootable media (USB) BIOS boot settings | |
| | 2.5 | Installing Windows/Linux OS, Initial OS configuration and activation, Hands-on: OS installation practice on 2–3 different hardware configurations | |
| **3** | | **Trade 3: Electrical Wiring** | |
| | 3.1 | Introduction to Electrical Tools and Accessories | **10** |

| | | | |
|---|---|---|---|
| | | Electrical Systems and Safety Protocols: Ohm's Law and its applications, AC vs. DC systems, Personal Protective Equipment (PPE), Electrical hazards and safety measures, First aid and emergency<br>Hand Tools and Equipment: Identification and use of screwdrivers, pliers, wire cutters, etc., Drilling machines and bits, Insulation resistance testers. | |
| | 3.2 | Electrical Wiring<br>Wiring Accessories, Types of switches, sockets, MCBs, ELCBs, and distribution board, Selection criteria and installation<br>Types of Wiring Systems and wiring practices for Single-phase and three-phase circuits, Installation and techniques and Cables | |
| | 3.3 | Earthing and Protection Systems<br>Earthing Methods<br>Copper Plate earthing, pipe earthing, and rod earthing<br>Protection Devices<br>MCBs, ELCBs, RCCBs<br>Electrical Testing and Troubleshooting, Testing Procedures, Polarity, continuity, insulation, and earthing tests, Use of testing instruments: Multimeter, Megger.<br>Identifying and rectifying faults in circuits, Electrical Installations in Residential and Commercial, Industry Standards and Regulations, Regulatory Bodies and Codes | |
| | 3.4 | Practical Sessions and Hands-On Training<br>Circuit Construction, Building and testing basic circuits, installation Projects, Residential and commercial wiring installations<br>Fault Simulation, Creating and diagnosing faults in circuits, Safety Drills, Emergency response and safety protocol exercises<br>Tools and Equipment, Multi-meter, Meggers, Insulation testers. Cable cutters, strippers, crimping | |
| | 3.5 | Electrical Networks<br>House Wiring, Stair Case and Go down wiring<br>Series bulb and Extension Board wiring<br>Electrical Gadgets, Repairing of appliances like Table fan/Ceiling fan<br>Emergency extension Board and Electrical fan | |
| | | **TOTAL** | **30** |

**Text Books:**


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2. Engineering Metrology and Measurements, Authors: N.V. Raghavendra, L. Krishnamurthy, Publisher: Oxford University Press
3. "Computer Hardware and Networking" Author: K. L. James, Publisher: Scitech Publications
4. "Electrical Wiring, Estimating and Costing", Author: S.L. Uppal and G.C. Garg, Publisher: Khanna Publishers

**Reference Books:**


1. "Fundamentals of Electrical Engineering and Technology" by BL Theraja (S. Chand Publishing)
2. PC Hardware: The Complete Reference", Author: Craig Zacker and John Rourke, Publisher: McGraw Hill Education
3. "Electrical Wiring, Maintenance and Estimating", Author: B.L. Theraja, Publisher: S. Chand Publishing


**Term Work:**
Students are expected to complete all Three trades conducted individually and batch-wise in laboratory settings.

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

## Branch: Computer Engineering/ Information Technology

<table>
<tr><th colspan="2">Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td colspan="2" rowspan="7">25FE1VSE01</td><td rowspan="7">Engineering Skills Workshop-I</td><td>L</td><td>T</td><td>P</td><td>L</td><td>T</td><td>P</td><td>Total</td></tr>
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<tr><td>Theory</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td></tr>
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**Course Objectives:**

1. To familiarize students with basic mechanical, electrical, and electronic measuring instruments and their applications in Engineering.
2. To develop practical skills in handling tools, workshop operations, assembling desktop computer systems, and executing electrical wiring projects.
3. To inculcate safety awareness and systematic procedures for installing, testing, and troubleshooting electrical and electronic systems in real-world environments.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of the course, students will be able to | |
| | CO1 | Recall the names, functions, and safety procedures for common mechanical, electrical, and electronic tools and measuring instruments used in engineering workshops.(Remembering) |
| | CO2 | Explain the principles of operation and application of linear measuring instruments, electronic instruments (DMM, Function Generator, CRO, Power Supply), wiring accessories, and earthing/protection systems.(Understanding) |
| | CO3 | Use hand tools, measuring instruments (Vernier caliper, micrometer, DMM, CRO), wiring tools, and testing equipment to perform basic mechanical measurements, assemble a PC, and construct/test electrical wiring circuits safely.(Applying) |
| | CO4 | Analyze electrical circuits and PC hardware configurations to identify faults, troubleshoot wiring problems, and diagnose system issues using appropriate testing methods and instruments.(Analyzing) |
| | CO5 | Select appropriate tools, instruments, wiring components, and PC hardware based on technical specifications, operational requirements, and safety standards for specific workshop tasks.(Evaluating) |

| | | |
|---|---|---|
| | CO6 | Assemble a functional desktop PC, construct basic electrical wiring installations conforming to safety standards, and develop solutions for troubleshooting.(Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Trade 1: Mechanical, Electrical & Electronics Measurements** | **10** |
| | 1.1 | Measurement of linear dimensions using linear measurement tools like Vernier caliper, micrometer,Vernier height gauge. | |
| | 1.2 | Measurement of small dimensions by Optical Profile Projector | |
| | 1.3 | Setting of dimensions using precision gauge blocks (slip gauges) by Wringing process, Measurement of components deviations w.r.t. standard using mechanical comparator | |
| | 1.4 | Spirit Level for Alignment test, Feeler Gauges for Gap measurement, Thread Gauges for thread measurement | |
| | 1.5 | Introduction to Electronic Measurement Instruments<br>Basics of Measurement Instruments and concepts<br>Overview of Key Instruments | |
| | 1.6 | Power Supply:<br>Types of Power Supplies, Block diagram and Functionality<br>Applications and Hands-On Exercise | |
| | 1.7 | Digital Multi-meter (DMM)<br>Introduction to DMM<br>Modes of Operation and functionality<br>Applications and Hands-On Exercise | |
| | 1.8 | Function Generator, Cathode Ray Oscilloscope (CRO)<br>Overview of Function Generators and CRO<br>Types of Function generators & its signals, CRO functions,<br>Applications and Hands-On Exercise | |
| **2** | | **Trade 2: PC Assembly** | |
| | 2.1 | Desktop Basics: Identifying components-motherboard, CPU, RAM, storage, etc. | **10** |
| | 2.2 | Assembling a PC | |
| | 2.3 | BIOS/UEFI overview and settings Hands-on: Build and boot a desktop system | |
| | 2.4 | Preparing bootable media (USB) BIOS boot settings | |
| | 2.5 | Installing Windows/Linux OS, Initial OS configuration and activation, Hands-on: OS installation practice on 2–3 different hardware configurations | |
| **3** | | **Trade 3: Electrical Wiring** | |
| | 3.1 | Introduction to Electrical Tools and Accessories | **10** |

| | | | |
|---|---|---|---|
| | | Electrical Systems and Safety Protocols: Ohm's Law and its applications, AC vs. DC systems, Personal Protective Equipment (PPE), Electrical hazards and safety measures, First aid and emergency<br>Hand Tools and Equipment: Identification and use of screwdrivers, pliers, wire cutters, etc., Drilling machines and bits, Insulation resistance testers. | |
| | 3.2 | Electrical Wiring<br>Wiring Accessories, Types of switches, sockets, MCBs, ELCBs, and distribution board, Selection criteria and installation<br>Types of Wiring Systems and wiring practices for Single-phase and three-phase circuits, Installation and techniques and Cables | |
| | 3.3 | Earthing and Protection Systems<br>Earthing Methods<br>Copper Plate earthing, pipe earthing, and rod earthing<br>Protection Devices<br>MCBs, ELCBs, RCCBs<br>Electrical Testing and Troubleshooting, Testing Procedures, Polarity, continuity, insulation, and earthing tests, Use of testing instruments: Multimeter, Megger.<br>Identifying and rectifying faults in circuits, Electrical Installations in Residential and Commercial, Industry Standards and Regulations, Regulatory Bodies and Codes | |
| | 3.4 | Practical Sessions and Hands-On Training<br>Circuit Construction, Building and testing basic circuits, installation Projects, Residential and commercial wiring installations<br>Fault Simulation, Creating and diagnosing faults in circuits, Safety Drills, Emergency response and safety protocol exercises<br>Tools and Equipment, Multi-meter, Meggers, Insulation testers. Cable cutters, strippers, crimping | |
| | 3.5 | Electrical Networks<br>House Wiring, Stair Case and Go down wiring<br>Series bulb and Extension Board wiring<br>Electrical Gadgets, Repairing of appliances like Table fan/Ceiling fan<br>Emergency extension Board and Electrical fan | |
| | | **TOTAL** | **30** |

**Text Books:**


1. "Practical Electronics for Inventors" by Paul Scherz and Simon Monk (4th Edition, McGraw-Hill Education, 2016)
2. Engineering Metrology and Measurements, Authors: N.V. Raghavendra, L. Krishnamurthy, Publisher: Oxford University Press
3. "Computer Hardware and Networking" Author: K. L. James, Publisher: Scitech Publications
4. "Electrical Wiring, Estimating and Costing", Author: S.L. Uppal and G.C. Garg, Publisher: Khanna Publishers

**Reference Books:**


1. "Fundamentals of Electrical Engineering and Technology" by BL Theraja (S. Chand Publishing)
2. PC Hardware: The Complete Reference", Author: Craig Zacker and John Rourke, Publisher: McGraw Hill Education
3. "Electrical Wiring, Maintenance and Estimating", Author: B.L. Theraja, Publisher: S. Chand Publishing


**Term Work:**
Students are expected to complete all Three trades conducted individually and batch-wise in laboratory settings.

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

# 1. Course Vertical – VSEC- Problem Solving Using C Programming

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="6">25FE1VSEC02</td><td rowspan="6">Problem Solving using C-Programming</td><td>L</td><td>P</td><td>T</td><td>L</td><td>P</td><td>T</td><td colspan="2">TOTAL</td></tr>
<tr><td>-</td><td>2*+ 2</td><td>-</td><td>-</td><td>2</td><td>-</td><td colspan="2">2</td></tr>
<tr><td colspan="9">Examination Scheme</td></tr>
<tr><td></td><td>CA</td><td>MSE</td><td>ESE</td><td>TW</td><td>OR</td><td>PR</td><td>Total</td></tr>
<tr><td>Theory</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Lab/Tut</td><td>25</td><td>-</td><td>-</td><td>-</td><td>-</td><td>25</td><td>50</td></tr>
<tr><td>Total</td><td colspan="7">50</td></tr>
</table>

**Course Objectives:**

1. To introduce students to the fundamental principles of problem-solving, algorithm design, and various programming paradigms, with a focus on structured programming using C.
2. To equip students with the ability to implement and apply core programming constructs to develop solutions for real-world problems.
3. To develop the capability to analyze and create modular, efficient, and maintainable programs by integrating different C programming concepts including structures and file handling.

<table>
<tr><td rowspan="7">Course Outcomes</td><td colspan="2">After successful completion, the students will be able to</td></tr>
<tr><td>CO1</td><td>Recall key concepts of problem-solving, programming paradigms, and characteristics of algorithms and programs. (Remembering)</td></tr>
<tr><td>CO2</td><td>Explain the use of variables, data types, operators, and control structures in computer programming. (Understanding)</td></tr>
<tr><td>CO3</td><td>Apply appropriate control structures, arrays, and strings to solve real-life computational problems. (Applying)</td></tr>
<tr><td>CO4</td><td>Analyze the use of functions, recursion, and modular programming techniques in structured problem solving. (Analyzing)</td></tr>
<tr><td>CO5</td><td>Compare the use of structures, unions, and pointers to organize and access data in different programming scenarios. (Evaluating)</td></tr>
<tr><td>CO6</td><td>Design and develop complete C programs to solve real-world problems. (Creating)</td></tr>
</table>

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Introduction to Problem Solving and Programming Paradigms** | |
| | 1.1 | Definition of a problem, steps in problem solving, writing and understanding algorithms, Distinction between an algorithm and program , characteristics of a good algorithm, examples of real-life problem solving. | 3 |
| | 1.2 | Introduction to computer programming, general programming paradigms and their comparison,top-down design approach, basics of C as a procedural language, concept of flowcharts, using flowcharts and algorithms for designing solutions. | |
| | **Self Learning:** Utilization of the SCRATCH tool for logic building : https://scratch.mit.edu/ | | |
| **2** | | **Basic Elements of Computer Programming and Control flow** | |
| | 2.1 | Variables, keywords, constant , Data types, Operators**:** Arithmetic, Relational and Logical, Assignment, Unary, Conditional, Bitwise, Expression, Statements. | 5 |
| | 2.2 | Branching Structures: if statement, if-else statement,nested if-else, multi-way decision, switch statement, continue statement, break statement, Iterative Structures: while, do-while, for, nested loops. | |
| | 2.3 | Problem Solving to apply, if, if-else, and nested if statements to make decisions based on conditions. Implement switch-case structures for multi-way branching.loops like for, while, and do-while to handle repeated operations.Utilize break, continue, and nested loops to manage flow in complex scenarios.<br>Eg. Grading System, ATM Cash Withdrawal, Electricity Bill Calculator, Prime Number Check, Menu-driven Program, etc. | |
| | **Self Learning:** Explore the virtual lab of this module in the link below: https://cse02-iiith.vlabs.ac.in/ | | |
| **3** | | **Problem Solving using Array Techniques** | |
| | 3.1 | Concept of arrays, declaration and initialization, accessing array elements, one-dimensional arrays, two-dimensional arrays, character arrays, and introduction to strings | 6 |
| | 3.2 | Problem solving such as reversing arrays, counting elements, searching, finding maximum or minimum values, and performing string operations like length calculation, keyword search, anagram and palindrome checks, and basic string modifications. | |
| | **Self Learning:** Explore the virtual lab of this module in the link below: https://cse02-iiith.vlabs.ac.in | | |
| **4** | | **Problem Solving using Modular Approach** | |
| | 4.1 | Defining a Function, accessing a Function, types of function, Function Prototype, Passing Arguments to a Function, call by value and call by reference, Recursion | 7 |
| | 4.2 | Problem solving using Functions and Recursion | |
| | **Self Learning :**Explore the virtual lab of this module in the link below: https://cse02-iiith.vlabs.ac.in | | |
| **5** | | **Structures, Unions and Pointers** | |

| | | | |
|---|---|---|---|
| | 5.1 | Structures and Union: Declaration, Initialization, structure within structure, Array of Structure, Operation on structures, Concept of Union, Difference between structure and union, Introduction to Pointers. | 6 |
| | 5.2 | Exercises demonstrating pointer arithmetic and data manipulation using pointers in arrays, functions, and strings and comparison of union , structure and pointers. | |
| | **Self Learning :**Explore the virtual lab of this module in the link below: https://cse02-iiith.vlabs.ac.in | | |
| **6** | | **File handling** | |
| | 6.1 | File handling**:** Types of File, File operation- creating ,opening, reading, writing, closing, introduction to dynamic memory allocation. | 3 |
| | | **Self-Learning:** Use any online compiler to print a student grade sheet using file handling techniques. | |
| | | **TOTAL** | **30** |

**Laboratory Experiments (Minimum 10)**

**Note: All problems should be implemented using C language.**

| Sr. No. | Title of the Experiment |
|---|---|
| **1** | Title: *Student Report Card Generator Using Console I/O in C*<br>Problem Statement: Mark Sheet Generation System<br>Create a C program that simulates a college mark sheet generation system. The program should collect student details such as name, roll number, and marks in three subjects, then display the result in a formatted manner. Use various C input/output functions like scanf(), printf(), getchar(), putchar(), gets(), and puts() to demonstrate basic console-based data handling. |
| **2** | Title: *Smart Billing Calculator for Grocery Store using Operators in C*<br>Problem Statement: Grocery Billing Assistant<br>Design a C program to assist a grocery store manager with daily billing tasks. The application should compute the total cost of items, apply discounts, calculate taxes, and compare prices using various C operators—arithmetic, relational, logical, assignment, unary, conditional, bitwise, and comma operators—to streamline routine calculations efficiently. |
| **3** | Title: *Automated Discount and Billing System Using Decision-Making Constructs in C*<br>Problem Statement: Clothing Store Billing System<br>Develop a C program to automate the billing process for a clothing store. The system should take the customer type and total purchase amount as input, determine applicable discounts based on store policies, and calculate the final bill. Use decision-making constructs like if, if-else, nested if, and switch-case to apply the correct discount rules. This program simulates a real-world retail scenario where billing decisions vary based on dynamic customer and purchase conditions. |
| **4** | Title: *Interactive ATM Application Using Looping Constructs in C*<br>Problem Statement: ATM Simulation System<br>Create a simple ATM simulation program in C that allows users to perform basic banking operations such as checking account balance, depositing money, withdrawing money, and exiting the application. Use while and do-while loops to repeatedly display the menu and |

| | |
|---|---|
| | manage user interaction until the user chooses to exit. This application mirrors the functionality of a real ATM interface and demonstrates the use of iterative control structures in practical scenarios. |
| **5** | Title: *Interactive Grade Classification System Using Control Flow Constructs in C*<br>Problem Statement: Student Grade Categorization System<br>Design a C program for a school that helps teachers input and categorize student grades into predefined ranges such as Excellent, Good, Average, or Poor. The system should use control flow mechanisms like switch, case, break, continue, and goto to manage user input, grade classification, and repeated interactions. This simulation mirrors how educational institutions classify academic performance efficiently. |
| **6** | Title: *Warehouse Stock Tracker Using Arrays and Control Structures in C*<br>Problem Statement: Inventory Management System<br>A warehouse maintains a variety of items and requires a basic inventory management system to monitor and update stock levels. Develop a C program that simulates the checking and updating of stock quantities for a specific item. The system should allow input of item details, current stock level, and restock quantity, then update and display the new stock status. Use arrays and control structures to manage item data and simulate real-time inventory operations typically needed in warehouse environments. |
| **7** | Title: *Seating Arrangement Permutations Using Iteration and Recursion in C*<br>Problem Statement: Event Planning – Seating Arrangement Calculation<br>You are tasked with organizing a formal event—such as a wedding, conference, or banquet—and need to calculate the number of possible ways to arrange a given number of guests in a row. This requires computing permutations based on the total number of guests, which is mathematically represented by the factorial of the number. Develop a C program that calculates the factorial using both iterative and recursive methods to determine all possible unique seating arrangements. This mirrors real-world event planning challenges where optimal arrangements and guest management are essential. |
| **8** | Title: *Library Management Using Arrays in C*<br>Problem Statement: Library Book Tracker<br>Create a C program to manage book borrowing in a small library using 1D arrays for book titles and 2D arrays to track borrowed copies by multiple users. This simulates a simple system to monitor library usage and book availability. |
| **9** | Title: *Hotel Guest Registry Using Strings in C*<br>Problem Statement: Guest Information Organizer<br>Design a C program to collect, store, and display guest details such as name, phone number, and email using character arrays and string handling. This simulates a simple hotel front desk system for managing guest information effectively. |
| **10** | Title: *Employee Record Management System Using Structures in C*<br>Problem Statement: Employee Record Manager<br>Design a C program to manage basic employee records for a company using structures. The program should store and display details like name, employee ID, department, and salary for multiple employees, simulating a simple HR database system. |

| | |
|---|---|
| **11** | Title: *Patient Heart Rate Tracker Using Pointers and Arrays in C*<br>Problem Statement: Health Monitoring System<br>Design a C program that simulates a basic health monitoring system. The program should record a patient's heart rate readings over a day using an array and then determine the maximum and minimum heart rate using pointer arithmetic. This system reflects how wearable health devices or medical software analyze real-time data to monitor patient health trends efficiently. |
| **12** | Title: *Persistent Contact Saver Using File Handling in C*<br>Problem Statement: Contact Management System<br>Develop a mini Contact Management System in C that enables users to efficiently add new contact details—such as name and phone number—to a file using append mode, preserving previously saved data. The program should also retrieve and display all stored contacts, demonstrating the use of file handling for simple, real-world data storage and retrieval operations. |

**Text Books:**


1. Kernighan, B. W., Ritchie, D. M., "The C Programming Language", Second Edition, Pearson, 2015
2. Forouzan, B. A., "Computer Science: A Structured Programming Approach Using C", Third Edition, Cengage India Private Limited, 2007
3. Kanetkar, Yashavant P., "Let Us C: Authentic Guide to C Programming Language", 20th Edition, BPB Publications, 2024


**Reference Books:**


1. Ghezzi, Carlo, & Jazayeri, Mehdi, "Programming Language Concepts", Third Edition, John Wiley & Sons, 2008.
2. Rajaraman, V., & Adabala, Neeharika, "Computer Programming in C", Second Edition, PHI Learning, Eastern Economy Edition, 2014.
3. Gottfried, Byron, "Programming with C", Fourth Edition, McGraw Hill (Schaum's Outline Series), 2018.


**Useful Links:**

1. NPTEL Course: https://nptel.ac.in/courses/106105171
2. OnlineGDB: https://www.onlinegdb.com/
3. Programiz C Compiler: ttps://www.programiz.com/c-programming/online-compiler/
4. JDoodle: https://www.jdoodle.com/c-online-compiler
5. Replit: https://replit.com/
6. TutorialsPoint Coding Ground: https://www.tutorialspoint.com/compile_c_online.php

## Assessment Methodology:

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-25** | • Certification: NPTEL (20 Marks) (Approved by instructor)<br>• Active Participation and Timely Submission of Laboratory and Programming Assignments ( 5 Marks)<br><br>OR<br><br>• Any two Pedagogies (10 marks each) and Active Participation and Timely Submission of Laboratory and Programming Assignments<br>• (5 Marks)<br><br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by instructor)<br>• Open Book Test<br>• Working model / simulation of a course-based concept. |
| | **OR-25** | Practical examination will be based on the experiments performed by the students during laboratory sessions. |

## 1. Course Vertical VEC- Universal Human Values

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE1VEC01 | Universal Human Values | L | P | T | L | P | T | TOTAL |
| | | 2 | - | - | 2 | - | - | 2 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| | | Theory | 50 | - | - | - | - | - | 50 |
| | | Lab/Tut | - | - | - | - | - | - | - |
| | | Total | 50 | | | | | | |

**Course Objectives:**

1. Develop a holistic understanding of human aspirations, values, and harmony in existence.
2. Reflect on self, relationships, society, and nature through rational and verifiable exploration.
3. Cultivate ethical conduct, empathy, and sustainable problem-solving skills.
4. Apply human values in personal and professional life for societal well-being.

| | | |
|---|---|---|
| Course Outcomes | After successful completion, the students will be able to | |
| | CO1 | Recall the fundamental concepts of human aspirations, harmony, and values in personal, social, and environmental contexts. (Remembering) |
| | CO2 | Explain the interrelationship between the self, body, family, society, and nature, and how harmony is achieved at each level. (Understanding) |
| | CO3 | Apply the principles of trust, respect, and ethical reasoning to resolve real-life interpersonal and societal conflicts. (Applying) |
| | CO4 | Analyze social, economic, and environmental systems to identify factors influencing harmony, sustainability, and human well-being. (Analyzing) |
| | CO5 | Evaluate professional practices, policies, and lifestyles based on their alignment with ethical values and the universal human order. (Evaluating) |
| | CO6 | Design sustainable, ethical, and human-centric models or solutions for personal, professional, and societal development. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Introduction to Value Education** | |
| | 1.1 | Purpose of education (NEP 2020 alignment), | **5** |
| | 1.2 | Self-exploration: Content, process, and motivation, | |
| | 1.3 | Human aspirations: Happiness, prosperity, and right understanding, Critical appraisal of modern societal challenges | |
| | Self-Learning Topics: NEP 2020 key points on value-based education; Current societal challenges (SDGs, social inequality, etc.) | | |
| **2** | | **Harmony in the Human Being** | |
| | 2.1 | Coexistence of 'I' (consciousness) and body | **5** |
| | 2.2 | Needs of self (happiness) vs. body (physical facilities) | |
| | 2.3 | Self-regulation, health, and prosperity | |
| | Self-Learning Topics: Case studies on balance between physical and mental well-being; Holistic health approaches | | |
| **3** | | **Harmony in the Family & Relationships** | |
| | 3.1 | Foundational values: Trust, respect, affection | 6 |
| | 3.2 | Programs for mutual fulfillment in relationships, | |
| | 3.3 | Case studies on family harmony | |
| | Self-Learning Topics: Conflict resolution methods (nonviolent communication); - Relationship-building techniques | | |
| **4** | | **Harmony in Society** | |
| | 4.1 | Human goals: Resolution, prosperity, fearlessness, coexistence, | **4** |
| | 4.2 | Vision of universal harmonious society (family to world family). | |
| | Self-Learning Topics: SDGs and their connection to societal harmony; Community welfare programs; Inspirational case studies on social entrepreneurs | | |
| **5** | | **Harmony in Nature & Existence** | |
| | 5.1 | Four orders of nature | **5** |
| | 5.2 | Interconnectedness and cyclability | |
| | 5.3 | Sustainable living and responsible resource use | |
| | Self-Learning Topics: Renewable energy technologies; - Traditional ecological knowledge and practices; Global sustainability movements | | |
| **6** | | **Professional Ethics & Universal Human Order** | |
| | 6.1 | Ethical human conduct in professions | 5 |
| | 6.2 | Humanistic education, constitution, and management models | |
| | 6.3 | Case studies: Eco-friendly technologies and systems | |

| | | | |
|---|---|---|---|
| | Self-Learning Topics: Renewable energy technologies; - Traditional ecological knowledge and practices; Global sustainability movements | | |
| | | **TOTAL** | **30** |

**Text Books:**

1. A Foundation Course in Human Values and Professional Ethics – R.R. Gaur.

**Reference Books:**

1. The Story of My Experiments with Truth – M.K. Gandhi
2. Small is Beautiful – E.F. Schumacher
3. Hind Swaraj – M.K. Gandhi

**Useful Links:**

1. Online Resources [UHV Foundation](https://uhv.org.in)

## Assessment Methodology

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **Theory** | **CA-50** | • Active Participation = 5 marks<br>• MCQ /Class Test= 10 marks<br>• Instructor Assessment of the Activity carried out by student = 25 marks<br>• Assignment = 10 marks |

AC: 02/26
Item No. 02

## The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

(An Autonomous Institute affiliated to University of Mumbai)

**Department of Basic Science and Humanities**

**CURRICULUM STRUCTURE FOR FIRST YEAR ENGINEERING**

**SEM II**

**( As Per NEP 2020 )**

## ( Scheme: DB25-V1 )
## Effective from Academic Year 2025-2026

## The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

**(An Autonomous Institute Affiliated to University of Mumbai)**

## CURRICULUM STRUCTURE FOR FIRST YEAR ENGINEERING

## SEMESTER II

## Department of Basic Science and Humanities

**(As per NEP 2020)**

## (Scheme: DB25-V1)

## Effective from Academic Year 2025-2026

# 1. Preamble

Don Bosco Institute of Technology, Kurla, Mumbai, proudly celebrates the achievement of autonomous status—an academic milestone that reaffirms our steadfast commitment to excellence, holistic development, and student-centric learning. This autonomy empowers us to craft and implement a curriculum that is forward-looking, contextually relevant, and deeply rooted in our institutional values and the aspirations of our nation.

As an autonomous institution affiliated with the University of Mumbai, DBIT embraces the opportunity to restructure its academic framework in alignment with the University Grants Commission (UGC) guidelines and the National Education Policy (NEP) 2020. This curriculum framework outlines the undergraduate engineering programs for the EXTC, COMP, IT, and MECH branches. It reflects NEP's emphasis on multidisciplinary learning, flexibility, and outcome-based education, while staying true to the Don Bosco educational philosophy.

The curriculum adopts a top-down approach, beginning with the institutional Vision and Mission, which guides the definition of Program Educational Objectives (PEOs) and Program Outcomes (POs). These outcomes are used to shape Course Outcomes (COs) and the content and assessment methods of each course. This ensures that all academic efforts remain aligned with the broader goals of transforming learners into technically sound, ethically responsible, and socially aware citizens. Importantly, this curriculum has been shaped through extensive consultations with stakeholders, including industry experts, academic peers, alumni, and students—to ensure that it remains aligned with contemporary industry requirements and societal expectations. Their inputs have been instrumental in designing a framework that bridges the gap between academic learning and practical applicability.

**Key Objectives in developing syllabus are:**

1. **Develop Strong Technical Foundations:** Equip students with robust knowledge and skills in core engineering domains to solve real-world problems through design, analysis, and innovation.
2. **Foster Research, Innovation, and Entrepreneurship:** Cultivate a spirit of inquiry, critical thinking, and entrepreneurial mindset to promote research-based problem-solving and startup culture.
3. **Enhance Interdisciplinary and Industry-Ready Competencies:** Integrate emerging technologies, multidisciplinary learning, and practical exposure to prepare students for dynamic industry requirements and lifelong learning.
4. **Promote Ethical, Sustainable, and Socially Responsible Engineering Practice:** Inculcate ethics, human values, and environmental consciousness to enable students to contribute meaningfully to society and sustainable development.
5. **Empower Communication, Leadership, and Teamwork Abilities:** Strengthen students' soft skills, collaboration, and leadership to perform effectively in diverse professional and global environments.

**Academic design includes:**

- A Choice-Based Credit System (CBCS) for flexibility
- A range of Minor and Honors options to encourage specialization and research
- Opportunities for field engagement, internships, and experiential learning
- Emphasis on skill enhancement and future workforce needs
- Integration of ethical reasoning, social awareness, and environmental consciousness

As an institution inspired by the values of Saint John Bosco, we strive to create a joyful and inclusive learning environment that fosters creativity, curiosity, and compassion. Through this curriculum framework, we reaffirm our commitment to producing graduates who are not only professionally competent but also dedicated to the greater good of society.

## 2. Vision and Mission

**Vision:**

DBIT will be recognized for providing an innovative, enjoyable, and holistic learning environment that transforms individuals into socially conscious citizens, the Don Bosco way, and will lead in research and entrepreneurship in the field of sustainable technologies.

**Mission:**

1. To create future engineers who work with honesty and integrity and excel in the use of technology for the benefit of the underprivileged.
2. To train engineers to be innovative problem-solvers and entrepreneurs who engage in research and lifelong learning.
3. To provide a diverse and stimulating environment for staff and students to grow holistically.

## 3. Curriculum Design Philosophy

The curriculum is structured in alignment with the National Education Policy (NEP) 2020 and UGC guidelines. It follows a top-down approach, wherein the institutional Vision and Mission guide the Program Educational Objectives (PEOs) and Program Outcomes (POs). These shape the Course Outcomes (COs) and form the foundation for the course structure, delivery, and assessments.

**Key design principles include:**

- Emphasis on Outcome-Based Education (OBE) with clear mappings of COs to POs
- Integration of core technical knowledge with interdisciplinary electives
- Inclusion of vocational skills, internships, and community engagement
- Development of entrepreneurship and research aptitude through minor and honors pathways
- Encouragement of ethical, sustainable, and socially responsible engineering practices

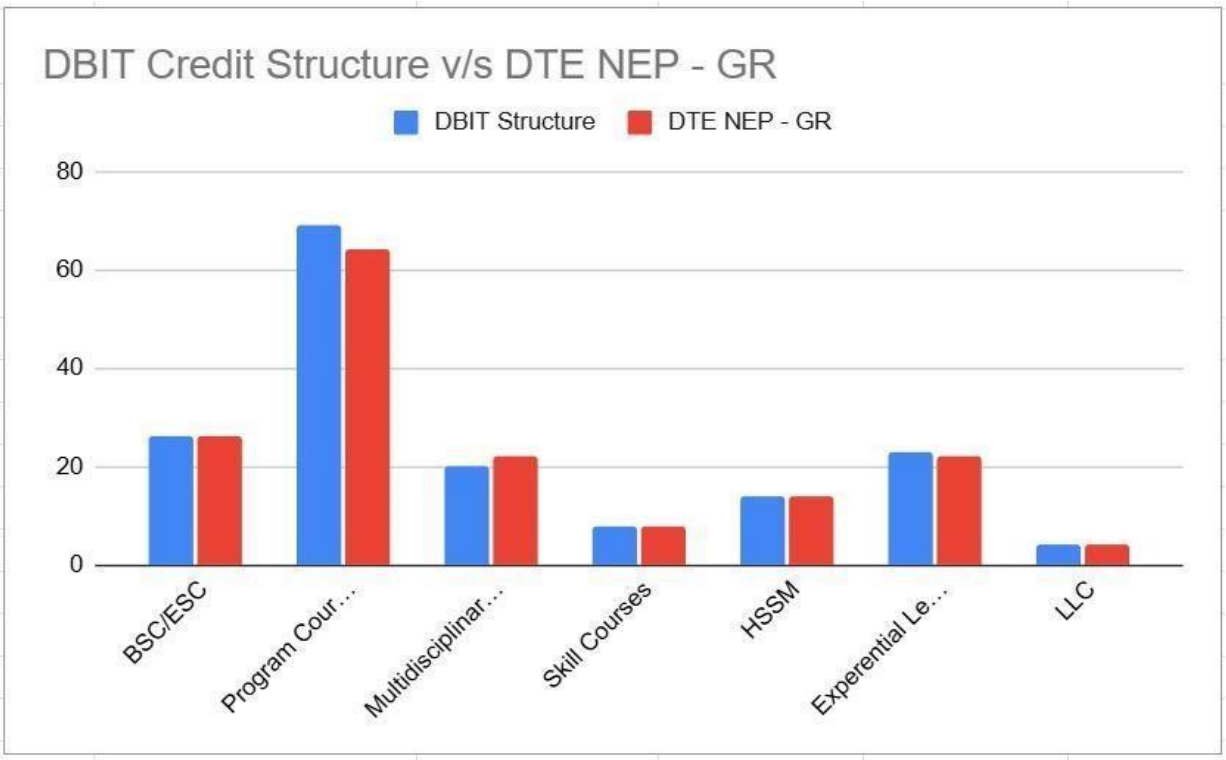
## 4. Credit Guidelines and Allocation

The curriculum is delivered through a structured credit system as follows:

| Activity Type | Credit Definition |
|---|---|
| Theory Course | 1 Credit = 15 Contact Hours |
| Laboratory / Studio / Workshop | 1 Credit = 30 Contact Hours |
| Internship / Field Work | 1 Credit = 40 Hours or 02 weeks |
| Seminar / Group Discussions | 1 Credit = 15 Hours |
| Community Engagement / Field Project | 1 Credit = 30 Hours |

## DBIT Overall Curriculum Credit Structure:

| Semester | | I | II | III | IV | V | VI | VII | VIII | Total Credits | DTE Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course | BSC/ESC | 9 | 6 | | | | | | | 15 | 14-18 |
| Engineering Science Course | | 7 | 4 | | | | | | | 11 | 12 - 16 |
| Programme Core Course (PCC) | Program Courses | | 3 | 16 | 14 | 6 | 6 | 6 | | 51 | 44-56 |
| Programme Elective Course (PEC) | | | | | | 3 | 3 | 6 | 6 | 18 | 20 |
| Multidisciplinary Minor (MDM) | Multidisciplinary Courses | | | | 3 | 4 | 4 | 3 | | 14 | 14 |
| Open Elective (OE) Other than a particular program | | | | | | 2 | 2 | 2 | | 6 | 8 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 3 | 3 | 2 | | | | | | 8 | 8 |
| Ability Enhancement Course (AEC -01, AEC-02) | Humanities Social Science and Management (HSSM) | | 2 | | | 2 | | | | 4 | 4 |
| Entrepreneurship/Economics/ Management Courses | | | | | 2 | | 2 | | | 4 | 4 |
| Indian Knowledge System (IKS) | | | 2 | | | | | | | 2 | 2 |
| Value Education Course (VEC) | | | | 2 | | | | | | 4 | 4 |
| Research Methodology | Experiential Learning Courses | | | | | 2 | | | | 2 | 4 |
| Community. Engagement. Project (CEP)/ Field Project (FP) (Mini - Project) | | | | 1 | 1 | 1 | | | | 3 | 2 |
| Project | | | | | | | 3 | 3 | | 6 | 4 |
| Internship/ OJT | | | | | | | | | 12 | 12 | 12 |
| Co-curricular Courses (CC) | Liberal Learning Courses | | 1 | | 1 | | 1 | | 1 | 4 | 4 |
| Total Credits (Major) | | 21 | 21 | 21 | 21 | 20 | 21 | 20 | 19 | 164 | 160 - 176 |




## 5. Degree Options and Exit Pathways

Students are offered flexible learning pathways through the following options:

**Undergraduate Degree Options:**

- B.E. - 164 credits
- B.E. Minor/Honors - 182 credits
- B.E. Honors with Research - 182 credits

**Multiple Entry-Exit Options (Aligned with NEP 2020):**

| Exit Options | Credits Structure |
|---|---|
| **Certificate after Year 1:** | 42 Credits + 08 credits<br>(04 credit Exit course + 04 Summer internship). |
| **Diploma after Year 2:** | 84 credits + 08 credits<br>(04 credit Exit course + 04 Summer internship). |
| **B. Vocational Degree after Year 3:** | 125 credits + + 08 credits<br>(04 credit Exit course + 04 Summer internship). |

**Credits earned** are banked in the **Academic Bank of Credits (ABC)** for lifelong learning flexibility.

## Abbreviations Used:

| | |
|---|---|
| AEC | Ability Enhancement Course |
| AEL | Ability Enhancement Laboratory |
| BSC | Basic Science Course |
| BSL | Basic Science Laboratory |
| CEP | Community Engagement Project |
| CC | Co-curricular Courses |
| CIE | Continuous Internal Evaluation |
| EEM | Entrepreneurship, Economics and Management |
| ELC | Experiential Learning Courses |
| ESC | Engineering Science Course |
| ESE | End Semester Examination |
| ESL | Engineering Science Laboratory |
| FP | Field Project |
| HSSM | Humanities Social Science and Management |
| IKS | Indian Knowledge System |
| L | Lecture |
| LLC | Liberal Learning Courses |
| MDM | Multidisciplinary Minor |
| MSE | Mid Semester Exam |
| OE | Open Elective |
| OJT | On Job Training |
| P | Practical |
| PCC | Program Core Course |
| PCL | Program Core Laboratory |
| PEC | Program Elective Course |
| T | Tutorial |
| VEC | Value Education Course |
| VSEC | Vocational and Skill Enhancement Course |

**UG First Year Engineering Program- Curriculum Structure-Semester-II**

| Course Code | Course Vertical | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | T | P | T | T | P | T | Total |
| 25FE2BSC01 | BSC | Foundations of Engineering Mathematics-II | 3 | - | 1 | 3 | - | 1 | 4 |
| 25FE2BSC02 | BSC | Environmental Science | 2 | - | - | 2 | - | - | 2 |
| 25FE2ESC01 | ESC | Engineering Mechanics | 3 | - | 1 | 3 | - | 1 | 4 |
| 25FE2PCC01 | PCC | Program Core Course (EXTC): Analogue and Digital Circuit<br>Program Core Course (MECH): Materials and Metallurgy<br>Program Core Course (COMP): Data Structure<br>Program Core Course (IT): Data Structure | 2 | 2 | - | 2 | 1 | - | 3 |
| 25FE2VSEC01 | VSEC | Engineering Skills Workshop II | - | 2 | - | - | 1 | - | 1 |
| 25FE2VSEC02 | VSEC | Object Oriented Programming using Python | - | 2* + 2 | - | - | 2 | - | 2 |
| 25FE2IKS01 | IKS | Indian Knowledge System | 2 | - | - | 2 | - | - | 2 |
| 25FE2AEC01 | AEC | Effective Communication Skills | - | 2* + 2 | - | - | 2 | - | 2 |
| 25FECC01 | CC | Liberal Learning Course | - | 2# | - | - | 1 | - | 1 |
| Total | | | 12 | 14 | 2 | 12 | 7 | 2 | 21 |

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

# Two hours of activity to be conducted for full class relative to respective LLC.

## Examination Scheme & Assessment Structure: Semester II

| Course Code | Course Vertical | Course Name | Examination Marks | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| 25FE2BSC01 | BSC | Foundations of Engineering Mathematics-II | 20 | 30 | 50 | 25 | - | - | 125 |
| 25FE2BSC02 | BSC | Environmental Science | 20 | 30 | 50 | - | - | - | 100 |
| 25FE2ESC01 | ESC | Engineering Mechanics | 20 | 30 | 50 | 25 | - | - | 125 |
| 25FE2PCC01 | PCC | Program Core Course | 20 | 30 | 50 | 25 | - | 25 | 150 |
| 25FE2VSEC01 | VSEC | Engineering Skills Workshop II | 50 | - | - | - | - | - | 50 |
| 25FE2VSEC02 | VSEC | Object Oriented Programming using Python | 25 | - | - | 25 | - | 25 | 75 |
| 25FE2IKS01 | IKS | Indian Knowledge System | 50 | - | - | - | - | - | 50 |
| 25FE2AEC01 | AEC | Effective Communication Skills | 25 | - | - | - | 25 | - | 50 |
| 25FECC01 | CC | Liberal Learning Course | 50 | - | - | - | - | - | 50 |
| Total Marks | | | 280 | 120 | 200 | 100 | 25 | 50 | 775 |

# UG First Year Engineering

## Assessment Methodology

| Type of Courses | Assessment Tools | Marks Distribution |
|---|---|---|
| **Theory** | **CA-20** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by Instructor)<br>• Open Book Test<br>• Working model / simulation of a course-based concept. |
| **Theory (PCC – Lab)** | **CA-50** | Choose any Pedagogy from the following list summing upto maximum 50 marks:<br>• MCQ /Class Test (10 marks)<br>• Case study/Assignment (10 marks)<br>• GATE based Tutorial (10 marks)<br>• MOOCs Certification (Approved by Instructor) (10 marks)<br>• Open Book Test (10 marks)<br>• Working model / simulation of a course-based concept (30 Marks) |
| **Theory (VEC)** | **CA-50** | • Active Participation = 5 marks<br>• MCQ /Class Test= 10 marks<br>• Assessment of the activity carried out by student = 25 marks<br>• Assignment = 10 marks |
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

| | | |
|---|---|---|
| **Liberal Learning Courses (LLC)** | **CA-50** | • Active Participation = 5 marks<br>• Assessment of the Activity carried out by student = 25 marks<br>• Cultural Event Participation = 10 marks<br>• Technical Event Participation = 10 marks |
| **Theory** | **MSE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **Theory** | **ESE** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• Q4 A or B - 10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (2 hours)<br>• Total Marks: 50 |
| **Course - Laboratory** | **TW- 25** | • Active Participation (Lab) = 5 marks<br>• Laboratory Report = 10 marks<br>• Laboratory performance = 10 marks<br>Based on the performance and satisfactory completion of assigned laboratory work. |
| **Community Engagement project** | **TW-25** | • Active Participation = 05 marks<br>• Project Report = 10 marks |

| | | |
|---|---|---|
| | | • Progress presentations (min 02) & demonstration = 10 marks |
| **Tutorial** | **TW-25** | • Active Participation = 5 marks<br>• Tutorial Submission = 20 marks<br>Tutorials should cover the entire syllabus. |
| **Laboratory** | **OR-25** | Oral examination will be based on the entire syllabus. |
| **Laboratory** | **PR-25** | Practical examination will be based on the experiments performed by the students during laboratory sessions. |

## Weightage of COs across all Assessments:

| Course Outcomes | Weightage (Percentage) |
|---|---|
| CO-1, CO-2 | 20-30 |
| CO-3, CO-4 | 40-50 |
| CO-5, CO-6 | 20-30 |

Note: Total weightage of all COs should be 100%.

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | P | T | L | P | T | Total |
| 25FE2BSC01 | Fundamentals of Engineering Mathematics -II | 3 | - | 1 | 3 | - | 1 | 4 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| | | Theory | 20 | 30 | 50 | - | - | - | 100 |
| | | Lab/Tut | - | - | - | 25 | - | | 25 |

| Pre-Requisite Courses: | |
|---|---|

**Course and Module Overview:**

This course aims to establish a solid foundation in mathematical modeling using differential equations, multivariable calculus, and numerical methods, providing essential tools for applications in engineering, physics and applied mathematics.

The curriculum is structured to progress from fundamental concepts to analytical techniques, then to higher-dimensional applications, and finally to numerical approximation methods for complex real-world problems.

**Module 1** This module focuses on how differential equations are formed, classified, and solved, especially in real-world contexts like growth, decay, and modeling.

**Module 2** This module focuses on solving higher-order linear differential equations using systematic algebraic methods. It builds on first-order concepts and introduces operator techniques.

**Module 3** This module focuses on advanced integration techniques and applications, including special functions, curve analysis, and differentiation under the integral sign.

**Module 4** This module introduces integration of functions of two variables, focusing on evaluating double integrals, transforming regions, and applying them to find areas.

**Module 5** This module extends integration to functions of three variables, allowing computation over three-dimensional regions. It is widely used in geometry, physics, and engineering.

**Module 6** This module focuses on approximate (numerical) techniques used when exact analytical solutions are difficult or impossible to obtain.

| | After successful completion of the course, the students will be able to | |
|---|---|---|
| Course Outcomes | CO1 | Define Beta, Gamma functions; first-order, exact D.E.s; know standard curves in Cartesian, polar forms. |
| | CO2 | Understand integrating factors, C.F., and P.I.; solve Beta and Gamma integrals; plot standard curves, locate regions, change integration order, and transform coordinates. |
| | CO3 | Use numerical techniques for integrals; Solve ODEs using variation of parameters and integrating factors; use single, double, and triple integrals for curve length, area, and volume. |

| | | |
|---|---|---|
| | CO4 | Deduce DUIS relations for solving integrals; analyze errors in numerical integration; evaluate double and triple integrals by identifying region. |
| | CO5 | Implement numerical methods to approximate solutions of differential equations and solve the differential equations by reducing it to appropriate form. |
| | CO6 | Design, code, and validate SCILAB programs for numerical integration, curve plotting, and solving ordinary differential equations. |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | | **Differential Equations of First Order and First Degree** | 08 |
| | | After completing this module, students will be able to:<br>● Mathematically formulate simple real life situations as first order differential equations<br>● Apply different methods for finding integrating factors<br>● Reduce a differential equation to linear form and solve.<br>● Reduce Bernoulli's differential equation to linear form and solve. | |
| | 1.1 | Differential equations in growth and decay; Mathematical modelling and Formulation of Differential equations. | |
| | 1.2 | Exact differential Equations, Equations reducible to exact form by using integrating factors. | |
| | 1.3 | Linear differential equations (Review), equations reducible to linear form, Bernoulli's equation | |
| | | **Self-Learning Topics:** RLC circuit, velocity, Shortest distance problems | |
| 2 | | **Linear Differential Equations With Constant Coefficients of Higher Order** | 07 |
| | | After completing this module, students will be able to:<br>● Solve linear differential equation with constant coefficients through methods to find complimentary functions and particular integrals of differential equations<br>● Apply the method of variation of parameters | |
| | 2.1 | Linear Differential Equations with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is $e^{(ax)}$, sin(ax + b) , cos (ax +b), $x^m$, $e^{(ax)}$ *V* | |
| | 2.2 | Method of variation of parameters | |
| | | **Self-Learning Topics**:RLC circuit, vibration of spring, Heat flow, brachistochrone and tautochrone problems | |
| 3 | | **Gamma and Beta Functions, Tracing of curves, DUIS** | 08 |
| | | After completing this module, students will be able to:<br>● Identify integrals through the definition of Gamma and beta functions and their properties<br>● Identify different types of curves<br>● Apply DUIS rule in integration | |
| | 3.1 | Gamma and Beta functions and their properties | |
| | 3.2 | Tracing & Rectification of curves. (Cartesian & Polar) | |
| | 3.3 | Differentiation under integral sign with constant limits of integration (one parameter) | |

| | | | |
|---|---|---|---|
| | **Self-Learning Topics**: Error Functions and its properties | | |
| **4** | **Double Integrals** | | **10** |
| | After completing this module, students will be able to<br>● Obtain the limit in a particular region of integration<br>● Find the limit by changing the order of integration<br>● Perform change of variables: Cartesian form into polar form and also able to evaluate double integral in polar form<br>● Apply double integration to compute area | | |
| | 4.1 | Double integration‑definition, Evaluation of Double Integrals over region.(Cartesian & Polar) | |
| | 4.2 | Change of order of integration | |
| | 4.3 | Evaluation of double integrals by changing to polar coordinates | |
| | 4.4 | Application of double integrals to compute Area | |
| | **Self-Learning Topics:** Calculation of Mass, centroid and Moment of inertia | | |
| **5** | **Triple Integrals** | | **06** |
| | After completing this module, students will be able to;<br>● Determine limits of integration for different regions<br>● Evaluate triple integrals in Cartesian, Cylindrical, and Spherical coordinates<br>● Apply triple integrals to compute volume of solids | | |
| | 5.1 | Triple integration definition and evaluation (Cartesian, cylindrical and spherical polar coordinates). | |
| | 5.2 | Application of triple integrals to compute Volume | |
| | **Self-Learning Topics**: Calculating volume for irregular shapes | | |
| **6** | **Numerical solution of ordinary differential equations of first order and first degree and numerical integration** | | **06** |
| | After completing this module, students will be able to:<br>● Apply numerical methods to solve first-order ODEs.<br>● Apply numerical integration techniques.<br>● Compare approximate results with exact analytical solutions. | | |
| | 6.1 | Numerical solutions of ordinary differential equations using (a) Euler's method (b) Modified Euler method and (c) Runge‑Kutta fourth order method | |
| | 6.2 | Numerical Integration: Trapezoidal, Simpson's one-third and three-eighth's rules | |
| | **Self-Learning Topics:** Midpoint rule to evaluate integrals | | |
| | | **TOTAL** | **45** |

**Suggested List of Tutorial:**

| Experiment No. | Title of the Tutorial |
|---|---|
| 1 | Exact and reducible to Exact Differential Equations<br><br>**Objective:** To learn how to identify and solve exact differential equations and convert non-exact equations into exact form.<br><br>**Outcome:** Ability to test exactness, apply integrating factors, and obtain solutions of differential equations in implicit form. |
| 2 | Linear and reducible to Linear Differential Equations<br><br>**Objective:** To understand how to solve linear differential equations and transform suitable non-linear equations into linear form.<br><br>**Outcome:** Ability to apply integrating factor methods and solve both linear and reducible-to-linear differential equations effectively |
| 3 | Linear Differential Equation with constant coefficient: Complementary function, particular integrals of differential equation of the type f(D)y = X where X is *e^(ax)*, sin(ax + b) , cos (ax +b).<br><br>**Objective:** To learn methods for solving linear differential equations with constant coefficients by finding complementary functions and particular integrals for standard forms of X.<br><br>**Outcome:** Ability to determine complete solutions by combining complementary functions and particular integrals for cases where X=eax,sin(ax+b),cos(ax+b)X = e^{ax}, \sin(ax+b), \cos(ax+b)X=eax,sin(ax+b),cos(ax+b). |
| 4 | Linear Differential Equation with constant coefficient: Complementary function, particular integrals of differential equation of the type f(D)y = X where X is *x^m*, *e^(ax) V* and Method of Variation of Parameter.<br><br>**Objective:** To learn how to solve linear differential equations with constant coefficients using complementary functions, particular integrals for x^m and Ve^{ax} and the method of variation of parameters.<br><br>**Outcome:**<br>Ability to obtain complete solutions of such differential equations by applying appropriate methods for complementary functions and particular integrals, including variation of parameters. |

| | |
|---|---|
| 5 | Gamma and Beta Functions<br><br>**Objective:** To understand the definitions, properties, and interrelation of Gamma and Beta functions. |

| | |
|---|---|
| | **Outcome:** Ability to evaluate integrals and apply Gamma and Beta functions in solving mathematical problems. |
| 6 | Differentiation under Integral Sign and rectification<br><br>**Objective:** To learn techniques of differentiation under the integral sign and rectification of curves.<br><br>**Outcome:** Ability to evaluate integrals using differentiation under the integral sign and compute arc length of curves accurately |
| 7 | Double Integrals: Evaluation and Changing the Order of Integration<br><br>**Objective:** To understand the evaluation of double integrals and the method of changing the order of integration.<br><br>**Outcome:** Ability to compute double integrals efficiently and simplify problems by changing the order of integration. |
| 8 | Double Integrals: Evaluation using Polar Coordinates and Applications<br><br>**Objective:** To learn evaluation of double integrals using polar coordinates and their applications in finding areas and related quantities.<br><br>**Outcome:** Ability to convert double integrals into polar form and evaluate them to solve problems involving area and physical applications. |
| 9 | Triple Integrals: Evaluation and Applications<br><br>**Objective:**To develop understanding and application of triple integrals for evaluating functions over three-dimensional regions using appropriate coordinate systems.<br><br>**Outcome:**Ability to evaluate triple integrals in different coordinate systems and apply them to determine limits and compute volumes of three-dimensional regions. |
| 10 | Numerical Solutions of Ordinary Differential Equations and Numerical Integration<br><br>**Objective:**To develop understanding and application of numerical methods for solving first-order differential equations and evaluating definite integrals.<br><br>**Outcome:**Ability to apply numerical methods such as Euler's, Runge–Kutta, Trapezoidal, and Simpson's rules to solve differential equations and evaluate integrals with error estimation. |
| | **SCILAB**:<br>(i) Plotting graphs of functions using cartesian and polar coordinates, (ii) Euler Method, (iii) Modified Euler Method (iv) Runge-Kutta Method of fourth order<br><br>**Objective:**To develop practical skills in using SCILAB for plotting graphs and implementing numerical methods for solving differential equations.<br><br>**Outcome:** Ability to use SCILAB to plot functions in Cartesian and polar coordinates and apply Euler, Modified Euler, and Runge–Kutta methods to solve differential equations. |

| | |
|---|---|
| | **SCILAB**:<br>(i) Trapezoidal Rule (ii) Simpson's 1/3rd Rule, (iii) Simpson's 3/8th rule<br>**Objective:**To implement numerical integration methods in SCILAB, for evaluating definite integrals.<br>**Outcome:** Ability to implement SCILAB programs to numerically evaluate integrals using Trapezoidal Rule, Simpson's 1/3rd Rule, and Simpson's 3/8th Rule. |

**Text Books:**

1. B S Grewal [2017] Higher Engineering Mathematics, Khanna Publishers.
2. B V Ramana [2009] Higher Engineering Mathematics, Mc Graw Hill Publications
3. N.P. Bali [2007] Engineering Mathematics, Laxmi Publication 8th edition.

**Reference Books:**

1. Kreyszig, Erwin 10thEd [2011] Advanced Engineering Mathematics, New Delhi Wiley Eastern Limited.
2. D.G. Zill and M.R. Cullen, III ed. 3rd reprint [2009] Advanced Engineering Mathematics, Narosa Publications
3. Ramachandran, Hema [2018] SCILAB (A Free Software to MATLAB), S. Chand

**Useful Links:**

1. **https://nptel.ac.in/courses/111105122 (Integral and Vector Calculus)**
2. **https://nptel.ac.in/courses/111106100 (Differential Equations for**

**Assessment Methodology:**

| **Type of Assessment** | **Assessment Tools** |
|---|---|
| **Continuous Assessment (CA)**<br><br>**(20 Marks)** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>**OR**<br>Any 02 Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Assignment<br>• Certification Udemy/Coursera (Approved by instructor)<br>• Open Book Test<br>• Working model / Simulation of a course-based concept. |
| **Mid Semester Examination (MSE)**<br><br>**(30 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes) |
| | • Total Marks: 30 |

| | |
|---|---|
| **End Semester Examination (ESE)**<br>**(50 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>● Q1 A or B - 10 marks<br>● Q2 A or B - 10 marks<br>● Q3 A or B - 10 marks<br>● Q4 A or B - 10 marks<br>● Q5 A or B - 10 marks<br>● For each question, A and B should be based on the same CO.<br>● ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>● Time: 120 minutes (02 hours)<br>● Total Marks: 50 |
| **Term work**<br><br>**(25 Marks)** | ● Active Participation (Lab) = 05 marks<br>● Tutorial Submission = 20 marks |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2BSC02 | Environmental Science | **L** | **P** | **T** | **L** | **P** | **T** | **Total** |
| | | 2 | - | - | 2 | - | - | 2 |
| | | **Examination Scheme** | | | | | | |
| | | | **CA** | **MSE** | **ESE** | **TW** | **OR** | **PR** | **Total** |
| | | **Theory** | 20 | 30 | 50 | - | - | - | **100** |
| | | **Lab/Tut** | - | - | - | - | - | | - |
| | | **Total** | **100** | | | | | | |

| **Pre-Requisites:** | **NIL** |
|---|---|

**Course and Module Overview**

This course introduces the fundamentals of environmental science and engineering, emphasizing sustainable development, population dynamics, and the role of technology in environmental monitoring through IT, Remote Sensing, and GIS. It covers environmental pollution, including air, water, noise, and marine pollution, their toxic effects, treatment methods, and sustainable chemical practices. The course also explores geosciences, groundwater management, natural hazards, and disaster mitigation strategies. Students learn ecological principles, energy flow, species interactions, toxicology, and links between environment and public health. The energy module examines renewable and non-renewable energy sources, solar, nuclear, and biomass energy, along with their environmental impacts. Finally, it addresses waste management, including solid, hazardous, and e-waste, with integrated management approaches to minimize environmental harm. Overall, the course equips learners with the knowledge to understand, assess, and manage environmental challenges in engineering and societal contexts.

**Module 1 :** This module introduces the fundamental importance of environmental science and engineering in addressing modern environmental challenges. It emphasizes the role of engineers in achieving sustainable development while balancing technological growth and environmental protection. The module covers the significance of environmental science in engineering practice, sustainable development goals, population growth impacts, and the application of information technology, remote sensing, and GIS in environmental monitoring and management.

**Module 2 :** This module deals with various forms of environmental pollution and their adverse effects on ecosystems and human health. It also introduces methods for pollution control and sustainable chemical practices. Topics include air, water, noise, and marine pollution; toxic chemicals; water and wastewater treatment processes; principles of green chemistry; and pollution control technologies.

**Module 3:** This module provides an understanding of Earth systems, natural resources, and environmental hazards, highlighting the importance of disaster preparedness and mitigation. It covers landform formation, groundwater resources and related issues, geological hazards such as floods, earthquakes, and landslides, and disaster management and mitigation strategies.

**Module 4**: This module focuses on the biological aspects of the environment, emphasizing ecosystem functioning and the effects of toxic substances on living organisms. It includes ecosystem structure, energy flow, species interactions, principles of toxicology, bioaccumulation, and the relationship between environmental quality and public health.

**Module 5**: This module examines different energy sources and their environmental implications, highlighting the need for sustainable energy solutions. Topics include renewable and non-renewable energy sources, principles of solar, nuclear, and biomass energy, and the environmental impacts of energy production and use.

**Module 6: This** module addresses the growing problem of waste generation and emphasizes effective waste management for environmental protection and public health. It covers solid waste, hazardous waste, and e-waste management methods, along with integrated waste management strategies.

**Course Objectives:**

1. To provide students with a foundational and interdisciplinary understanding of environmental science and its real-world applications.
2. To develop awareness of ecological systems, biodiversity, and the effects of human activities on natural resources.
3. To introduce key environmental challenges such as pollution, waste management, energy sustainability, and natural hazards.
4. To promote the use of scientific tools and green technologies for monitoring, protection, and sustainable development.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion | |
| | CO1 | Students will be able to recall key concepts of sustainability, ecosystems, pollution, energy, and water/air quality. |
| | CO2 | Students will be able to explain the causes and effects of environmental pollution, explain basic environmental processes, and describe simple management and mitigation strategies to real-life engineering and societal problems, supporting sustainability |
| | CO3 | Student will be able to demonstrate the use of environmental tools, techniques and principles (GIS, remote sensing, water treatment methods, pollution control devices, and green chemistry principles) to address practical engineering problems and also perform numerical calculations related to COD/BOD, atom economy, productivity, and energy efficiency. |

| | | |
|---|---|---|
| | CO4 | Students will be able to analyze dataset related to solar efficiency, atom economy, population dynamics, ecosystem productivity (NPP), pollution studies, Margin of safety and water quality indicators (BOD and COD) and observe trends, further interpret their implications for sustainability, resource use, ecological balance, and environmental quality. |
| | CO5 | Students will be able to critique the sustainability of energy resources and evaluate the effectiveness of environmental mitigation strategies. |
| | CO6 | Students will investigate advanced technologies for pollution control, waste reduction, and ecological conservation to propose innovative environmental solutions and communicate them through technical reports/presentation |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Need for Environmental Science and Engineering** | **06** |
| | | After completing this module, students will be able to:<br>• **Define** the concepts of Sustainable Development Goals (SDGs), equity, carrying capacity, and environmental legislation.<br>• **Explain** the role of Environmental Science in engineering and population growth models.<br>• **Apply** population growth equations and Remote Sensing & GIS techniques.<br>• **Analyze** growth models and the impact of carrying capacity on sustainable development.<br>• **Evaluate** environmental laws and GIS applications for climate change and resource management. | |
| | 1.1 | Introduction to-UN Sustainable Development Goals. Intergenerational and Intragenerational Equity.<br>Role of Environmental Science in Engineering. | |
| | 1.2 | Concept of Carrying capacity and its impact on sustainable development. | |
| | 1.3 | Population dynamics & Growth Models-Exponential growth (J-curve), Logistic growth (S-curve), Comparison and examples. Numerical on Population growth | |

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| | 1.4 | Environmental Protection Act-Environmental legislation (EPA 1986). Introduction to ISO 14000 Standard | |
| | 1.5 | Remote Sensing & GIS-Basics of remote sensing, GIS concepts Applications in resource assessment & climate change. | |
| Self-Learning Topics: Population explosion in India – causes and environmental impacts | | | |
| **2** | | **Environmental Pollution - Toxicity, Treatment and Sustainable Chemical Practices** | **08** |
| | | After completing this module, students will be able to **Define** landform controls, groundwater systems, and geological hazards.<br>• **Explain** the influence of geological structure, climate, and human activities on landform formation and degradation.<br>• **Apply** concepts of groundwater movement and hazard prediction to real-world scenarios.<br>• **Analyze** the causes and impacts of floods, landslides, earthquakes, and volcanoes.<br>• **Evaluate** disaster management strategies including mitigation, preparedness, and early warning systems. | |
| | 2.1 | Air Pollution – Particulate Matter & Atmospheric Reactions- Particulate Matter: $PM_{10}$ and $PM_{2.5}$.Sources and health/environmental effects, Thermochemical reactions in the atmosphere, Photochemical reactions and smog formation | |
| | 2.2 | Toxic Chemicals and Pollutants- Sources and environmental impact of Indoor Air Pollution, Persistent organic pollutants, Air toxics: CO, $O_3$, VOCs, (Peroxyacetyl Nitrate) PAN, Heavy metals (Hg, Cd, Pb, Cr) Metalloids (Arsenic ). | |
| | 2.3 | Control Devices for Particulate Matter: Principle and Working Of: Cyclone Separator, And Electrostatic Precipitator | |
| | 2.4 | Water Quality Parameters-Dissolved Oxygen (DO) – concept and significance, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and its importance in water quality | |
| | 2.5 | Water Pollution-Abatement Measures-Effluent and sewage treatment plants. Numerical on Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) | |

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| | 2.6 | Control and Abatement Measures for: Thermal, Marine Pollution, Noise pollution | |
| | 2.7 | Ibuprofen synthesis – case study based on green chemistry principles, Atom economy concept. Numerical problems on atom economy, E- factor | |
| Self-Learning Topics: Green Chemistry principles, Acid Rain-and its impact on environment, Global warming. | | | |
| **3** | **Geosciences, Groundwater Issues and Disaster Mitigation** | | **04** |
| | After completing this module, students will be able to<br>• **Define** landform controls, groundwater systems, and geological hazards.<br>• **Explain** the influence of geological structure, climate, and human activities on landform formation and degradation.<br>• **Apply** concepts of groundwater movement and hazard prediction to real-world scenarios.<br>• **Analyze** the causes and impacts of floods, landslides, earthquakes, and volcanoes.<br>• **Evaluate** disaster management strategies including mitigation, preparedness, and early warning systems. | | |
| | 3.1 | Controls on landform formation: Geological structure, Climate and weathering. Human influence on landform modification. | |
| | 3.2 | Land resources and land degradation, Groundwater occurrence and movement, Effects of excessive groundwater extraction Land subsidence and its impacts. Groundwater quality and contamination sources | |
| | 3.3 | Introduction to catastrophic geological hazards, -Floods, landslides, earthquakes, volcanoes, Causes and Impacts of geological disasters | |
| | 3.4 | Prediction of hazards and early warning systems- Mitigation, preparedness, and disaster management strategies for cyclones, floods,earthquake. | |
| Self-Learning Topics: -Earth systems: lithosphere, hydrosphere, Atmosphere. Formation of igneous and metamorphic rocks. Natural disaster -tsunami, avalanche, cloud burst- causes, impact and mitigation | | | |
| **4** | **Environmental Biology, Ecology and Toxicology** | | **05** |
| | After completing this module, students will be able to<br>• Define ecosystem processes, ecological interactions, toxicology, and microbiology concepts.<br>• Explain energy flow, ecological productivity, succession, and species interactions.<br>• Analyze ecological productivity, efficiency, and margin of safety using quantitative approaches.<br>• Apply concepts of food chains, food webs, bioaccumulation, and biomagnification to | | |

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| | ecological scenarios.<br>• Evaluate the impacts of toxic substances and biological invasions on ecosystems and human health. | | |
| | 4.1 | Energy Flow in Ecosystems, Ecological Productivity Numerical on productivity and efficiency**.** | |
| | 4.2: | Food Chains and Food Webs, Ecological Succession<br>Concept of Community Ecology. | |
| | 4.3 | Species Interaction - Predation, Herbivory, Parasitism, Allelopathy and Biological Invasions, Concepts of gene pool, biopiracy and bio-prospecting | |
| | 4.4 | Toxicology Acute vs chronic toxicity, Bioaccumulation and Bio magnification, Margin of safety-Problems and Case Study | |
| | Self-Learning Topics: -Basics of Ecology, Selected Major Water-Borne Diseases And Air-Borne Diseases**.** | | |
| **5** | | **Energy and Environment** | **04** |
| | After completing this module, students will be able to<br>• **Define** principles of solar energy, biomass energy, and renewable energy systems.<br>• **Explain** the working of solar collectors, photovoltaics, and biomass conversion processes.<br>• **Apply** numerical methods to analyze photovoltaic energy generation.<br>• **Analyze** the advantages, limitations, and environmental impacts of nuclear and renewable energy sources.<br>• **Evaluate** the effects of large-scale exploitation of renewable energy resources on the environment. | | |
| | **5.1** | Solar Energy-Principles of solar energy, Solar collectors and photovoltaics (basic working). Numerical on photovoltaics | |
| | **5.2** | Nuclear energy: Environmental View -Advantages and limitations of nuclear energy | |
| | **5.3** | Renewable Energy Principles for Generation of hydropower, tidal, ocean thermal, wind, and geothermal power.<br>Impact Of Large-Scale Exploitation of Renewable Energy Sources | |

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| | **5.4** | Bio-mass Energy- Definition, sources, advantages, disadvantages, Biomass-conversion to biofuel based on pyrolysis. | | |
| Self-Learning Topics: Renewable Energy and Non-Renewable Energy Resources: Advantages and Limitations, Nuclear energy: fission and fusion (concept only)- Case study | | | | |
| **6** | | **Waste Management** | **03** | |
| After completing this module, students will be able to<br>• **Define** solid waste, hazardous waste, and biomedical waste concepts.<br>• **Explain** methods of waste management including landfill, incineration, pyrolysis, and deep well injection.<br>• **Apply** appropriate techniques for handling and treatment of biomedical and hazardous waste.<br>• **Analyze** the characteristics and health impacts of different types of waste.<br>• **Evaluate** integrated waste management practices using case studies | | | | |
| | 6.1 | Solid Waste Management-Deep well injections, Plasma gasification /pyrolysis, Sanitary Landfill, Incineration | | |
| | 6.2 | Hazardous Waste – Types, Characteristics and Health Impacts. | | |
| | **6.3** | Bio Medical Waste -Handling and Treatment,<br>Integrated waste management-case study | | |
| **Self-Learning Topics:** Solid Waste - Types and Sources, Composting | | | | |
| | | TOTAL LECTURES | **30** | |

Text Books:


1. "Environmental Biology" by P.S. Verma & V.K. Agarwal, *S. Chand Publishing, December ,2000 edition*
2. "Environmental Chemistry" by A.K. De
   *New Age International Publishers, 11th Edition (Multicolor Edition, 2023)*
3. Environmental Chemistry" by B.K. Sharma
   *Krishna Prakashan Media, 12th Edition,2014*
4. "Perspectives in Environmental Studies" by Anubha Kaushik & C.P. Kaushik-New Age International, 8th Edition, 2024

Reference Books:

1. Environmental Science" by G. Tyler Miller & Scott Spoolman
*Cengage Learning India, 16th Edition (2023)*

2. Essentials of Geology" by Frederick K. Lutgens & Edward J. Tarbuck
*Pearson Education, 12th Edition*

3. Fundamentals of Ecology" by Eugene P. Odum & Gary W. Barrett
*Cengage Learning, 5th Edition*

4.Environmental Studies: From Crisis to Cure by R. Rajagopalan-*Oxford University Press, 4th Edition, 2023*

**Useful Links:**

1.. Global leader in wildlife conservation and environmental advocacy- wwf.org

2.. Research on chemicals, agriculture, and consumer safety. - ewg.org

3.. Climate data, satellite imagery, and Earth system science. climate.nasa.gov

4.News and analysis on environmental issues and green living. - ecowatch.coms

**5. https://www.e-education.psu.edu/eme812/node/4**

**6.** https://cdn.cseindia.org

**Assessment Methodology**:

| Type of Course | Assessment Tool | Marks Distribution |
|---|---|---|
| **BSC** | **Continuous Assessment**<br>**(20 Marks)** | Certification: NPTEL (20 Marks) (Approved by instructor)<br>OR<br>Any two Pedagogies (10 marks each)<br>● MCQ /Class Test<br>● Case study/Assignment<br>● GATE based Assignment<br>● MOOCs Certification: (Approved by instructor)<br>● Open Book Test<br>● Working model / simulation of a course-based concept. |
| | **Mid Semester Examination**<br>**(30 Marks)** | Question Paper Pattern is as follows:<br>All Questions are compulsory.<br>● Q1 A or B - 10 marks<br>● Q2 A or B - 10 marks<br>● Q3 A or B - 10 marks<br>● For each question, A and B should be based on the same CO.<br>● MSE should be based on 50% syllabus.<br>● Time: 90 minutes (1 hour 30 minutes)<br>● Total Marks: 30 |
| | **End Semester Examination** | Question Paper Pattern is as follows:<br>All Questions are compulsory. |

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|---|---|---|
| | **(50 Marks)** | ● Q1 A or B - 10 marks<br>● Q2 A or B - 10 marks<br>● Q3 A or B - 10 marks<br>● Q4 A or B - 10 marks<br>● Q5 A or B - 10 marks<br>● For each question, A and B should be based on the same CO.<br>● ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>● Time: 120 minutes (2 hours)<br>● Total Marks: 50 |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | P | T | L | P | T | Total |
| | | 3 | - | 1 | 3 | - | 1 | 4 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| 25FE2ESC01 | Engineering Mechanics | Theory | 20 | 30 | 50 | - | - | - | 100 |
| | | Lab/Tut | - | - | - | 25 | | - | 25 |
| | | Total | 125 | | | | | | |

| Pre-Requisite Courses: | Fundamentals of Engineering Mathematics –I |
|---|---|

**Course Overview:**

Engineering Mechanics is a foundational course designed for undergraduate engineering students who want to build strong problem-solving skills and a clear understanding of how forces and motion affect real-world engineering systems. This course forms the backbone for many advanced subjects in mechanical, civil, robotics, and related engineering disciplines.

The course matters because it helps students learn how to analyze and predict the behavior of particles, rigid bodies, and simple mechanical systems under various forces and motions—skills that are essential for safe, efficient, and practical engineering design.

The course is structured around core topics in statics, dynamics, and introductory robot kinematics, supported by problem-solving sessions, laboratory experiments, and continuous assessments. Students are expected to have basic prior knowledge of trigonometry, vector algebra, and elementary motion concepts.

**Module 1 Overview**

This module introduces the fundamental concepts of force systems and their applications in engineering mechanics. Students learn to classify different types of forces and understand the principle of transmissibility. The module covers analytical methods for the composition and resolution of forces, along with the determination of resultants for coplanar and non-coplanar force systems. Concepts of moments, couples, and Varignon's theorem are included to help students analyze the rotational effects of forces. This module forms the foundation for understanding equilibrium and load analysis in engineering structures and mechanical systems.

**Module 2 Overview**

This module focuses on the determination of centroids of plane laminas composed of simple and composite geometrical shapes. Students learn the physical significance of the centroid and its role in stability, balance, and load distribution. Analytical techniques are applied to locate centroids, which are essential in the design and analysis of structural components, machine parts, and mechanical assemblies. The module helps students visualize how geometry influences mass distribution in engineering applications.

**Module 3 Overview**

In this module, students study the conditions necessary for equilibrium of particles and rigid bodies subjected to various force systems. Emphasis is placed on drawing accurate free-body diagrams and applying equilibrium equations to analyze beams, frames, and other rigid bodies. The module also

introduces friction, including its laws and practical implications. Students solve real-life engineering problems involving ladders, wedges, blocks, and inclined planes, gaining insight into how friction affects stability and motion in mechanical systems.

**Module 4 Overview**

This module deals with the study of motion without considering the forces that cause it. Students analyze rectilinear and curvilinear motion of particles, including motion with variable acceleration and projectile motion. The module also introduces the kinematics of rigid bodies through general plane motion and the instantaneous centre of rotation method. These concepts are crucial for understanding the motion of mechanisms, linkages, and machine components used in engineering applications.

**Module 5 Overview**

This module establishes the relationship between forces and motion. Students apply Newton's laws, D'Alembert's principle, the work–energy principle, and the impulse–momentum principle to solve dynamic problems. Topics such as impact and collision, motion under gravitational and frictional forces, and spring-mass systems are included. The module enables students to analyze real-world dynamic systems and predict their behaviour under various loading and motion conditions.

**Module 6 Overview**

This module introduces students to the basics of robot mechanics and kinematics. Students learn about degrees of freedom, Denavit–Hartenberg parameters, and homogeneous transformation matrices. The focus is on forward kinematics of simple serial robots, limited to two degrees of freedom. This module bridges classical engineering mechanics with modern automation and robotics, providing a foundation for advanced studies in robotics and mechatronics.

| | After successful completion, the students will be able to | |
|---|---|---|
| **Course Outcomes** | **CO1** | state fundamental principles and definitions used in statics and dynamics systems. |
| | **CO2** | Explain the behavior of particles and rigid bodies under different force systems by interpreting free-body diagrams using basic principles of engineering mechanics. |
| | **CO3** | Apply principles of statics and dynamics to analyze and solve problems involving force systems, equilibrium, friction, and motion of particles and rigid bodies. |
| | **CO4** | Analyze simple systems by breaking down force interactions and motion into components to determine internal forces, support reactions, and dynamic responses. |
| | **CO5** | Evaluate the stability, efficiency, and feasibility of mechanical systems and structures by assessing the effects of forces, friction, and motion under given loading conditions. |
| | **CO6** | Design and develop simplified models or solutions for real-life engineering problems by integrating concepts of force analysis, equilibrium, friction, and motion |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | | **System of Forces** | 08 |
| | | **Learning Outcomes:**<br>After completing this module, students will be able to:<br>1. Identify and classify different types of force systems such as concurrent, parallel, coplanar, and non-coplanar forces.<br>2. Explain the principle of transmissibility and its significance in force analysis.<br>3. Resolve forces into rectangular components and compose forces using analytical methods.<br>4. Determine the resultant of coplanar force systems using force and moment principles.<br>5. Calculate moments of forces about a point and apply Varignon's theorem to simplify force analysis.<br>6. Analyze the effect of couples and equivalent force–couple systems on rigid bodies. | |
| | **1.1** | Classification of force systems, Principle of transmissibility, composition and resolution of forces. Resultant of coplanar force system (Concurrent forces, Parallel forces, general system of forces). | |
| | **1.2** | Moment of a force about a point, Varignon's Theorem, Couple force system. | |
| | **1.3** | Resultant of non-coplanar forces (Space forces), Concurrent force system | |
| | **Self-Learning Topics:** Moment of coplanar forces in space about a point and line | | |
| 2 | | **Centroid** | 04 |
| | | **Learning Outcomes:**<br>After completing this module, students will be able to:<br>1. Define the concept of centroid and explain its physical significance in engineering applications.<br>2. Locate the centroid of plane laminas consisting of simple geometrical shapes using analytical methods.<br>3. Determine the centroid of composite plane areas by decomposing them into basic shapes.<br>4. Apply centroid concepts to analyze stability, balance, and load distribution in engineering components. | |
| | **2.1** | Centroids of plane laminas: Plane lamina consisting of primitive geometrical shapes. | |
| | **2.2** | Centroids of plane homogenous cut cross section areas. | |
| | **Self-Learning Topics:** Centroid of Sectors and composite shapes | | |
| 3 | | **Equilibrium of bodies under force systems and Friction** | 10 |
| | | After completing this module, students will be able to:<br>1. Explain the conditions required for equilibrium of particles and rigid bodies under various force systems.<br>2. Draw accurate free-body diagrams for rigid bodies, beams, and connected systems.<br>3. Analyze equilibrium of beams subjected to point loads, UDLs, UVLs, and couples.<br>4. Determine support reactions for different types of beam supports such as hinged, roller, and fixed supports.<br>5. Explain the laws of friction and define angle of friction, angle of repose, and cone of friction.<br>6. Solve practical engineering problems involving friction in wedges, | |

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| | | ladders, blocks, and inclined planes. | |
| | **3.1** | **Basics of Equilibrium**<br>Conditions of Equilibrium for concurrent forces, parallel forces and general forces, Couples; Equilibrium of rigid bodies, free body diagrams | |
| | **3.2** | **Equilibrium of Beams**<br>Types of beams: simple and compound beams, Types of Loads: Point Loads, Uniformly Distributed load (UDL), Uniformly varying loads (UVL), Couples Type of supports; Hinged Support, Fixed Support, Roller Support Determination of support reactions for various types of loaded beams, Problems on Equilibrium of Bars, Rollers, Beams. | |
| | **3.3** | **Friction**<br>Laws of friction, Angle of friction, Angle of Repose, Cone of Friction, Problems on Wedge and Block friction, Ladder Friction | |
| | **Self-Learning Topics:** Equilibrium of ropes, wires, rods | | |
| **4** | | **Kinematics of Particles & Rigid Bodies** | **10** |
| | | **Learning Outcomes:**<br>After completing this module, students will be able to:<br>1. Describe rectilinear and curvilinear motion of particles using kinematic principles.<br>2. Analyze motion with variable acceleration using equations of motion and motion curves.<br>3. Resolve velocity and acceleration into rectangular, tangential, and normal components.<br>4. Analyze projectile motion and motion along curved paths in engineering applications.<br>5. Explain general plane motion of rigid bodies using the instantaneous centre of rotation method.<br>6. Apply kinematic concepts to analyze the motion of simple mechanisms and linkages. | |
| | **4.1** | Motion of particles with variable acceleration. Motion along horizontal curved path, Velocity and acceleration in terms of rectangular components, tangential and normal component of acceleration, Motion Curves up to liner acceleration, projectile motion | |
| | **4.2** | Introduction to General Plane motion (GPM), problems based on Instantaneous Centre (ICR) method (for two linkage mechanisms) | |
| | **Self-Learning Topics:** Rectilinear motion including Motion under Gravity | | |
| **5** | | **Kinetics of Particles** | **10** |
| | | **Learning Outcomes:**<br>After completing this module, students will be able to:<br>1. Apply Newton's laws of motion and D'Alembert's principle to analyze dynamic systems.<br>2. Formulate equations of dynamic equilibrium for particles in motion.<br>3. Apply impulse–momentum principles to solve problems involving impact and collision.<br>4. Evaluate energy transfer using the work–energy principle for various force systems.<br>5. Analyze motion under gravitational, frictional, and spring forces.<br>6. Determine energy loss during inelastic collisions and assess system performance. | |
| | **5.1** | **Force and Acceleration:** D'Alembert's Principle, Concepts of Inertia force, Equations of dynamic equilibrium. | |
| | **5.2** | **Force and Time:** Impulse and momentum Principle. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central | |

| | | | |
|---|---|---|---|
| | | Impact, Oblique Central Impact, Loss of Kinetic energy in collision in inelastic bodies | |
| | **5.3** | **Force and Velocity:** Work Energy Principle, Work done by<br>i) force parallel to the direction of motion and inclined force<br>ii) Gravitational force (Vertical motion and motion along inclined plane)<br>iii) Frictional force (Horizontal plane and Inclined plane)<br>iv) Spring force | |
| | **Self-Learning Topics:** D'Alembert's principle and Work-Energy principle for rotating motion | | |
| **6** | | **Introduction to Robot Kinematics** | **03** |
| | | **Learning Outcomes:**<br>After completing this module, students will be able to:<br>1. Explain basic concepts of robot mechanics and types of robotic manipulators.<br>2. Define degrees of freedom and identify joints and links in robotic systems.<br>3. Apply Denavit–Hartenberg (D-H) parameters to model simple robotic manipulators.<br>4. Construct homogeneous transformation matrices for serial robots.<br>5. Determine the position and orientation of the end-effector using forward kinematics for simple 2-DOF robots. | |
| | **6.1** | Fundamental of Robot Mechanics, Degree of Freedom, D- H Parameters, robot kinematics (Forward). | |
| | **6.2** | Homogeneous transformation (limited to 2 DOF Serial robot) | |
| | **Self-Learning Topics:** Case study | | |
| | | **Total** | **45** |

**List of Tutorials:**

| Session No. | Topic / Module | Key Concepts Covered | Objectives | Outcomes | CO Mapping |
|---|---|---|---|---|---|
| 1 | Basics of Force Systems | Classification of forces, composition and resolution of forces | To understand different types of force systems and their representation | Students will be able to classify forces and resolve them into components | CO1, CO2 |
| 2 | Resultant of Coplanar Forces | Concurrent and parallel force systems | To determine resultant forces using analytical methods | Students will be able to compute resultant of coplanar force systems | CO2, CO3 |
| 3 | Moments and Couples | Moment of force, Varignon's theorem, couples | To analyze rotational effects of forces | Students will be able to calculate moments and apply Varignon's theorem | CO2, CO3 |
| 4 | Centroid of Plane Lamina | Centroid of simple and composite plane areas | To locate centroid of different geometrical shapes | Students will be able to determine centroid of composite sections | CO3, CO4 |
| 5 | Equilibrium of Rigid Bodies | Conditions of equilibrium, Free Body Diagrams | To apply equilibrium conditions using FBD | Students will be able to draw FBDs and solve equilibrium problems | CO3, CO4 |

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|---|---|---|---|---|---|
| 6 | Equilibrium of Beams | Simply supported beams, point load, UDL, UVL | To analyze beam reactions under different loads | Students will be able to calculate support reactions of beams | CO3, CO4 |
| 7 | Friction | Laws of friction, angle of friction, angle of repose, ladder friction | To understand frictional effects in mechanical systems | Students will be able to solve friction-related problems | CO3, CO5 |
| 8 | Kinematics of Particles | Rectilinear motion, variable acceleration, projectile motion | To study motion of particles under different conditions | Students will be able to analyze particle motion using kinematic equations | CO2, CO3 |
| 9 | Kinematics of Rigid Bodies | General plane motion, Instantaneous Centre of Rotation | To understand motion of rigid bodies | Students will be able to analyze motion using ICR method | CO3, CO4 |
| 10 | Kinetics – Force and Acceleration | D'Alembert's principle, inertia force, dynamic equilibrium | To relate force and motion in dynamic systems | Students will be able to apply D'Alembert's principle in problem solving | CO3, CO4 |
| 11 | Kinetics – Energy and Momentum | Work-energy principle, impulse-momentum, impact and collision | To analyze energy and momentum relationships | Students will be able to solve problems on energy and collision | CO3, CO5 |
| 12 | Robot Kinematics and Revision | Degrees of freedom, D-H parameters, forward kinematics | To introduce basic robotics concepts | Students will be able to analyze simple robotic mechanisms | CO6 |

**List of Home Assignments:**

| Sr. No. | Title of the Assignment | No. of Problems |
|---|---|---|
| 1 | Resultant of Coplanar & non-co-planar force system | 4 |
| 2 | Centroid of Composite plane Laminas | 4 |
| 3 | Equilibrium of System of Coplanar Forces including support reaction of beams | 4 |
| 4 | Equilibrium of bodies on inclined plane and problems involving ladder. | 4 |
| 5 | Kinematics of particles (Variable acceleration) | 4 |
| 6 | Kinetics of particles (D'Alembert's Principle, Impulse-momentum Principle, Impact and Collisions.) | 4 |

**Text Books:**

1. Engineering Mechanics by F. L. Singer, Harper& Raw Publication
2. Engineering Mechanics by Beer &Johnston, Tata McGraw Hill
3. Engineering Mechanics by R. C. Hibbeler.

**Reference Books:**

1. Engineering Mechanics by Macklin & Nelson, Tata McGraw Hill
2. Engineering Mechanics (Statics) by Meriam and Kraige, Wiley Bools
3. Engineering Mechanics (Dynamics) by Meriam and Kraige, Wiley Bools
4. Introduction to Industrial Robotics by Ramchandran Nagrajan, Pearson publication

**Useful Links:**

1. https://archive.nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/112106286
3. https://archive.nptel.ac.in/course.html

**Assessment Criteria:**

1. Continuous Assessment 1 & 2; 10 Marks each based on topics covered in class.

2. Mid Semester Examination (MSE) (30 Marks) will be based on 50% of the syllabus. The MSE question paper has three main questions.
   Question 1 (10 marks) has four sub-questions. Attempt any two.
   Questions 2 and 3 each have two options (A or B). Attempt only one option from each question. Each of these questions carries 10 marks.

3. End Semester Examination (ESE) (50 Marks) will be based on the entire syllabus. The ESE question paper has five main questions.
   Question 1 (10 marks) has four sub-questions. Attempt any two.
   Questions 2 to 5 each have two options (A or B). Attempt only one option from each question. Each of these questions carries 10 marks.

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2PCC01 | Analog and Digital Circuits | L | P | T | L | P | T | Total |
| | | 2 | 2 | - | 2 | 1 | - | 3 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| | | Theory | 20 | 30 | 50 | 25 | - | - | 125 |
| | | Lab/Tut | - | - | - | | - | 25 | 25 |
| | | Total | 150 | | | | | | |

| Pre-Requisite Courses: | 25FE1BSC02 Applied Physics |
|---|---|
| | 25FE1ESC02 Basic Electrical and Digital Electronics |

**Course and Module Overview**

This course provides a comprehensive understanding of analog and digital electronics, covering semiconductor devices, amplifier analysis, and logic circuit design. It builds a strong foundation for analyzing, designing, and applying electronic circuits used in communication systems, embedded systems, and digital electronics, enabling learners to build and evaluate modern electronic systems.

**Module 1** introduces the semiconductor devices, focusing on Bipolar Junction Transistors (BJTs) and EMOSFETs; their construction, working, and characteristics of BJT in CE configuration and E-MOSFET in CS configuration. It includes current equations, input/output and transfer characteristics, and explains the regions of operation of both devices along with a comparative understanding of BJT and MOSFET technologies.

**Module 2** emphasizes the biasing and stability of the operating point in transistor circuits. It covers DC load line analysis, Q-point determination, stability factors, and the design of practical biasing circuits for BJTs and MOSFETs to ensure reliable amplifier operation. The module also explains factors affecting Q-point stability and the importance of stability factor.

**Module 3** covers the small-signal analysis of amplifiers using BJT and MOSFET models. It includes small signal analysis of CE and CS amplifiers and comparison with other configurations. The module also explains the frequency response of amplifiers and the role of coupling, bypass, and parasitic capacitors. Additionally, it introduces the differential amplifier, focusing on key performance parameters.

**Module 4** introduces logic families and combinational logic circuit design. The module explores TTL and CMOS logic families, performance metrics, and comparisons among logic technologies. It also covers the design of code converters, adders, and subtractors circuits, emphasizing efficient and reliable digital system design.

**Module 5** focuses on sequential logic circuits, covering flip-flops, counters, and shift registers. It

explains triggering methods, conversions, and applications of sequential circuits as counter, data storage, and shift register.

**Module 6** deals with the design of sequential circuits, including synchronous and asynchronous counters, MOD-N counters, and an introduction to finite state machines using Moore and Mealy models; enabling the design structured and application-oriented digital systems.

Overall, the course builds a strong foundation in analog and digital electronics, integrating device-level understanding with circuit design and analysis. It equips learners with the ability to analyze, design, and optimize electronic circuits, preparing them for advanced studies and practical applications in electronics and related engineering fields.

| | **After successful completion of the course, the students will be able to** | |
|---|---|---|
| **Course Outcomes** | CO1 | State the fundamental principles of semiconductor devices and identify the terminal characteristics and parameters of BJTs and MOSFETs. (Remembering) |
| | CO2 | Explain the operational mechanisms of analog amplifiers and the functional logic of basic sequential circuits. (Understanding) |
| | CO3 | Solve circuit based numerical related to BJT and E-MOSFET biasing. (Applying) and concept of shift registers. |
| | CO4 | Examine the performance of small signal amplifiers using linear models and analyze the behaviour of sequential logic circuits using state diagrams. (Analyzing) |
| | CO5 | Compare the different types of flip-flops and performance parameters of amplifier. (Evaluating) |
| | CO6 | Design a small signal analog amplifier circuit using BJTs/MOSFETs and Asynchronous Digital counters using flip-flops. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | **Semiconductor Devices** | | 04 |
| | 1.1 | BJT: Construction, Working, input and output characteristics of BJT in CE configuration. | |
| | 1.2 | MOSFET: Construction, Operation, current equation, output and transfer characteristics of E-MOSFET in CS configuration, Regions of operations of BJT and MOSFET. | |
| | **Self-Learning Topics**: Comparison between BJT and MOSFET. | | |
| | **Biasing and Stability of Operating Point** | | |
| | 2.1 | Concept of DC load line, Q point, stability and stability factor | |

| | | | |
|---|---|---|---|
| **2** | 2.2 | Biasing circuits for BJT using Fixed bias & Voltage divider Bias. Design of fixed bias circuit and Voltage divider bias. | 05 |
| | 2.3 | Biasing circuits for E-MOSFET for voltage divider bias. | |
| | 2.4 | Parameters impacting variation in Q point and significance of Stability factor for voltage divider bias. | |
| | **Self-Learning Topics**: Collector to base bias in BJT and self-bias in MOSFET. | | |
| **3** | **Analysis of Small Signal Amplifiers** | | 06 |
| | 3.1 | Small Signal model of BJT (hybrid pi) and MOSFET | |
| | 3.2 | Small Signal Analysis of CE amplifier, Comparison of CE, CB and CC amplifier | |
| | 3.3 | Small Signal Analysis of CS for E-MOSFET amplifier, Comparison of CS, CG and CD amplifier, | |
| | 3.4 | Low frequency and High frequency response of the amplifier and significance of coupling, bypass and parasitic capacitors | |
| | 3.5 | Introduction to Differential Amplifier: types and parameters like Differential gain, Common Mode gain, CMRR, Input and Output impedance | |
| | **Self-Learning Topics:** Small Signal h-parameters of BJT. | | |
| **4** | **Introduction to Logic families and Design of Combinational Logic Circuits** | | 05 |
| | 4.1 | Operation of TTL and CMOS inverter, performance metrics of Analog and Digital circuits. parameters of Digital circuits like speed, prorogation delay, set up and hold time, fan in fan out, Comparison between TTL, CMOS and ECL technology | |
| | 4.2 | Design using combinational circuits: Binary to Gray code, Gray to BCD code, BCD to 7 Segment Decoding. | |
| | 4.3 | Adder-Subtractor: 4-bit parallel adder (Binary /BCD), 4-bit adder subtractor. | |
| | **Self-Learning Topics:** ALU, application of gray code in digital communication system. | | |
| **5** | **Sequential Logic Circuits** | | 06 |
| | 5.1 | Introduction to Sequential Circuits: Using NAND technology, Flip flops (FF)- SR, JK, T, D, Master Slave JK flip flops, excitation table, triggering methods and flip flop conversions. | |
| | 5.2 | Counters: Introduction to Asynchronous and Synchronous counter, Up/Down Counter, Ring and Johnson Counter | |
| | 5.3 | Shift Register: Operation of shift register, types, Universal shift register | |
| | **Self-Learning Topics** Application of shift register in communication, Application of asynchronous counter in automated industrial counting. | | |
| **6** | **Design of Sequential Circuits** | | 04 |
| | 6.1 | Design of Synchronous and Asynchronous Counter, MOD-N counters. | |
| | 6.2 | Introduction to FSM, Moore and Mealy Circuits | |
| | **Self-Learning Topics**: LED Sequence Generator using Ring Counter, Frequency Division using Counters. | | |

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|---|---|
| **TOTAL** | **30** |

**Suggested List of Experiments:**

| Experiment Number | Title of the Experiment |
|---|---|
| 01 | Bipolar Junction Transistor characteristics<br>**Objective:**<br>To study the operation of a Bipolar Junction Transistor (BJT) in common emitter (CE) configuration and to analyze its input and output characteristics.<br>**Outcome:**<br>Students will be able to explain the operation of a BJT in CE mode, plot its input and output characteristics, and evaluate its input and output resistance. |
| 02 | BJT Biasing<br>**Objective:**<br>To study various biasing circuits of a Bipolar Junction Transistor (BJT), measure their DC parameters, and determine the stability factor.<br>**Outcome:**<br>Students will be able to explain the design and analysis of BJT biasing circuits for given specifications, evaluate DC parameters, and determine stability factors. |
| 03 | BJT Amplifier<br>**Objective:**<br>To study the operation of a BJT common emitter (CE) amplifier and analyze its performance parameters.<br>**Outcome:**<br>Students will be able to explain the working of a BJT CE amplifier, analyze the effect of the bypass capacitor, plot the frequency response, and determine key performance parameters such as voltage gain and bandwidth. |
| 04 | Transfer and Output Characteristics of EMOSFET<br>**Objective:**<br>To study the operation of an Enhancement-type MOSFET (EMOSFET) in common source (CS) configuration and analyze its transfer and output characteristics.<br>**Outcome:**<br>Students will be able to explain the operation of an EMOSFET in CS mode and plot its transfer and output characteristics. |
| 05 | MOSFET Amplifier<br>**Objective:**<br>To study the operation of a MOSFET common source (CS) amplifier and analyze its performance parameters.<br>**Outcome:**<br>Students will be able to explain the working of a MOSFET CS amplifier, plot its frequency response, and determine key performance parameters such as voltage gain and bandwidth. |

| | |
|---|---|
| 06 | EMOSFET Biasing<br>**Objective:**<br>To study the voltage divider biasing circuit of an Enhancement-type MOSFET and measure its DC parameters.<br>**Outcome:**<br>Students will be able to explain the design and analysis of the voltage divider biasing circuit for an EMOSFET based on given specifications and determine its DC parameters. |
| 07 | Flip-Flop<br>**Objective:**<br>To study the operation of SR, D, JK, and T flip-flops.<br>**Outcome:**<br>Students will be able to explain the operation and different types of flip-flops, and implement and verify their truth tables. |
| 08 | Flip-Flop Conversion<br>**Objective:**<br>To study the conversion of one type of flip-flop to another.<br>**Outcome:**<br>Students will be able to understand and perform flip-flop conversions such as JK to D, JK to T, and JK to SR flip-flops. |
| 09 | UP/Down Counter<br>**Objective:**<br>To study the design of counters using ICs such as 7490/7493 (ripple counters) and 74192/74193 (synchronous counters).<br>**Outcome:**<br>Students will be able to understand counter operation and implement UP/Down counter using JK or T flip flop |
| 10 | MOD-N Counter<br>**Objective:**<br>To study the design of MOD-N counter.<br>**Outcome:**<br>Students will be able to understand the design of MOD-N counter and implement it using IC7490. |
| 11 | MOD-16 Counter<br>**Objective:**<br>To study the design of sequential circuits using Logisim software.<br>**Outcome:**<br>Students will be able to understand the design of an asynchronous counter, implement it using Logisim software, and analyze its waveforms. |
| 12 | Shift Register<br>**Objective:**<br>To study the design of sequential circuits using Logisim software.<br>**Outcome:**<br>Students will be able to understand shift registers and their types, implement SISO and PIPO shift registers using Logisim software, and analyze their waveforms. |

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| 13 | Shift Register<br>**Objective:**<br>To study the design of sequential circuits using Logisim software.<br>**Outcome:**<br>Students will be able to understand bidirectional shift registers, implement them using Logisim software, and analyze their waveforms. |

**PROPOSED TASK BASED ACTIVITY**

**Suggested List of Tasks:**

| Task Number | Title of the Task | Task Description |
|---|---|---|
| 1 | Signal Amplification for Sensor Interface | You are working on a temperature monitoring system. Design and simulate a BJT CE amplifier to amplify a low-level sensor signal and verify suitable gain and operating region. |
| 2 | Low-Power Amplifier Selection | As a design engineer for a portable device, compare BJT and MOSFET amplifiers through simulation and recommend the suitable device based on power consumption and input impedance. |
| 3 | Stable Bias Design for Audio Circuit | Design a voltage divider bias BJT amplifier for an audio pre-amplifier and ensure a stable Q-point under parameter variation. |
| 4 | Biasing for MOSFET-Based Switching Circuit | Design and simulate a voltage divider biased E-MOSFET circuit for switching a low-power load and verify correct operation. |
| 5 | Gain Optimization in Amplifier Design | You are required to achieve a specified voltage gain. Simulate a CE amplifier, adjust component values, and justify the final design. |
| 6 | Frequency Response Improvement | Design an amplifier where low-frequency distortion is observed. Modify coupling and bypass capacitors to improve frequency response and validate through simulation. |
| 7 | Noise Reduction Using Differential Amplifier | Simulate a basic differential amplifier and demonstrate how common-mode noise is reduced compared to single-ended amplification. |
| 8 | Logic Family Selection for Digital System | As a digital designer, compare TTL and CMOS inverters in simulation and recommend the suitable logic family for a low-power application. |
| 9 | Digital Code Conversion for Display System | Design a BCD to 7-segment display system for a digital meter and verify correct display for different inputs. |
| 10 | Arithmetic Unit Design for Calculator | Design and simulate a 4-bit adder-subtractor block to be used in a simple calculator application. |
| 11 | Data Storage Using Flip-Flops | Design a flip-flop-based data storage unit that stores a single bit of data and verify its operation using clock and control signals. |
| 12 | Automated Counting System | Design and simulate an asynchronous or synchronous counter to count items on a conveyor belt and display the count. |

| | | |
|---|---|---|
| 13 | Pattern Generation Using Shift Registers | Design a shift-register-based LED pattern generator and observe the shifting sequence in simulation. |
| 14 | Sequence Control Using Ring Counter | Design a ring counter to control the sequence of traffic lights or LED indicators and verify correct operation. |
| 15 | Finite State Machine for Control Application | Design a Moore or Mealy FSM for a simple control system (e.g., door control or vending machine logic) and simulate state transitions. |

**Text Books:**


1 S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition
2 Boylestad and Nashelesky, "Electronic Devices and Circuits Theory", Pearson Education,11th Edition
3 R.P. Jain, "Modern Digital Electronics", Tata McGraw Hill Publication, 4th Edition.
4 Morris Mano, Michael D. Ciletti, "Digital Design", Pearson Education, Fifth Edition (2013).
5 A. Anand Kumar, "Fundamentals of Digital Circuits", PHI, Fourth Edition (2016).


**Reference Books:**


1 Jacob Millman, Christos C. Halkias, and Satyabrata Jit, "Integrated Electronics: Analog and Digital Circuits and Systems", McGraw Hill Education, 2nd Edition.
2 Donald A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition.
3 Thomas L. Floyd, "Digital Fundamentals", Pearson Education, 11th Edition.
4 Charles H. Roth Jr. and Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning, 7th Edition.
5 Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, "Digital Systems: Principles and Applications", Pearson Education, 12th Edition.


**Assessment Methodology:**

| Assessment Tools | Marks Distribution |
|---|---|
| **Continuous Assessment (CA) (20 Marks)** | Certification: NPTEL (20 Marks) (Approved by Instructor)<br>**OR**<br>Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by Instructor)<br>• Open Book Test<br>• Working model / Simulation of a course-based concept. |

| | |
|---|---|
| **Mid Semester Examination (MSE) (30 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |
| **End Semester Examination (ESE) (50 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>• Q1 A or B -10 marks<br>• Q2 A or B -10 marks<br>• Q3 A or B -10 marks<br>• Q4 A or B -10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (02 hours)<br>• Total Marks: 50 |
| **Term Work (25 Marks)** | • Laboratory Performance = 10 marks<br>• Assignments = 5 marks<br>• Attendance = 5 marks<br>• Task-Based Activity = 5 marks<br><br>Based on the performance and satisfactory completion of assigned laboratory work. |
| **Oral Examination (25 Marks)** | Oral examination will be based on the entire syllabus. |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2PCC01 | Materials & Metallurgy | L | P | T | L | P | T | Total |
| | | 2 | 2 | - | 2 | 1 | - | 3 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | TW | OR | PR | Total |
| | | Theory | 20 | 30 | 50 | 25 | - | - | 125 |
| | | Lab/Tut | - | - | - | - | - | 25 | 25 |
| | | Total | 150 | | | | | | |

| Pre-Requisite Courses: | Engineering Chemistry |
|---|---|

**Course Overview**

This course introduces first-year mechanical engineering students to the fundamental principles of materials science and metallurgy, emphasizing the relationship between structure, properties, and performance of engineering materials. It covers crystal structures, phase transformations, heat treatment processes, and mechanical behavior of materials. The course also explores advanced materials such as composites, nanomaterials, and smart materials along with modern testing techniques. Overall, it equips students with essential knowledge for material selection, processing, and application in engineering practice.

**Module 1: Introduction to Materials and Concept of Crystal**

This module lays the foundation of materials science by introducing different classes of engineering materials and their importance. It focuses on crystal structures, unit cells, and crystallographic concepts essential for understanding material behavior. The role of crystal defects and their influence on mechanical properties and deformation is also discussed.

**Module 2: Metal Alloys and Phase Diagrams**

This module covers the behavior of metals and alloys under different conditions, emphasizing cold working and recrystallization processes. It introduces the iron–carbon phase diagram and explains microstructural changes in steels and cast irons. The module also includes phase transformation diagrams such as TTT and CCT for analyzing material behavior.

**Module 3: Heat Treatment**

This module focuses on various heat treatment processes used to modify the properties of steels. It explains methods like annealing, normalizing, hardening, and tempering along with their microstructural effects. Surface hardening techniques and different types of alloy steels are also introduced for enhancing performance in engineering applications.

**Module 4: Material Properties and Standards**

This module explains key mechanical properties such as strength, ductility, toughness, fatigue, and creep. It also discusses fracture mechanisms and the concept of ductile-to-brittle transition. Additionally, it introduces material standards and guidelines for selecting appropriate materials for engineering applications.

**Module 5: Composites, Nanomaterials, and Smart Materials**

This module introduces advanced materials, including composites, nanomaterials, and smart materials. It highlights their structure, processing methods, advantages, and applications. The module also covers engineering polymers and ceramics, emphasizing their growing importance over conventional materials.

**Module 6: Non-Destructive Testing (NDT)**

This module introduces techniques used to evaluate material integrity without causing damage. It covers various NDT methods such as ultrasonic, radiographic, magnetic particle, and liquid penetrant testing. The module emphasizes the importance of quality control and defect detection in engineering materials.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion of this course the students will be able to | |
| | **CO1** | Know the classification of materials, crystal structures, and crystal defects relevant to engineering applications. **(Remembering)** |
| | **CO2** | Explain the principles of phase diagrams, iron-carbon systems, and various heat treatment processes, including their microstructural changes. **(Understanding)** |
| | **CO3** | Select appropriate non destructive testing methods and heat treatment, surface treatments, to enhance material properties for engineering use. **(Applying)** |
| | **CO4** | Analyze the microstructural evolution and property changes in metallic materials based on phase diagrams and various heat treatment processes. **(Analyzing)** |
| | **CO5** | Compare the change in the mechanical properties due to heat treatment in steels **(Evaluating)** |
| | **CO6** | Create the specimen set for microstructural evaluation of materials after heat treatment processes **(Creating)** |

Syllabus:

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | | **Introduction to materials and Concept of Crystal** | 4 |
| | | **Learning Outcomes:**<br>**1.** Identify and classify engineering materials, crystal structures, unit cells, and crystal defects relevant to engineering applications. **CO1**<br>**2.** Explain the role of crystallographic features and crystal defects in influencing material properties and deformation behavior. **CO2** | |
| | **1.1** | Classification of materials: Introduction to engineering materials significance of structure property correlations in all classes of engineering materials | |
| | **1.2** | Concepts of crystals- Crystalline and Non-crystalline Materials Unit cell, Crystal structures of metals, Crystal systems, Crystallographic planes and directions. | |
| | **1.3** | Crystal Defects: Crystal Imperfections-definition, classification and significance of imperfections -point defects, line defects, Surface defects and volume defects and significance of crystal defects in deformation | |
| | **Self-Learning Topics:** Importance of dislocations in deformation and its mechanisms. | | |
| 2 | | **Metal alloys and phase diagrams** | 7 |
| | | **Module Outcomes:**<br>**1.** Explain the principles of cold working, recrystallization annealing, and the iron–iron carbide phase diagram, including associated microstructural changes. **CO2**<br>**2.** Analyze phase transformations and microstructural evolution in steels and cast irons using Fe–$Fe_3C$, TTT, and CCT diagrams. **CO4** | |
| | **2.1** | Cold Working and Recrystallization annealing: Definition, effects and mechanism of cold work, Need for Recrystallization Annealing, the stages of recrystallization annealing and factors affecting it | |
| | **2.2** | Iron-Iron carbide phase diagram – Invariant reactions – microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram, Graphitization in cast irons. | |
| | **Self-Learning Topics:** Hardenability and its tests | | |
| 3 | | **Heat Treatment** | 7 |
| | | **Module Outcomes:**<br>**1.** Apply appropriate heat treatment and surface hardening processes to achieve desired microstructures and mechanical properties in steels. **CO3**<br>**2.** Analyze the effects of heat treatment and surface hardening | |

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|---|---|---|---|
| | | on microstructural evolution and resulting material properties. **CO4** | |
| | **3.1** | Heat treatment: Overview – Objectives – Thorough treatments: Annealing and types, normalizing, hardening and tempering, austempering and martempering – microstructure changes | |
| | **3.2** | Surface hardening processes: Carburizing –, nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths | |
| | **3.3** | Alloy steels-Stainless steels, Tool steels, Maraging steels and Ausformed steels | |
| | **Self-Learning Topics:** Effect of heat treatment on mechanical properties | | |
| **4** | | **Material Properties and standards** | **4** |
| | | **Module Outcomes:**<br>**1.** Explain mechanical properties, fracture behavior, fatigue, creep, and alloy classification in relation to engineering material performance. **CO2**<br>**2.** Analyze material behavior and property changes to support material selection for engineering applications in accordance with standards. **CO4** | |
| | **4.1** | Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT) Introduction to Fatigue, Creep | |
| | **4.2** | Mechanical properties of materials, Ductility, malleability, strength toughness Introduction to ASTM and International standards for materials<br>Selection of materials for various engineering applications | |
| | **4.3** | Classification of Alloys effect of alloying elements on the properties of alloy materials | |
| | **Self-Learning Topics:** Effects of strengthening mechanisms on material properties | | |
| **5** | | **Composites, Nano materials, Smart Materials** | **5** |
| | | **Module Outcomes:**<br>**1.** Identify different types of composites, nanomaterials, smart materials, polymers, and ceramics along with their characteristics and applications. **CO1**<br>**2.** Analyze the advantages and limitations of advanced materials compared to conventional materials for specific engineering applications. **CO4** | |
| | **5.1** | Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications | |
| | **5.2** | Nano Materials: Introduction, Concepts, synthesis of nanomaterials, examples, applications and Nano composites | |
| | **5.3** | Introduction to Smart materials: Classification, Shape Memory | |

| | | | |
|---|---|---|---|
| | | Alloys and its applications | |
| | **5.4** | Engineering Polymers and Ceramics-types and their advantages over metallic materials | |
| | **Self-Learning Topics:** Advantages and limitations of Composites, Nano-materials and smart materials | | |
| **6** | | **Non-destructive testing** | **3** |
| | | **Module Outcome:**<br>**1.** Explain the principles, advantages, and limitations of various non-destructive testing techniques used for material evaluation. **CO2**<br>**2.** Apply suitable NDT methods for defect detection and quality assessment of engineering materials. **CO4** | |
| | 6.1 | Destructive testing and its limitations, Scope of NDT Nondestructive Testing of Materials, Advantages and limitations of NDT | |
| | 6.2 | Ultrasonic testing, radiographic methods, magnetic particle testing, Liquid penetrant testing | |
| | **Self-Learning Topics:** Specific applications of each NDT method | | |
| | | **TOTAL** | **30** |

**Text Books:**


1. WILLIAM D. CALLISTER Materials Science and Engineering, 2nd edition by Wiley India Pvt. Ltd.
2. R.K. Rajput. A Textbook of Material Science & Engineering, Publisher,5th edition, S.K. Kataria & Sons
3. Dr. V.D Kodgire and S.V Kodgire MATERIAL SCIENCE AND METALLURGY FOR ENGINEERS.Everest Publishing House


**Reference Books:**


1. Introduction to Materials Science for Engineers; 8th Edition by James F. Shackelford Pearson
2. Introduction to Physical Metallurgy,2nd edition by Sidney Avner, TataMcGrawHill
3. Mechanical Metallurgy, 3rd edition by GH Dieter,TataMcGraw Hill
4. Fundamentals of Materials Science and Engineering: An Integrated Approach, 5th Edition by William D. Callister, Jr., David G. Rethwisch, Wiley & Sons.
5. Materials Science and Engineering,5th edition by V.Raghavan, Prentice Hall India


**Useful Links:**

https://www.youtube.com/watch?v=JOQpbJIakRM
https://www.youtube.com/watch?v=2F9NEoXvkQE
https://www.youtube.com/watch?v=XUB1wiKfbUk
https://www.youtube.com/watch?v=MoiJSjwjbxs
https://www.youtube.com/watch?v=Yx-bIKo-_wg

**Laboratory work:**

| Sr. No. | List Of Experiments |
|---|---|
| **1.** | **Study of Characterization Techniques and Metallographic Sample Preparation and Etching**<br>**Objective:**<br>To familiarize students with various material characterization techniques and to develop skills in metallographic sample preparation, polishing, and etching for microstructural examination.<br>**Outcome:**<br>Students will be able to prepare metallographic specimens and identify microstructural features using appropriate characterization techniques. |
| 2. | **Comparison of Hardness Before and After Annealing in Mild Steel**<br>**Objective:**<br>To study the effect of annealing on the hardness of mild steel using standard hardness testing methods.<br>**Outcome:**<br>Students will be able to evaluate the reduction in hardness due to annealing and relate it to changes in microstructure and ductility. |
| 3. | **Comparison of Hardness Before and After Normalizing in Mild Steel**<br>**Objective:**<br>To investigate the effect of normalizing heat treatment on the hardness of mild steel.<br>**Outcome:**<br>Students will be able to compare hardness values and explain the influence of normalizing on grain refinement and mechanical properties. |
| 4. | **Comparison of Hardness Before and After Hardening in Mild Steel**<br>**Objective:**<br>To study the effect of hardening on the hardness of mild steel through controlled heat treatment.<br>**Outcome:**<br>Students will be able to analyze the increase in hardness due to hardening and correlate it with phase transformation. |
| 5. | **Comparison of Hardness Before and After Normalizing in Medium Carbon Steel**<br>**Objective:**<br>To examine the influence of normalizing on the hardness of medium carbon steel.<br>**Outcome:**<br>Students will be able to interpret hardness variations and relate them to microstructural refinement in medium carbon steel. |
| 6. | **Comparison of Hardness Before and After Annealing in Medium Carbon Steel**<br>**Objective:**<br>To determine the effect of annealing on the hardness and softness of medium carbon steel.<br>**Outcome:**<br>Students will be able to assess the decrease in hardness and explain the improvement in machinability due to annealing. |

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| 7. | **Comparison of Hardness Before and After Hardening in Medium Carbon Steel**<br>**Objective:**<br>To study the hardening process and its effect on the hardness of medium carbon steel.<br>**Outcome:**<br>Students will be able to quantify hardness improvement and explain the formation of hard phases such as martensite. |
| 8. | **Study of Tempering Characteristics of Hardened Steel**<br>**Objective:**<br>To study the effect of tempering temperature on the hardness and toughness of hardened steel.<br>**Outcome:**<br>Students will be able to correlate tempering temperature with reduction in brittleness and improvement in toughness. |
| 9. | **Determination of Hardenability of Steel using Jominy End Quench Test**<br>**Objective:**<br>To determine the hardenability of steel using the Jominy end quench test and measure hardness variation along the specimen using different hardness testers.<br>**Outcome:**<br>Students will be able to plot hardenability curves, interpret hardness distribution, and compare the effectiveness of different hardness testing methods. |

Assessment Criteria:

| Assessment Tools | Marks Distribution |
|---|---|
| **Continuous Assessment (CA) (20 Marks)** | Certification: NPTEL (20 Marks) (Approved by Instructor)<br>**OR**<br>Any two Pedagogies (10 marks each)<br>• MCQ /Class Test<br>• Case study/Assignment<br>• GATE based Tutorial<br>• MOOCs Certification (Approved by Instructor)<br>• Open Book Test<br>• Working model / Simulation of a course-based concept. |
| **Mid Semester Examination (MSE) (30 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>• Q1 A or B - 10 marks<br>• Q2 A or B - 10 marks<br>• Q3 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• MSE should be based on 50% syllabus.<br>• Time: 90 minutes (1 hour 30 minutes)<br>• Total Marks: 30 |

| | |
|---|---|
| **End Semester Examination (ESE) (50 Marks)** | Question Paper Pattern is as follows:<br><br>All Questions are compulsory.<br>• Q1 A or B -10 marks<br>• Q2 A or B -10 marks<br>• Q3 A or B -10 marks<br>• Q4 A or B -10 marks<br>• Q5 A or B - 10 marks<br>• For each question, A and B should be based on the same CO.<br>• ESE should be based on 30% syllabus of MSE and 70% syllabus after MSE.<br>• Time: 120 minutes (02 hours)<br>• Total Marks: 50 |
| **Term Work (25 Marks)** | • Laboratory Performance = 10 marks<br>• Assignments = 10 marks<br>• Attendance = 5 marks<br><br>Based on the performance and satisfactory completion of assigned laboratory work. |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2PCC01 | Data Structure | **L** | **T** | **P** | **L** | **T** | **P** | **Total** |
| | | 2 | - | 2 | 2 | - | 1 | 3 |
| | | **Examination Scheme** | | | | | | |
| | | | **CA1** | **CA2** | **MSE** | **ESE** | **Total** | |
| | | **Theory** | 10 | 10 | 30 | 50 | 100 | |
| | | | **TW** | **PR** | | | | |
| | | **Lab** | 25 | 25 | | | 50 | |

| Pre-Requisite Courses: | 1. C programming fundamentals |
|---|---|

**Course and Module Overview:**

Data structure is a foundational course that builds the vocabulary, intuition, and implementation skills needed for every subsequent CS/IT subject. Students progress from arrays and algorithm analysis through linked lists and recursion, to trees, graphs, sorting, and hashing each module providing the groundwork the next one builds on.

**Module 1: Introduction to Data Structures and Algorithms**

Module 1 establishes the entire vocabulary of the course - what data structures are, why they exist, and how algorithms are measured. Big O, Omega, and Theta are introduced here so every subsequent module can discuss complexity immediately without pausing to explain notation.

**Module 2: Linear Data Structure**

This module introduces the linked list as the course's first pointer-based structure, covering all operations with complexity analysis.

**Module 3: Linear Data Structure – STACKS & QUEUES**

This module covers Stacks and Queues built on top of the linked list foundation from last module. Recursion is introduced here immediately after the call-stack mechanism of stacks is understood making recursive tree traversals in module 4 and graph DFS in Module 5.

**Module 4: Non-Linear Data Structure – TREES**

Module 4 covers from linear to hierarchical structures. BST builds directly on the Binary Search intuition from M2. Expression Trees complete the Infix/Postfix story begun in M3. AVL Trees are core not self-learning because they are the direct conceptual predecessor to Red-Black Trees in Sem III ADSA.

**Module 5: Non-Linear Data Structure – GRAPHS**

This module extends tree concepts to general networks. Directed, undirected, weighted graphs, and DAGs are explicitly named so that Topological Sort is properly contextualized. BFS and DFS leverage the recursion and queue/stack skills from module 3.

**Module 6: Searching, Sorting & Hashing**

This module closes the course with comparison-based sorting (Selection, Insertion, Bubble, Merge Sort) followed by hash-based lookup two independent techniques that round out a student's algorithmic toolkit.

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| **Course Outcomes** | **After successful completion, the students will be able to** | |
| | CO1 | Recall and define core concepts of data structures, algorithms, and asymptotic notations. **(Remembering)** |
| | CO2 | Explain the functioning and utility of various linear and non-linear data structures. **(Understanding)** |
| | CO3 | Apply appropriate data structures to solve computational problems. **(Applying)** |
| | CO4 | Analyze time and space complexities of algorithms and compare efficiency of different approaches. **(Analyzing)** |
| | CO5 | Evaluate different searching, sorting, and hashing techniques for specific scenarios. **(Evaluating)** |
| | CO6 | Design and implement optimal solutions using data structures for real-life problem contexts. **(Creating)** |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Module 1: Introduction to Data Structures and Algorithms** | **05** |

| | | | |
|---|---|---|---|
| | | **After completing this module, students will be able to:**<br>• Define data structures, classify them as primitive/non-primitive and linear/non-linear, and justify the choice of a data structure category for a given storage problem.<br>• Explain the concept of an Abstract Data Type and distinguish it from its concrete implementation in code.<br>• State the properties of an algorithm and express the time and space complexity of a given code snippet using Big O, Omega, and Theta notation.<br>• Compare the growth rates of common complexity classes and identify the dominant term in a composite expression. | |
| | 1.1 | Data Structures concepts: Definition, classification, and need for data structures.<br>Types of data structures: primitive, non-primitive, linear, and non-linear, Abstract Data Types (ADT) | |
| | 1.2 | Concept of algorithms: properties, design techniques, and performance analysis.<br>Asymptotic notation: Big O, Omega, Theta with examples | |
| Self-Learning | | Comparative growth analysis of functions; Sparse Matrix operations using arrays | |
| **2** | | **Module 2: Linear Data Structure – LISTS** | |
| | | **After completing this module, students will be able to:**<br>• Explain the node-pointer-head structure of a linked list, contrast it with array-based storage, and select the appropriate type singly, doubly, or circular for a given application.<br>• Implement insertion, deletion, merge, traversal, update, and copy operations on singly and doubly linked lists, stating the time complexity of each operation.<br>• Implement Linear Search and Binary Search, trace their execution on a given dataset, and compare them on time complexity and applicable data conditions.<br>• Explain why Binary Search requires a sorted array | |
| | 2.1 | List as an ADT. Linked List implementation concept — nodes, pointers, head. | **05** |
| | 2.2 | Types of Linked List- Singly linked lists, doubly linked lists and circular linked lists. | |
| | 2.3 | All operations on Singly and Doubly Linked Lists: Insertion, Deletion, Merge, Traversal, Update, Copying with complexity analysis. | |

| | | | |
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| | 2.4 | Searching: Linear Search and Binary Search - concepts, implementation, and complexity analysis | |
| Self-Learning | | Reversing a singly linked list; Polynomial arithmetic using linked lists | |
| **3** | | **Module 3: Linear Data Structure – STACKS & QUEUES** | |
| | | **After completing this module, students will be able to:**<br>• Implement Stack and Queue ADTs using both arrays and linked lists, and demonstrate push, pop, enqueue, dequeue, and peek operations with edge-case handling.<br>• Apply a stack to convert infix expressions to prefix and postfix forms, tracing each step of the algorithm.<br>• Implement Linear, Circular, and Priority Queues; explain false overflow in a linear queue and how a circular queue resolves it; and compare all three on space utilization and complexity.<br>• Explain the call stack mechanism of recursion, write recursive solutions for standard problems (factorial, Fibonacci, array sum, linked list reversal), and compare recursive vs iterative approaches. | |
| | 3.1 | Stack as an ADT. Operations: push, pop, peek, isEmpty. Array and Linked List representation of Stack. Applications: reversing data, conversion of Infix to Prefix and Postfix expressions. | **07** |
| | 3.2 | Queue as an ADT. Operations on Queue. Implementation of Linear Queue, Circular Queue, and Priority Queue using Arrays and Linked Lists. | |
| | 3.3 | Recursion: concept, call stack mechanism, base case vs recursive case. Examples – factorial, Fibonacci, sum of array. Recursive reversal of a linked list | |
| Self-Learning | | Evaluation of postfix and prefix expressions, Double Ended Queue | |
| **4** | | **Module 4: Non-Linear Data Structure – TREES** | |

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| | | **After completing this module, students will be able to:**<br>• Apply tree terminology to a given diagram, implement Binary Tree traversals (Inorder, Preorder, Postorder) both recursively and iteratively, and predict traversal output without executing code.<br>• Implement BST Insert, Search, and Delete operations; trace pointer changes for all three deletion cases; and analyse best-case and worst-case time complexity relating the worst case to a skewed tree.<br>• Construct an expression tree from a postfix expression, evaluate it recursively, and connect it to the infix-to-postfix conversion.<br>• Perform all four AVL rotations (LL, RR, LR, RL) on an unbalanced node, insert a sequence of keys maintaining the AVL property, and explain how the height bound guarantees O(log n) operations the foundation for Red-Black Trees. | |
| | 4.1 | Tree terminologies. Binary Tree — structure, properties, operations. Tree Traversals: Inorder, Preorder, Postorder (recursive and iterative). | **06** |
| | 4.2 | Binary Search Tree (BST): properties, Insert, Delete, Search operations and complexity. | |
| | 4.3 | Expression Trees: construction from postfix expression, evaluation. Applications. | |
| | 4.4 | AVL Trees: need for balancing, rotations (LL, RR, LR, RL), insert with rebalancing, height and complexity. | |
| Self-Learning | | AVL deletion; Applications of Trees in file systems and compilers | |
| **5** | | **Module 5: Non-Linear Data Structure – GRAPHS** | |
| | | **After completing this module, students will be able to:**<br>• Define graph terminology, distinguish directed, undirected, weighted graphs, and DAGs, and construct both Adjacency Matrix and Adjacency List representations for a given graph.<br>• Determine which graph representation is preferable for sparse vs dense graphs and justify the choice on space complexity grounds.<br>• Implement BFS (using a queue) and DFS (using recursion or a stack), trace the visited order on a given graph, and compare the two on time complexity, space complexity, and problem suitability.<br>• Apply Topological Sort to a given DAG, explain why it is undefined for cyclic graphs, and describe real-world applications of BFS and DFS. | |

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| | 5.1 | Graph terminologies: vertices, edges, degree, path, cycle. Directed vs Undirected graphs. Weighted graphs. Directed Acyclic Graph (DAG). Adjacency Matrix and Adjacency List representations. | **04** |
| | 5.2 | Graph traversals: BFS and DFS — working, applications, complexity. Topological Sorting (applicable to DAGs only). | |
| Self-Learning | | Graph applications in networking; Introduction to weighted shortest paths | |
| **6** | | **Module 6: Searching, Sorting & Hashing** | |
| | | **After completing this module, students will be able to:**<br>• Trace Selection Sort, Insertion Sort, Bubble Sort, and Merge Sort on a given array pass by pass, and state the best, average, and worst-case time and space complexity of each.<br>• Compare the four sorting algorithms and recommend the most suitable one for a given input size and data condition.<br>• Explain the Divide and Conquer strategy in Merge Sort and relate it to the recurrence<br>• Design a hash table for a given problem by choosing an appropriate hash function and collision resolution strategy (Separate Chaining or Open Addressing), and calculate the load factor and its effect on performance. | |
| | 6.1 | Sorting: Selection Sort, Insertion Sort, Bubble Sort, Merge Sort algorithm, trace, time and space complexity. Comparison of sorting algorithms. | **03** |
| | 6.3 | Hashing: Hash Functions, Collision, Collision Resolution Techniques Separate Chaining, Open Addressing (Linear Probing, Quadratic Probing). Linear hashing | |
| Self-Learning | | Quick Sort algorithm and trace, Overflow handling techniques in Hashing | |
| | | **TOTAL** | **30** |

| Exp No. | Experiment Title |
|---|---|
| **1** | Recall and write definitions and properties of arrays, linked lists, stacks, and queues.<br><br>**Objective:**<br>To understand and recall the definitions, structures, and properties of fundamental data structures including arrays, linked lists, stacks, and queues. |

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| | **Outcome**:<br>Students will be able to define and differentiate between linear data structures and explain their properties, advantages, and limitations. |
| **2** | Create a Singly and Doubly Linked List with insert, delete, traverse, and reverse operations<br><br>**Objective:**<br>To implement singly and doubly linked lists and perform insertion, deletion, traversal, and reversal operations.<br><br>**Outcome:**<br>Students will be able to construct and manipulate linked lists and understand memory representation and pointer operations. |
| **3** | Trace and explain existing implementations of linked list and stack operations.<br><br>**Objective:**<br>To analyze and trace the execution of existing linked list and stack operations step-by-step.<br><br>**Outcome:**<br>Students will be able to interpret algorithm flow, debug logic, and understand internal working of data structures. |
| **4** | Implement stack using array and linked list. Demonstrate push, pop and isEmpty.<br><br>**Objective:**<br>To implement stack using both array and linked list and perform push, pop, and isEmpty operations.<br><br>**Outcome:**<br>Students will be able to compare stack implementations and demonstrate LIFO behavior effectively. |
| **5** | Apply recursion factorial, fibonacci, sum of array, and recursive reversal of a linked list. Trace the call stack<br><br>**Objective:**<br>To apply recursion for solving problems like factorial, Fibonacci, sum of array, and linked list reversal, and trace the call stack.<br><br>**Outcome:**<br>Students will be able to design recursive solutions and visualize function call execution using stack frames. |
| **6** | Implement Circular Queue and Priority Queue using Array and Linked List<br><br>**Objective:**<br>To implement circular queue and priority queue using arrays and linked lists. |

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| | **Outcome:**<br>Students will be able to handle queue overflow efficiently and understand priority-based processing. |
| **7** | Create a singly and doubly linked list with insert, delete, and reverse operations.<br><br>**Objective:**<br>To reinforce implementation of singly and doubly linked lists with insertion, deletion, and reversal.<br><br>**Outcome:**<br>Students will gain confidence in implementing dynamic data structures and solving pointer-related problems. |
| **8** | Implement Linear Search and Binary Search. Analyse performance on sorted and unsorted datasets. Plot comparison<br><br>**Objective:**<br>To implement linear and binary search algorithms and analyze their performance on sorted and unsorted datasets.<br><br>**Outcome:**<br>Students will be able to compare search algorithms based on time complexity and dataset characteristics. |
| **9** | Implement Selection Sort, Insertion Sort, and Bubble Sort. Compare time complexity using operation counters.<br><br>**Objective:**<br>To implement selection sort, insertion sort, and bubble sort and compare their performance using operation counters.<br><br>**Outcome:**<br>Students will be able to evaluate sorting algorithms based on efficiency and understand time complexity concepts. |
| **10** | Write definitions and draw examples of Trees and Graphs. Include BST, AVL, and graph terminology.<br><br>**Objective:**<br>To understand definitions and structures of trees and graphs, including BST, AVL trees, and graph terminology.<br><br>**Outcome:**<br>Students will be able to illustrate hierarchical and non-linear data structures and explain their real-world applications. |
| **11** | Implement BST: insert, delete, search. Perform Inorder, Preorder, Postorder traversals (recursive).<br><br>**Objective:**<br>To implement BST operations such as insertion, deletion, search, and |

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| | recursive traversals.<br><br>**Outcome:**<br>Students will be able to efficiently organize and retrieve data using tree structures. |
| **12** | Implement BST and perform traversals (inorder, preorder, postorder).<br><br>**Objective:**<br>To perform and analyze inorder, preorder, and postorder traversals of a BST.<br><br>**Outcome**:<br>Students will be able to differentiate traversal techniques and their applications. |
| **13** | Create adjacency matrix/list representation and perform BFS and DFS.<br><br>**Objective:**<br>To represent graphs using adjacency matrix and list, and implement BFS and DFS traversal algorithms.<br><br>**Outcome:**<br>Students will be able to explore graph structures and apply traversal techniques to solve problems. |
| **14** | Compare BFS vs DFS for different graph types (directed, undirected, weighted). Analyze traversal outputs.<br><br>**Objective:**<br>To compare BFS and DFS on different types of graphs (directed, undirected, weighted) and analyze traversal results.<br><br>**Outcome:**<br>Students will be able to choose appropriate traversal strategies based on problem requirements. |
| **15** | Design a contact book using hash tables with collision resolution (separate chaining and open addressing).<br><br>**Objective:**<br>To design and implement a contact book using hash tables with collision resolution techniques.<br><br>**Outcome:**<br>Students will be able to apply hashing concepts and handle collisions using chaining and open addressing. |
| **MP** | Mini project: Student group to design a real-world application (e.g., parking system, hospital queue) using multiple data structures.<br><br>**Objective:**<br>To design and develop a real-world application (such as a parking management system or hospital queue system) by integrating multiple data |

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| | structures like arrays, linked lists, stacks, queues, trees, graphs, and hash tables.<br><br>**Outcome:**<br>Students will be able to analyze real-world problems, select appropriate data structures, and implement an efficient, scalable solution while demonstrating problem-solving, system design, and coding skills. |

**Text Books:**

1. Reema Thareja, "Data Structures using C", 3rd Edition, Oxford, 2023.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, W. H. Freeman and Company, 2008.
3. "Introduction to Algorithms" – Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein (CLRS), 4th Edition (2022).

**Reference Books:**

1. "Data Structures and Algorithms Made Easy" – Narasimha Karumanchi, Latest (2022) – CareerMonk Publications.
2. "Data Structures and Algorithm Analysis in C++" – Mark Allen Weiss, 4th Edition.
3. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication, 2nd edition, 2015.

**Useful Links:**

1. Use visualization tools like Visualgo or Pythontutor.
2. https://nptel.ac.in/courses/106/102/106102064/
3. Data Structure using C Programming - Course (swayam2.ac.in)

**Assessment Criteria:**

1. Continuous Assessment 1 (CA1): 10 Marks on topics covered in class.
2. Continuous Assessment 2 (CA2): 10 Marks will be based on self-learning topics.
3. Mid Semester Examination (MSE) (30 Marks) will be based on 50% of the syllabus. The MSE question paper has three main questions.
   Question 1 (10 marks) has four sub-questions. Attempt any two.
   Questions 2 and 3 each have two options (A or B). Attempt only one option from each question. Each of these questions carries 10 marks.
4. End Semester Examination (ESE) (50 Marks) will be based on the entire syllabus. The ESE question paper has five main questions.
   Question 1 (10 marks) has four sub-questions. Attempt any two.

Questions 2 to 5 each have two options (A or B). Attempt only one option from each question. Each of these questions carries 10 marks.

**Term Work:**

Students are expected to complete a minimum of _____10_____experiments conducted in a batch-wise laboratory setting. Wherever applicable, students are encouraged to undertake computation or simulation-based experiments to deepen their conceptual understanding. Active participation, initiative, and creative engagement in all lab activities are expected.

Students should maintain a professional and positive attitude throughout the course—demonstrated through regular attendance, timely submissions, collaboration with peers, and responsiveness to feedback.

Term work marks will be based on overall performance, including the quality and timely completion of experiments and assignments. Continuous grading will be carried out, and the final term work marks will be computed by averaging the converted grades earned across all experiments and assignments.

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2VSEC01 | Engineering Skills Workshop-II | L | P | T | L | P | T | Total |
| | | - | 2 | - | - | 1 | - | 1 |
| | | Examination Scheme | | | | | | |
| | | Lab | Trade 1 | Trade 2 | Trade 3 | Attendance | | Total |
| | | | 15 | 15 | 15 | 05 | | 50 |
| | | Total | 50 | | | | | |

| Pre-Requisite Courses: | 25FE1ESC02: Basic Electrical and Digital Electronics |
|---|---|
| | 25FE1BSC02: Applied Physics |
| | 25FE1BSC03: Engineering Chemistry |

**Course and Trade Overview:**

This course provides a practical foundation in electronics hardware, embedded systems, and web technologies with applications in automation and IoT. It enables students to develop both design and implementation skills through hands-on learning across multiple domains.

**Trade 1: PCB Design and Fabrication**

This trade covers PCB types, materials, schematic design, SPICE simulation, PCB layout, and Gerber generation, along with hands-on processes such as etching, drilling, and soldering. It equips students with fundamental knowledge and practical skills required for designing, fabricating, and testing printed circuit boards using EDA tools.

**Trade 2: Website Designing**

This trade introduces front-end web development using HTML, CSS, and Bootstrap. Students learn webpage structuring, styling, responsive design, and UI components, enabling them to create user-friendly interfaces, dashboards, and project presentation websites.

**Trade 3: Arduino-based Embedded Systems**

This trade focuses on Arduino programming, digital and analog I/O, PWM, serial communication, and interfacing of sensors and actuators such as temperature sensors, ultrasonic sensors, motors, and relays. It helps students develop skills in building and controlling embedded systems.

Thus, overall, this course develops strong practical and conceptual understanding, preparing students to design, implement, and demonstrate real-world embedded and IoT-based solutions for industrial and automation applications.

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| **Course Outcomes** | After successful completion of this course, the students will be able to | |
| | CO1 | Recall the basic components, materials, and tools used in PCB design, web development, and Arduino systems. (Remembering) |
| | CO2 | Explain the concepts of schematic design, HTML/CSS structure, and analog/digital interfacing in Arduino. (Understanding) |
| | CO3 | Use simulation software, web development tools, and Arduino IDE to build and test basic circuits and webpages. (Applying) |
| | CO4 | Differentiate between types of PCBs, web layout strategies, and input/output behavior in microcontroller-based systems. (Analyzing) |
| | CO5 | Test and troubleshoot PCBs and Arduino circuits, and evaluate website responsiveness and functionality based on given specifications. (Evaluating) |
| | CO6 | Design and develop a functional prototype involving a PCB-based electronic circuit, a responsive web page, or a sensor-actuator system using Arduino. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | **Trade 1: PCB Design and Fabrication** | | |
| | 1.1 | Introduction to PCBs: types, layers, materials (FR4, CEM-1), Basics of schematic circuit design.<br>Introduction to Ngspice or LTspice (student version), Simulating a simple circuit (LED blink/regulator/sensor), Create & simulate a power supply or sensor circuit in PSpice. | **10** |
| | 1.2 | Installing and setting up PCB Designing software and Schematic design, Creating and Assigning footprint.<br>Electrical Rules Check (ERC,) Circuit building,<br>PCB Designing using Software Schematic tool. | |
| | 1.3 | PCB Layout: Routing, DRC, Copper Pour, Board Edge Cutting and shape, Generating Gerber and drill files,<br>PCB layout for printing. | |
| | 1.4 | PCB printing on photo paper/transparency, UV exposure method, Etching using $FeCl_3$, Drilling and Tinning,<br>Soldering techniques, Etching and solder components on PCB. | |
| | 1.5 | Continuity testing using multimeter, Power-up check, Common issues like shorting, dry solder, incorrect polarity, Troubleshooting and Testing. | |

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| **2** | **Trade 2: Website Designing** | | |
| | 2.1 | Introduction to HTML - HTML Document Structure (<!DOCTYPE html>, <html>, <head>, <body>) - Headings, Paragraphs, Text Formatting - Links and Images - Lists: Ordered & Unordered - Tables - Basic Form Elements (input, textarea, button, etc.) | **10** |
| | 2.2 | Introduction to CSS (inline, internal, external) - CSS Syntax & Selectors (element, class, ID) - Colors, Fonts, Backgrounds - Box Model (margin, padding, border) - Positioning & Layout Basics - Flexbox Introduction | |
| | 2.3 | Introduction to Bootstrap and CDN setup - Bootstrap Grid System: Container, Row, Column - Responsive Design and Breakpoints - Bootstrap Utility Classes (margins, padding, text align, colors) | |
| | 2.4 | Bootstrap Navbar - Buttons and Alerts - Bootstrap Cards - Carousel for image slides - Form Styling with Bootstrap - Icons (Font Awesome or Bootstrap Icons) | |
| | 2.5 | JavaScript - Role java script in web. Adding JS to HTML-inline, internal <script>, and external .js file., Browser console, Variables, Data types, Operators, Control Flow & Functions, Arrays and its methods, Objects. | |
| **3** | **Trade 3: Arduino Programming and Hardware Interfacing** | | |
| | 3.1 | Introduction to Arduino: History of Arduino, Types of Arduino Boards (UNO, Nano, Mega),<br>Overview of Arduino UNO Board,<br>Installation & Drivers, Program for blinking LED | **10** |
| | 3.2 | Analog and Digital I/O in Arduino and PWM: Digital Input/Output Pins and Interfacing LEDs and Buttons,<br>Analog Input with Potentiometer, Analog Output using PWM (LED Fading) using analog Read () and analog Write () | |
| | 3.3 | Serial Communication: Introduction to Serial Monitor, Serial.begin(), Serial.print(), and Serial.println(),<br>Debugging with Serial Monitor | |
| | 3.4 | Sensor Interfacing: Interfacing with various sensors like Temperature, Humidity, Ultrasonic, Gas, IR, PIR, Soil Moisture, Vibration, Colour, Distance,<br>Displaying Data on Serial Monitor and LCD, | |
| | 3.5 | Actuators: Motors and Relays,<br>Interfacing DC Motor using Transistor,<br>Introduction to Relay Module and interfacing. | |
| | | **TOTAL** | **30** |

**Text Books:**

1. Author Walter C. Bosshart- Printed Circuit Boards: Design and Technology,
2. Author: Uttam K. Roy, Publisher: Oxford University Press -Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax,
3. Author: Ashwin Pajankar, Publisher: BPB Publications- Getting Started with Arduino and Embedded Systems",

**Reference Books:**

1. Author: Bruce R. Archambeault -PCB Design for Real-World EMI Control,
2. Author: N. P. Gopalan, J. Akilandeswari, Publisher: PHI Learning -Web Technology: Theory and Practice,
3. Author: J.M. Hughes, Publisher: Shroff Publishers & Distributors Pvt. Ltd. (India edition) -"Arduino: A Technical Reference.

**Assessment Methodology:**

| Type of Courses | Assessment Tools | Marks Distribution |
|---|---|---|
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2VSE02 | Engineering Skills Workshop-II | L | T | P | L | T | P | Total |
| | | | | 2 | | | 1 | 1 |
| | | Examination Scheme | | | | | | |
| | | | CA1 | CA2 | MSE | ESE | Total | |
| | | Theory | - | - | - | - | | |
| | | | Trade 1 | Trade 2 | Trade 3 | Att | Total | |
| | | Lab | 15 | 15 | 15 | 05 | 50 | |

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| **Pre-Requisite:** | 1. Understanding of file and folder structures and performing basic file operations (create, delete, rename, move).<br>2. Knowing how to browse websites, download files, and use search engines. |

**Course and Module Overview:**

The Engineering Skills Workshop-II course introduces students to Linux system operations, GitHub-based version control, and web development. It covers terminal commands, shell scripting, repository management, and building responsive websites using HTML, CSS, Bootstrap, and JavaScript. The course focuses on practical skills and ends with an integrated project combining all three areas.

**Trade 1: Boot to Bash**
This module covers Linux basics, terminal commands, file handling, permissions, and package management. It also introduces shell scripting, networking commands, and task automation using cron.

**Trade 2: GitHub**
This module focuses on Git and GitHub basics, including cloning, pushing, pulling, and pull requests, along with repository creation, management, and collaboration workflows.

**Trade 3: Website Designing**
This module teaches HTML, CSS, Bootstrap, and JavaScript to build responsive and interactive websites, including DOM manipulation and basic data handling with JSON.

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| **Course Outcomes** | **After successful completion of this course, the students will be able to** | |
| | CO1 | Recall fundamental Linux commands, HTML/CSS syntax, and Git/GitHub terminology. (Remembering) |
| | CO2 | Explain the functions of wiring accessories, structure of a web page using HTML/CSS, and the workflow of GitHub repositories. (Understanding) |
| | CO3 | Use terminal commands, build basic responsive web pages, and perform repository operations like cloning and pushing code. (Applying) |

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| | CO4 | Compare different Linux package management techniques, web layout designs, and Git workflows to identify the most effective approach for a given task. (Analyzing) |
| | CO5 | Test and troubleshoot shell scripts, web interfaces, and collaborative Git workflows to ensure desired outcomes. (Evaluating) |
| | CO6 | Develop an integrated project involving automated shell scripts, a styled web interface, and version-controlled deployment using GitHub. (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Trade 1: Boot to Bash** | |
| | | **After completing this trade, students will be able to:**<br>• Explain Linux fundamentals, distributions, and system types, and demonstrate installation using VirtualBox.<br>• Use Linux terminal commands for file handling, navigation, and accessing help utilities efficiently.<br>• Apply user management and file permission concepts, including ownership and access control.<br>• Manage software packages and edit files using tools like Nano.<br>• Develop and execute basic shell scripts and control system services using systemd.<br>• Perform networking, file system operations, and automate tasks using cron. | |
| | 1.1 | What is Linux? Brief history and benefits - Linux distributions (Ubuntu, Fedora, Mint, etc.) - Live vs installed systems - Installing Ubuntu in VirtualBox - Navigating the Linux desktop environment | **08** |
| | 1.2 | Introduction to the Terminal - Basic commands: pwd, ls, cd, mkdir, rmdir, cp, mv, rm - File and directory permissions - Using man, --help, and keyboard shortcuts | |
| | 1.3 | Understanding users and groups - File ownership and permissions (chmod, chown, chgrp) - Introduction to package management (apt, dpkg) - Installing and removing software | |
| | 1.4 | Nano Editor - Text Editin, Manipulation, Search & Navigation and File Management commands<br>Writing simple shell scripts (variables, conditions, loops) - Making scripts executable - Introduction to systemd and services - Managing services (systemctl, service) | |

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| | 1.5 | Basic networking commands (ifconfig, ping, netstat, ip a) - Mounting drives and exploring file systems - Introduction to crontab and automation - Final Project Overview | |
| **2** | | **Trade 2: GitHub – Version Control System** | |
| | | **After completing this trade, students will be able to:**<br>• Explain the fundamentals of version control and Git concepts.<br>• Perform basic Git operations such as cloning, pulling, and pushing repositories.<br>• Create and manage repositories, including initialization and organization of projects.<br>• Apply collaboration workflows by creating pull requests and contributing to shared projects.<br>• Use GitHub features such as forking repositories and managing .gitignore files.<br>• Collaborate effectively with others using standard GitHub practices and workflows. | 8 |
| | 2.1 | Version control and Git basics,<br>Clone a repository<br>Pull changes<br>Push changes<br>Create a pull request | |
| | 2.2 | Collaborating with Others<br>Creating and Managing Repositories<br>Create a repository<br>Initialize a repository<br>Git Ignore files<br>Fork a repository | |
| **3** | | **Trade 3: Website Designing** | |

| | | | |
|---|---|---|---|
| | | **After completing this trade, students will be able to:**<br><br>• Design structured web pages using HTML elements such as headings, links, images, tables, and forms.<br>• Apply CSS techniques for styling, layout design, and responsive presentation using selectors, box model, and Flexbox.<br>• Develop responsive web interfaces using Bootstrap components, grid system, and utility classes.<br>• Implement interactivity in web pages using JavaScript concepts such as variables, functions, arrays, and control flow.<br>• Manipulate web page content dynamically using DOM methods, event handling, and form processing.<br>• Work with JSON data and visualize information using tools like Chart.js. | |
| | 3.1 | Introduction to HTML - HTML Document Structure (<!DOCTYPE html>, <html>, <head>, <body>) - Headings, Paragraphs, Text Formatting - Links and Images - Lists: Ordered & Unordered - Tables - Basic Form Elements (input, textarea, button, etc.) | **14** |
| | 3.2 | Introduction to CSS (inline, internal, external) - CSS Syntax & Selectors (element, class, ID) - Colors, Fonts, Backgrounds - Box Model (margin, padding, border) - Positioning & Layout Basics - Flexbox Introduction | |
| | 3.3 | Introduction to Bootstrap and CDN setup - Bootstrap Grid System: Container, Row, Column - Responsive Design and Breakpoints - Bootstrap Utility Classes (margins, padding, text align, colors) | |
| | 3.4 | Bootstrap Navbar - Buttons and Alerts - Bootstrap Cards - Carousel for image slides - Form Styling with Bootstrap - Icons (Font Awesome or Bootstrap Icons) | |
| | 3.5 | JavaScript, Role java script in web. Adding JS to HTML: inline, internal <script>, and external .js file., Browser console, Variables, Data types, Operators, Control Flow & Functions, Arrays and its methods, Objects. | |

| | | | |
|---|---|---|---|
| | 3.6 | Document Object Model, Document as a tree of nodes<br>Selecting elements: getElementById, querySelector, querySelectorAll, Reading and changing content: innerHTML, textContent, Changing CSS styles and class names via JS, Creating and removing DOM elements dynamically, Event listeners: addEventListener, click, keyup, submit, mouseover, Event object — accessing target, value, key, Form handling: reading input values, preventing default submit<br>JSON — JavaScript Object Notation, Working with a JSON array, Chart.js — visualizing JSON data | |
| | | **TOTAL** | **30** |

**Assessment Methodology:**

| | |
|---|---|
| **PR-50** | Practical examination will be based on the experiments performed by the students during laboratory sessions.<br><br>Instructor Assessment of the Activity carried out by student<br><br>Trade 1 = 15 marks<br>Trade 2 = 15 Marks<br>Trade 3 = 15 Marks<br>Active Participation = 5 marks |

**Suggested List of Experiments:**

| Expt No. | List of Experiments |
|---|---|
| | **Trade 1: Boot to Bash** |
| 1 | **Objective**:<br>To explore Linux environment, distributions, and install Ubuntu using VirtualBox.<br>**Outcome**:<br>Students will be able to install and navigate a Linux system. |
| 2 | **Objective**:<br>To perform basic terminal operations using commands like pwd, ls, cd, mkdir, cp, mv, and rm.<br>**Outcome**:<br>Students will be able to manage files and directories using terminal commands. |

| | |
|---|---|
| 3 | **Objective**:<br>To understand file permissions and user management using chmod, chown, and chgrp.<br>**Outcome**:<br>Students will be able to control file access and manage users/groups. |
| 4 | **Objective**:<br>To create and edit files using Nano editor and perform text manipulation tasks.<br>**Outcome**:<br>Students will be able to efficiently edit and manage files in Linux. |
| 5 | **Objective**:<br>To write and execute basic shell scripts and automate tasks using crontab.<br>**Outcome**:<br>Students will be able to automate repetitive system tasks using shell scripting.. |
| | **Trade 2: GitHub – Version Control System** |
| 6 | **Objective:**<br>To understand Git basics and set up Git environment.<br>**Outcome**:<br>Students will be able to configure and use Git for version control. |
| 7 | **Objective**:<br>To clone a repository and perform pull and push operations.<br>**Outcome**:<br>Students will be able to synchronize local and remote repositories. |
| 8 | **Objective**:<br>To create and initialize a new repository and manage project files.<br>**Outcome**:<br>Students will be able to create and manage repositories on GitHub. |
| 9 | **Objective**:<br>To implement collaboration using fork and pull request workflows.<br>**Outcome:**<br>Students will be able to contribute to shared projects using GitHub workflows. |
| 10 | **Objective**:<br>To use .gitignore and manage repository structure effectively.<br>**Outcome:**<br>Students will be able to control tracked files and maintain clean repositories. |
| | **Trade 3: Website Designing** |
| 11 | **Objective**:<br>To create a basic web page using HTML elements like headings, links, images, and lists.<br>**Outcome**:<br>Students will be able to design structured static web pages. |

| | |
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| 12 | **Objective**:<br>To apply CSS styling using inline, internal, and external methods.<br>Outcome:<br>Students will be able to style web pages using CSS. |
| 13 | **Objective**:<br>To design responsive layouts using Bootstrap grid system and components.<br>**Outcome**:<br>Students will be able to create responsive web designs. |
| 14 | **Objective:**<br>To implement JavaScript for basic interactivity and DOM manipulation.<br>**Outcome:**<br>Students will be able to create dynamic web pages using JavaScript. |
| 15 | **Objective:**<br>To work with JSON data and visualize it using Chart.js.<br>**Outcome:**<br>Students will be able to handle and visualize data in web applications. |

**Text Books:**


1. Linux: The Complete Reference, Author: Richard Petersen, Publisher: McGraw Hill Education
2. Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax, Author: Uttam K. Roy, Publisher: Oxford University Press
3. Mastering GitHub, Author: Ankita Thakur, Publisher: BPB Publications


**Reference Books:**


1. Introduction to Linux: A Hands-on Guide, Author: Machtelt Garrels, Publisher: FOSSwire / TLDP (Free PDF available)
2. Web Technology: Theory and Practice, Author: N. P. Gopalan, J. Akilandeswari, Publisher: PHI Learning
3. Learn Git in a Month of Lunches, Author: Rick Umali, Publisher: Dreamtech Press (Indian imprint)


**Useful Links:**

1. https://www.w3schools.com/bash/
2. https://github.com/freeCodeCamp/freeCodeCamp
3. https://www.w3schools.com/git/
4. https://www.w3schools.com/css/
5. https://www.w3schools.com/js/

<table>
<tr><th>Course Code</th><th>Course Name</th><th colspan="3">Teaching Scheme (Hrs. / Week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><td rowspan="8">25FE2VSE02</td><td rowspan="8">Engineering Skills Workshop-II</td><td>L</td><td>T</td><td>P</td><td>L</td><td>T</td><td>P</td><td>Total</td></tr>
<tr><td></td><td></td><td>2</td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td colspan="7">Examination Scheme</td></tr>
<tr><td></td><td>CA1</td><td>CA2</td><td>MSE</td><td>ESE</td><td colspan="2">Total</td></tr>
<tr><td>Theory</td><td>-</td><td>-</td><td>-</td><td>-</td><td colspan="2"></td></tr>
<tr><td></td><td>Trade 1</td><td>Trade 2</td><td>Trade 3</td><td>Att</td><td colspan="2">Total</td></tr>
<tr><td>Lab</td><td>15</td><td>15</td><td>15</td><td>05</td><td colspan="2">50</td></tr>
</table>

| **Pre-Requisite:** | 25FE1BSC02: Applied Physics |
|---|---|
| | 25FE1ESC02: Basic Electrical and Digital Electronics |

**Course Overview:**

This course provides a multidisciplinary foundation by integrating basic mechanical operations, plumbing and welding practices, and introductory embedded systems using Arduino. It emphasizes hands-on learning through workshop skills, fabrication techniques, and simple automation projects. Students develop practical competencies in tool handling, joining processes, and electronic interfacing. The course prepares learners for real-world engineering applications by combining mechanical, electrical, and programming fundamentals.

Trade 1: Mechanical Engineering Operations

This trade introduces fundamental mechanical workshop practices and the safe use of basic hand tools such as hacksaws, drills, taps, and grinders. It focuses on essential operations like marking and punching, which are critical for fabrication accuracy. Students learn basic workshop standards, measurements, and simple calculations required in engineering practice. The module builds hands-on skills and familiarity with common mechanical processes used in industry.

Trade 2: Plumbing & Welding

This trade provides practical exposure to essential plumbing and welding techniques used in construction and manufacturing. In plumbing, students learn the use of tools and fittings while assembling a basic domestic water line. The welding section introduces edge preparation and arc welding methods for various joints such as lap, butt, and right-angle joints. Emphasis is placed on safety, accuracy, and proper joining techniques for durable connections.

| | | |
|---|---|---|
| Module 3: Arduino<br><br>This module introduces students to embedded systems using Arduino platforms such as UNO, Nano, and Mega. It covers programming basics, digital and analog input/output operations, and PWM for controlling devices like LEDs. Students gain hands-on experience with serial communication, sensor interfacing, and real-time data monitoring. The module also explores actuator control, including motors and relays, enabling students to develop simple automation and smart system applications. | | |
| **Course Outcomes** | After successful completion of this course, the students will be able to | |
| | CO1 | Know the names, functions, and applications of basic mechanical tools, plumbing components, and Arduino hardware. (Remembering) |
| | CO2 | Explain the working principles of plumbing tools, welding equipment, and Arduino board components with appropriate terminology. (Understanding) |
| | CO3 | Demonstrate marking, punching, tapping, and basic welding/plumbing techniques in a workshop setting. (Applying) |
| | CO4 | Differentiate between analog and digital I/O operations in Arduino and analyze sensor data using serial communication. (Analyzing) |
| | CO5 | Evaluate the suitability of tools, materials, and Arduino components for specific workshop or project requirements. (Evaluating) |
| | CO6 | Develop a functional system using Arduino by integrating sensors, actuators, and appropriate programming logic (Creating) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| **1** | | **Trade 1: Mechanical Engineering operations** | |
| | 1.1 | Basic Mechanical Engineering tools & applications:<br>Basic hand tools like Hacksaw, hand and pedestal drilling, tapping, hand grinding. | **10** |
| | 1.2 | Operations like marking punching. | |
| | 1.3 | Basic workshop standards & calculations | |
| **2** | | **Trade 2: Plumbing & Welding** | |
| | 2.1 | **Plumbing:**<br>Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving | **10** |

| | | | |
|---|---|---|---|
| | | fixing of a water tap and use of coupling, elbow, tee, and union etc. | |
| | 2.2 | **Welding:**<br>Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles. | |
| **3** | | **Module 3: Arduino** | |
| | 3.1 | Introduction to Arduino: History of Arduino, Types of Arduino Boards (UNO, Nano, Mega),<br>Overview of Arduino UNO Board,<br>Installation & Drivers, Program for blinking LED | **10** |
| | 3.2 | Analog and Digital I/O in Arduino and PWM: Digital Input/Output Pins and Interfacing LEDs and Buttons,<br>Analog Input with Potentiometer, Analog Output using PWM (LED Fading) using analog Read () and analog Write () | |
| | 3.3 | Serial Communication: Introduction to Serial Monitor, Serial.begin(), Serial.print(), and Serial.println(),<br>Debugging with Serial Monitor | |
| | 3.4 | Sensor Interfacing: Interfacing with various sensors like Temperature, Humidity, Ultrasonic, Gas, IR, PIR, Soil Moisture, Vibration, Colour, Distance,<br>Displaying Data on Serial Monitor and LCD, | |
| | 3.5 | Actuators: Motors and Relays,<br>Interfacing DC Motor using Transistor,<br>Introduction to Relay Module and interfacing. | |
| | | **TOTAL** | **30** |

**Text Books:**


1. Elements of workshop technology. Vol. 1 & II by S K Hajra Choudhury
2. Welding technology by O P Khanna,3rd Edition
3. Getting Started with Arduino and Embedded Systems", Author: Ashwin Pajankar, Publisher: BPB Publications


**Reference Books:**


1. Manufacturing Science by Ghosh and Malik
2. "Welding Technology",Author: Richard Little, Publisher: McGraw-Hill Education

3. "Arduino: A Technical Reference", Author: J.M. Hughes, Publisher: Shroff Publishers & Distributors Pvt. Ltd. (India edition)

**Assessment Methodology:**

| Type of Courses | Assessment Tools | Marks Distribution |
|---|---|---|
| **Workshop** | **CA-50** | • Active Participation = 5 marks<br>• Trade 1# = 15 marks<br>• Trade 2# = 15 marks<br>• Trade 3# = 15 marks<br># Based on the performance and satisfactory completion of trade wise tasks. |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|---|
| 25FE2VSEC02 | Object Oriented Programming using Python | L | P | T | | L | P | T | Total |
| | | - | 2*+2 | - | | - | 02 | - | 02 |
| | | Examination Scheme | | | | | | | |
| | | | Termwork | Practical Exam | CA | MSE | ESE | Total | |
| | | Theory | - | - | - | - | - | - | |
| | | Lab | 25 | 25 | 25 | - | - | 75 | |

| | |
|---|---|
| **Pre-Requisite Course:** | 25FE1VSEC02: Problem Solving using C Programming |
| **Course Overview** | This course introduces Python programming as a high-level language for engineering and real-world problem solving. It covers Python fundamentals, structured programming, file handling, error management, object-oriented concepts, and key libraries such as NumPy, Pandas, and Matplotlib. Through hands-on 08 lab experiments and 06 self-learning activities, students develop problem-solving skills and gain practical experience in building modular Python solutions. |

**Course and Module Overview:**

The foundational elements of Python programming are introduced by covering its syntax, data types, and data structures. Students are enabled to understand and implement control structures and user-defined functions in order to develop structured solutions. Learners are also equipped with the skills required to build modular programs using file handling, exception management, and packaging techniques. Furthermore, students are familiarized with object-oriented programming paradigms and their implementation in Python.

**Module 1** introduces Python basics, including syntax, variables, data types, operators, and input/output. It also supports the transition from C to Python and familiarizes students with development environments like IDLE, PyCharm, Jupyter Notebook, and Google Colab.

**Module 2** covers decision-making using conditional statements and repetition using loops, along with function definitions, parameters, return values, and variable scope. Students learn to structure programs efficiently and reuse code.

**Module 3** focuses on fundamental Python data structures including strings, lists, tuples, dictionaries, and sets, and their operations for efficient data handling.

**Module 4** introduces object-oriented concepts such as classes, objects, encapsulation, inheritance, and polymorphism. Students learn to create classes, use constructors and destructors, and implement single, multiple, and multilevel inheritance.

**Module 5** covers file handling for reading and writing data, exception handling for managing runtime errors, and debugging techniques to identify and fix program errors. It also introduces the fundamentals of creating and using Python modules and packages.

**Module 6** introduces NumPy, Pandas, and Matplotlib for numerical computation, data analysis, and

visualization. Students can apply Python libraries to analyze data and solve engineering problems.

**Overall, this course introduces Python programming fundamentals, including syntax, data types, control structures, and functions. It helps learners build modular programs using data structures, file handling, and exception handling. Students also explore object-oriented programming and basic data analysis using libraries like NumPy, Pandas, and Matplotlib.**

| | | |
|---|---|---|
| **Course Outcomes** | **After successful completion, the students will be able to:** | |
| | CO1 | Identify Python syntax, basic data types, operators, control structures, and core OOP concepts like classes and inheritance. |
| | CO2 | Explain the role of Python features such as functions, file handling, and libraries in solving computational problems in engineering applications. |
| | CO3 | Apply Python programming concepts incorporating loops, conditionals, functions, file I/O, and exception handling to solve given computational tasks. |
| | CO4 | Analyze and decompose engineering problems into modular designs using object-oriented programming concepts such as encapsulation, inheritance, and polymorphism. |
| | CO5 | Examine alternatives and determine the most appropriate Python library for data manipulation, analysis, and visualization tasks |
| | CO6 | Construct complete, reusable Python applications integrating OOP, data structures, and libraries to address real-world problems. |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | | **Module 1: Introduction to Python** | **04** |
| | 1.1 | Basic Syntax and Data Types - Variables and data types, Operators, Input and output, Understanding the Syntax | 02 |
| | 1.2 | Transition: From C to Python , Introduction to programming environments- like pycharm, idle, jupyter, google colab. | 02 |
| | **Self Learning:** Install Python, Install and experience IDE-Pycharm Set up and explore Google Colab or Jupyter Notebook. | | |
| 2 | | **Module 2: Control Flow and Functions** | **05** |
| | 2.1 | Conditional Statements: if, else, elif , Loops: for and while loop | 03 |
| | 2.2 | Functions- Defining functions, Parameters and return values, Scope and lifetime of variables | 02 |
| | **Self Learning:** Write a menu-driven calculator using if-elif-else. Implement a number pattern generator using for and while loops. | | |
| 3 | | **Module 3: Useful Python Concepts for Coding** | **05** |
| | 3.1 | Introduction to string operations: concatenation, formatting, slicing, and common string methods | 01 |
| | 3.2 | Lists and tuples: creating, accessing, updating, and looping through elements | 02 |
| | 3.3 | Dictionary usage: key-value pairs, adding and retrieving data,introduction to sets: uniqueness, union, intersection, and difference | 02 |
| | **Self Learning:** Create a student report program that:Takes student names and marks as input. Store them in a dictionary. Adds all student names to a list and displays them. | | |
| 4 | | **Module 4: Object-Oriented Programming (OOP) in Python** | **05** |
| | 4.1 | Introduction to OOP: Classes and objects, Encapsulation, inheritance, and polymorphism | 02 |
| | 4.2 | Creating Classes and Objects: Class attributes and methods constructor and destructor. | 02 |
| | 4.3 | Type of Inheritance: Single, multiple and multilevel inheritance. | 01 |
| | **Self Learning**: Define a class Student with attributes and methods; instantiate objects. Implement constructor and destructor to observe object lifecycle. Demonstrate single, multilevel, and multiple inheritance using classes like Vehicle, Car, and Electric Car. | | |

| | | | |
|---|---|---|---|
| **5** | | **Module 5: File Handling, Packaging, and Debugging** | **05** |
| | 5.1 | File Handling- Reading and writing files, Exception Handling | 02 |
| | 5.2 | Creating Python Packages, Modules and executable files | 02 |
| | 5.3 | Dealing with Syntax Errors, Runtime Errors. | 01 |
| | **Self Learning:** Create and open a text file, read/write data, and display it line by line. Introduce and handle common exceptions (e.g., file not found, divide by zero). | | |
| **6** | | **Module 6: Python Libraries** | **06** |
| | 6.1 | Introduction to Popular Libraries, NumPy for numerical computing. | 02 |
| | 6.2 | Pandas for data manipulation, Matplotlib for data visualization | 03 |
| | 6.3 | Application of NumPy, Pandas, and Matplotlib | 01 |
| | **Self Learning:** Use numpy to create arrays and perform basic math operations.Read a CSV using pandas and display data using .head() and .info(). Perform sorting, filtering, and grouping operations on the data. Create a line or bar chart using matplotlib.pyplot. | | |
| | | **TOTAL** | **30** |

**Suggested List of Experiments:**

**Note: All experiments should be implemented using Python language.**

| Sr. No. | Title of the Experiment |
|---|---|
| 1 | **Getting Started with Python: Basic Output, Arithmetic, and User Input**<br><br>**Objective**:<br>To introduce students to the basics of Python programming, including displaying output, performing simple calculations, and accepting user input to create interactive programs.<br>**Outcome:**<br>Students will be able to write Python programs that print text, perform basic arithmetic operations, and take input from users. They will understand how to create simple interactive programs by combining input, processing, and output. |
| 2 | **Control Structures in Python: Decision Making and Loops**<br><br>**Objective:**<br>To help students understand how to control the flow of a Python program using conditional statements and loops, enabling them to make decisions and repeat actions efficiently.<br>**Outcome:**<br>Students will be able to use if-else statements to evaluate conditions such as voting eligibility and apply loops to repeat tasks like generating multiplication tables or displaying messages. They will develop the ability to write logical and structured programs using control flow concepts. |
| 3 | **Functions in Python: Building Reusable Code and a Basic Calculator** |

| | |
|---|---|
| | **Objective:**<br>To help students understand how to define and use functions in Python to perform specific tasks, such as calculating the area of shapes and creating a simple calculator for arithmetic operations.<br>**Outcome:**<br>Students will be able to write and call functions to solve problems like calculating areas and performing basic mathematical operations. They will understand how functions improve code reusability and help in building structured programs like a simple calculator. |
| 4 | **Python Data Structures: Lists, Strings, Tuple, Dictionaries, and Sets**<br><br>**Objective:**<br>To introduce students to fundamental Python data structures and demonstrate how to store, manage, and manipulate data using lists, strings, tuples, dictionaries, and sets.<br>**Outcome:**<br>Students will be able to create and modify lists, store and retrieve data using dictionaries, and perform basic set operations like union and intersection. They will gain the ability to choose appropriate data structures for organizing and handling different types of data in Python programs. |
| 5 | **Object-Oriented Programming in Python**<br><br>**Objective:**<br>To help students understand the core principles of object-oriented programming in Python and how they are used to design modular, reusable, and efficient programs.<br>**Outcome:**<br>Students will be able to apply key OOP concepts such as encapsulation, inheritance, abstraction, and polymorphism in Python programs. They will gain the ability to design structured and flexible code by modeling real-world problems using classes and objects. |
| 6 | **File and Error Handling in Python**<br><br>**Objective:**<br>To help students understand how to work with files for reading and writing data, and how to handle runtime errors using exception handling techniques in Python.<br>**Outcome:**<br>Students will be able to create, read, and write files in Python, and use try-except blocks to handle common errors like division by zero. They will develop the ability to write robust programs that manage data safely and handle unexpected situations effectively. |
| 7 | **Database Programming with SQLite and Python**<br><br>**Objective:**<br>To introduce students to database concepts and demonstrate how to use SQLite with Python to store, retrieve, and manage data efficiently.<br>**Outcome:**<br>Students will be able to connect Python programs to an SQLite database, perform basic operations like creating tables, inserting, and fetching data. They will understand how databases help in organizing and persisting data in real-world applications. |
| 8 | **Introduction to Data Analysis with Pandas**<br><br>**Objective:**<br>To help students understand how to use the Pandas library in Python to load and explore data from CSV files.<br>**Outcome:** |

| | |
|---|---|
| | Students will be able to load a CSV file using Pandas and display the first few rows of the dataset. They will gain basic skills in exploring and understanding data for simple analysis tasks. |
| 9 | **Data Visualization with Matplotlib: Creating Bar Charts**<br><br>**Objective:**<br>To introduce Students to basic data visualization techniques in Python using Matplotlib by creating simple bar charts to represent data.<br>**Outcome:**<br>Students will be able to create and display bar charts using sample data such as student marks. They will understand how visual representation helps in interpreting and comparing data effectively. |
| 10 | **Pattern Matching in Python: Regular Expressions for Data Validation**<br><br>**Objective:**<br>To help Students understand how to use regular expressions (regex) in Python to identify patterns and validate inputs such as email IDs and phone numbers.<br>**Outcome:**<br>Students will be able to use regex patterns to validate formats like email addresses and phone numbers. They will gain the ability to implement pattern matching for input validation in real-world applications. |

**Text Books:**


1. Core Python Programming (2nd Edition), Dr. R. Nageswara Rao, Dreamtech Press
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Introduction to Computing and Problem Solving with Python, E. Balagurusamy, McGraw Hill Education.


**Reference Books:**


1. Learning Python (5th Edition), Mark Lutz, O'Reilly Media, Python Crash Course (2nd Edition)
2. Eric Matthes, No Starch Press.


**Useful Links:**

1. https://www.w3schools.com/python/
2. https://www.programiz.com/python-programming
3. https://docs.python.org/3/tutorial/
4. https://www.edx.org/course/introduction-to-python-programming
5. https://www.geeksforgeeks.org/python-programming-language TutorialsPoint

**Assessment Methodology:**

| Type of Assessment | Assessment Tools |
|---|---|
| **Continuous** | • Certification: NPTEL (20 Marks) (Approved by instructor) Active |

| | |
|---|---|
| **Assessment (25 Marks)** | Participation and Timely Submission of Laboratory and Programming Assignments ( 5 Marks)<br><br>OR<br><br>● Any two Pedagogies (10 marks each) and Active Participation and Timely Submission of Laboratory and Programming Assignments (5 Marks)<br>● MCQ /Class Test<br>● Case study/Assignment<br>● GATE based Tutorial<br>● MOOCs Certification (Approved by instructor)<br>● Open Book Test<br>● Working model / simulation of a course-based concept. |
| **Termwork (25 Marks)** | Students are expected to complete a minimum 08 experiments conducted in a batch-wise laboratory setting and integrate it into a miniproject. Wherever applicable, students are encouraged to undertake computation or simulation-based experiments to deepen their conceptual understanding. Active participation, initiative, and creative engagement in all lab activities are expected.<br><br>Attendance : 05 marks<br>Lab Experiment and Miniproject : 20 marks |
| **Practical Exam (25 Marks)** | Practical examination will be based on the experiments performed by the students during laboratory sessions. |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| 25FE2IKS01 | Introduction to Indian knowledge System | L | P | T | L | P | T | Total |
| | | 2 | _ | _ | 2 | _ | _ | 2 |
| | | Examination Scheme | | | | | | |
| | | | CA | MSE | ESE | OR | PR | Total |
| | | Theory | 50 | _ | _ | _ | _ | 50 |
| | | Lab | _ | _ | _ | _ | _ | _ |

| Pre-Requisite Courses: | NIL |
|---|---|

**Course and Module Overview:**

The *Introduction to Indian Knowledge System* course introduces students across disciplines to the rich intellectual heritage and multidisciplinary knowledge traditions of India. It explores the philosophical foundations, scientific achievements, artistic expressions, governance systems, and sustainable practices that have shaped Indian civilization over millennia.

This course highlights how Indian Knowledge Systems offer valuable insights for contemporary challenges in sustainability, ethical governance, healthcare, and education. In this course, students will develop cultural literacy and an appreciation of indigenous knowledge systems that complement modern scientific approaches.

**Module 1:** This module introduces the conceptual, philosophical, and educational foundations of Indian Knowledge Systems (IKS). It explores the definition, scope, and multidisciplinary nature of IKS, the traditional Gurukul education model, foundational texts such as the Vedas and Vedangas, and the legacy of ancient universities. The module also critically compares the ancient Indian education system with the modern system.

**Module 2:** This module explores the rich scientific and technological heritage of India, highlighting contributions in mathematics, astronomy, metallurgy, medicine, atomic theory, and applied sciences. The module demonstrates how Indian knowledge traditions integrated observation, experimentation, and theory in advancing science. sustainable development, wellness, governance, and innovation in contemporary India.

**Module 3:** This module highlights the intellectual legacy of India through the contributions of ancient scholars in mathematics, astronomy, medicine, philosophy, and alchemy, along with modern Indian Nobel Laureates who have made significant global contributions in literature,

science, economics, and peace. The module bridges classical Indian knowledge traditions with contemporary global recognition.

**Module 4:** This module explores the artistic and architectural heritage of India as expressions of cultural knowledge systems. It examines temple architecture styles, urban planning of the Indus Valley Civilization, sculpture and mural traditions, and performing arts rooted in Vedic and classical traditions.

**Module 5:** This module examines the foundations of political thought, governance, and administrative systems in ancient India. It highlights statecraft as articulated in the Arthashastra, ethical governance principles rooted in Dharma and the edicts of Ashoka, and the functioning of non-monarchial and monarchical systems in ancient India.

**Module 6:** This module explores the sustainable practices, environmental consciousness, and holistic life philosophy embedded in Indian Knowledge Systems. It examines eco-friendly architecture, traditional water conservation systems, Yoga as a way of life, and the concept of Pancha Kosha .

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion, the students will be able to | |
| | CO1 | Recall the fundamental concepts, philosophy of the Indian Knowledge System (IKS) and the historical developments in India. |
| | CO2 | Explain the contributions of ancient Indian thinkers, scientific innovations, and traditional practices in mathematics, astronomy, medicine, and technology. |
| | CO3 | Apply concepts from traditional Indian knowledge systems—such as principles from Ayurveda, ancient mathematics, governance models, and ecological practice to address contemporary societal challenges in sustainability, health, and education. |
| | CO4 | Compare ancient and modern Indian education systems, governance models, and artistic expressions to identify underlying principles and patterns. |
| | CO5 | Evaluate the relevance, strengths, and limitations of traditional Indian knowledge systems in comparison with modern scientific frameworks in fields such as healthcare, architecture, environmental sustainability, and governance. |
| | CO6 | Design proposal or awareness initiatives based on literature survey and present their findings through a structured report or presentation that will promote the contemporary application of indigenous knowledge systems |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| 1 | **Introduction to Indian Knowledge System (IKS)** | | 05 |
| | After completing this module, students will be able to:<br>● Explain how Indian knowledge integrates science, arts, philosophy and social systems.<br>● Describe the functioning and features of the Gurukul system.<br>● Explain the features and significance of ancient universities.<br>● Compare ancient and modern education systems. | | |
| | 1.1 | Definition, scope, and philosophy of IKS, Multidisciplinary nature of IKS | |
| | 1.2 | Bhartiya Education System: Gurukul system | |
| | 1.3 | Philosophical Foundations: Vedas, Vedangas, Upavedas, Shastras, grammar & phonetics | |
| | 1.4 | Ancient Universities (Nalanda) | |
| | 1.5 | Ancient vs Modern Indian Education System | |
| | **Self-Learning Topics:** Takshashila -Ancient University | | |
| 2 | **Scientific Traditions and Innovations in Ancient India** | | 08 |
| | After completing this module, students will be able to:<br>● Explain ancient methods used in mathematics and astronomy.<br>● Describe the scientific basis of ancient calendar systems.<br>● Explain ancient metal extraction and processing techniques.<br>● Analyze ancient knowledge about surgery, medicine and chemical processes. | | |
| | 2.1 | Mathematics: Zero, decimal system, geometry, algebra (Aryabhata, Brahmagupta, Bhaskaracharya) | |
| | 2.2 | Astronomy: Planetary motion, eclipses, equinoxes (Aryabhata, Varahamihira) | |
| | 2.3 | Technology: Metallurgy, Civil engineering and Vastu Shastra | |
| | 2.4 | Life sciences and Medicine: Ayurveda, medicinal plants, Surgery (Charaka, Sushruta) | |

| | | | |
|---|---|---|---|
| | 2.5 | Rasa Shastra and Alchemy (Nagarjuna), Ancient Atomic Theory (Kashyapa/ Kanada) | |
| | **Self-Learning Topics:**Panchang- Hindu Astronomical Calender | | |
| **3** | **Contributions of Indian Thinkers and Nobel Laureates** | | **04** |
| | After completing this module, students will be able to:<br>● Analyze contributions of Indian mathematicians and philosophers.<br>● Recognize global contributions of Indian scholars. | | |
| | 3.1 | Ancient Indian Thinkers: Boudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Varahamihira | |
| | 3.2 | Ancient Indian Thinkers: Kanada, Nagarjuna, Sushruta, Charaka | |
| | 3.3 | Modern Nobel Laureates: Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyan Chandrasekhar | |
| | 3.4 | Modern Nobel Laureates: Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi, Abhijit Banerjee | |
| | **Self-Learning Topics:** Rabindranath Tagore's works for cultural and philosophical insights, linking them to global humanistic traditions**,** Vinayak Damodar Savarkar-Kala Pani-Sagara Pran Tamala | | |
| **4** | **Indian Art, Architecture & Aesthetics** | | **05** |
| | After completing this module, students will be able to:<br>● Explain how architecture and art reflects culture and traditions of India<br>● Identify major styles of temple architecture<br>● Describe urban planning systems of the Indus Valley<br>● Explain the origin of Indian music, dance, drama traditions | | |
| | 4.1 | Temple architecture: Nagara, Dravida, Vesara;<br>Indus Valley town planning | |
| | 4.2 | Sculpture traditions & iconography; Ajanta & Ellora Murals | |
| | 4.3 | Architecture as cultural expression – forts, palaces, stupas (Daulatabad Fort) | |
| | 4.4 | Natyakala & Folk arts: Sama Veda chanting, Gandharva music, dance (Nataraj,Tandav) | |
| | **Self-Learning Topics:** Natyashastra of Bharata Muni, temple rituals, folk dance traditions | | |

| | | | |
|---|---|---|---|
| **5** | **Governance Systems in Ancient India** | | **04** |
| | After completing this module, students will be able to:<br>● Explain administrative systems and governance in ancient India<br>● Evaluate advantages and limitations of democratic rule and monarchical systems<br>● Compare ancient ethical governance with modern ideas of human rights, welfare state, and rule of law | | |
| | 5.1 | Administrative system - Arthashastra of Kautilya | |
| | 5.2 | Judicial & Ethical governance - Dharma, Ashokan edicts | |
| | 5.3 | Gana Sangha (democratic rule) & Monarchical systems | |
| | **Self-Learning Topics:** Mauryan & Gupta administration | | |
| **6** | **Sustainable Practices, Yoga & Consciousness** | | **04** |
| | After completing this module, students will be able to:<br>● Analyze sustainable architecture and water systems<br>● Explain yogic philosophy and its purpose<br>● Describe the concept of Pancha kosha and the relationship between body, mind, and consciousness | | |
| | 6.1 | Sustainable engineering - Konark, Brihadeeswarar, Ellora | |
| | 6.2 | Water conservation & Urban planning | |
| | 6.3 | Yoga as a way of life - health & well-being | |
| | 6.4 | Pancha Kosha - five sheaths of consciousness, meditation | |
| | **Self-Learning Topics:** Indigenous approaches to agriculture, water management, and biodiversity conservation, and how they can be applied today. Eco-conscious crafts – bamboo & mud houses | | |
| | | **TOTAL** | **30** |

**Text Books:**

Mahadevan, B., Bhat, Vinayak Rajat, & Nagendra, Pavana R. N. (2022). Introduction to Indian Knowledge System: Concepts and Applications. New Delhi: PHI Learning Pvt. Ltd.

**Reference Books:**

1. Bag, A. K. (1997). *History of Technology in India*. New Delhi: Indian National Science Academy.
2. Goswamy, B. N. (2014). *Indian Art: An Overview*. New Delhi: Roli Books.
3. Kautilya. (1992). *Arthashastra* (Translated by L. N. Rangarajan). New Delhi: Penguin Books.
4. Samskrita Bharati. (2006). *Pride of India: Scientific Heritage*. Bangalore: Samskrita Bharati.

**Useful Links:**

1. https://swayam.gov.in/explorer?searchText=iks
2. https://iksindia.org/book-list.php
3. https://iksindia.org/index.php

**Assessment Methodology**:

| Type of Assessment | Assessment Tools |
|---|---|
| **Continuous Assessment CA**<br><br>**(50 Marks)** | • Active Participation & Timely Submission = 5 marks<br>• MCQ /Class Test = 10 marks<br>• Assignments = 10 marks<br>• Instructor Assessment of the Activity carried out by student = 25 marks |

| Course Code | Course Name | Teaching Scheme (Hrs. / Week) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | L | T | P | Total |
| 25FE2AEC01 | Effective Communication Skills | *2+2 | _ | - | 2 | _ | _ | 2 |
| | | Examination Scheme | | | | | | |
| | | | CA | | MSE | OR | ESE | Total |
| | | Theory | _ | | _ | - | _ | _ |
| | | Lab | 25 | | _ | 25 | _ | 50 |

| Pr-Requisite Courses: | 1. Basic course in Grammar and vocabulary |
|---|---|
| | 2. Language skills |

## Course and Module Overview

The *Effective Communication Skills* course is designed for undergraduate learners who possess a basic foundation in grammar and vocabulary and wish to strengthen their academic, professional, and workplace communication abilities. It is particularly suitable for students preparing for industry interaction, internships, interviews, and collaborative professional environments.

This course is highly relevant in today's multidisciplinary and corporate settings, where technical knowledge alone is insufficient without the ability to communicate ideas clearly, confidently, and ethically. By addressing verbal, non-verbal, written, and interpersonal communication, the course equips learners with essential soft skills that enhance employability and professional effectiveness.

**Module 1** covers fundamentals, processes, methods, barriers of communication, and the role of soft skills in professional contexts.

**Module 2** focuses on vocabulary development, grammar accuracy, and professional email writing for effective communication.

**Module 3** covers listening skills, pronunciation, body language, and public speaking through guided speaking activities.

**Module 4** covers reading comprehension, summarization, and formal writing business

communication principles.

**Module 5** covers personality development, workplace etiquette, grooming, interview readiness, and professional conduct.

**Module 6** covers confidence building in public speaking and presentations using voice control, structure, and visual aids.

**The course runs in a blended lecture–practical format, emphasizing activity-based learning. Students participate in role plays, group discussions, listening exercises, public speeches, and presentation design using tools such as Canva. Assessment is continuous and practical, based on assignments, term work, presentations, public speaking, and active participation rather than written examinations, ensuring skill development through application and practice.**

| | | |
|---|---|---|
| **Course Outcomes** | **After successful completion, the students will be able to** | |
| | CO1 | Demonstrate knowledge of fundamental concepts of grammar, listening skills, reading skills, core principles of verbal, non-verbal, and written communication. (Remembering) |
| | CO2 | Explain communication processes, identify barriers to effective communication, interpret the significance of body language in professional and organizational contexts (Understanding) |
| | CO3 | Apply appropriate grammatical structures, vocabulary, listening techniques, and non-verbal cues in academic, professional, and workplace communication situations. (Applying) |
| | CO4 | Analyze different forms of organizational communication, reading texts, and summarization methods to extract, organize, and present information logically (Analyzing) |
| | CO5 | Evaluate and select suitable formats, language styles, and professional etiquette to draft formal letters, emails, and public speeches effectively. (Evaluating) |
| | CO6 | Create well-structured, confident, and engaging public speeches and presentations using appropriate visual aids and digital presentation tools. (Creating) |

**Syllabus:**

<table>
<tr><th>Module No.</th><th colspan="2">Unit No.</th><th>Topics</th><th>Hours</th></tr>
<tr><td rowspan="6">1</td><td colspan="3">Review of Fundamentals of Communication</td><td rowspan="6">06</td></tr>
<tr><td colspan="3">After completing this module, students will be able to:<br>● Understand the postulates of communication.<br>● Explain the concept and meaning of Communication,<br>● Describe Communication cycle and methods of communication.<br>● Understand the barriers to communication.</td></tr>
<tr><td>1.1</td><td colspan="2">Postulates of communication, Process and Methods of Communication</td></tr>
<tr><td>1.2</td><td colspan="2">Barriers to communication and Organizational Communication</td></tr>
<tr><td>1.3</td><td colspan="2">Introduction to Soft Skills<br>Difference between soft skills and Technical skills,<br>Importance of Soft skills</td></tr>
<tr><td colspan="3">Self-Learning Topics: Watch TED Talk / Read article on "Communication in Industry"</td></tr>
<tr><td rowspan="7">2</td><td colspan="3">Developing Verbal Aptitude</td><td rowspan="7">06</td></tr>
<tr><td colspan="3">After completing this module, students will able to:<br>● Understand root words, Synonyms and Antonyms and its role in developing Vocabulary.<br>● Understand the format, features , language and style used in writing mails.<br>● Apply appropriate grammatical structures, vocabulary, and non-verbal cues in formal and informal situations.</td></tr>
<tr><td>2.1</td><td colspan="2">Vocabulary Building :Etymology<br>Collocations, Tautologies, Pleonasms</td></tr>
<tr><td>2.2</td><td colspan="2">Grammar : Identifying common errors</td></tr>
<tr><td>2.3</td><td colspan="2">Subject -Verb Agreement<br>Misplaced Modifiers, Articles and Punctuation marks</td></tr>
<tr><td>2.4</td><td colspan="2">Email Writing : Email etiquette</td></tr>
<tr><td colspan="3">Self-Learning Topics: Listening to a podcast and writing gist of It.</td></tr>
</table>

<table>
<tr><td>3</td><td colspan="2">Developing Listening and Speaking Skills</td><td>06</td></tr>
<tr><td></td><td colspan="2">After completing this module, students will be able to:<ul><li>Know the basics of public speaking.</li><li>Use correct vocabulary and grammar to design a well structured public speech on a given topic.</li><li>Use body language effectively while delivering the speech and self introduction.</li><li>Understand the importance of pronunciation, stress and intonation in oral communication.</li></ul></td><td></td></tr>
<tr><td></td><td>3.1</td><td>Types of Listening :Active Listening</td><td></td></tr>
<tr><td></td><td>3.2</td><td>Public speaking : Introduction to Public Speaking,Speech Preparation and Structuring,Audience analysis and purpose identification,Verbal and Vocal Skills ,Language clarity and choice of words</td><td></td></tr>
<tr><td></td><td>3.3</td><td>Self-introduction, Use of body language in public speaking, one minute impromptu speeches ,Pronunciation , Stress and Intonation</td><td></td></tr>
<tr><td></td><td colspan="2">Self-Learning Topics: Practice JAM topics at home; Record 1-minute speech</td><td></td></tr>
<tr><td>4</td><td colspan="2">Developing Reading and Writing Skills</td><td>07</td></tr>
<tr><td></td><td colspan="2">After completing this module, students will be able to:<ul><li>Explain the types of reading comprehend the given passages</li><li>Summarize the given infographics into a paragraph and visa- versa.</li><li>Understand the prescribed essential and optional parts of a business letter.</li></ul></td><td></td></tr>
<tr><td></td><td>4.1</td><td>Reading and Summarization skills</td><td></td></tr>
<tr><td></td><td>4.2</td><td>Summarizing text to Info-Graphic Organizers<br>Verbal to non- verbal and visa-versa.</td><td></td></tr>
<tr><td></td><td>4.3</td><td>Seven Cs of Business writing</td><td></td></tr>
<tr><td></td><td>4.4</td><td>Format and types of Formal letters: Request/Permission Letter ,Claim and Adjustment Letter and Sales Letter</td><td></td></tr>
<tr><td></td><td colspan="2">Self-Learning Topics: Draft Application letters for , internship, Permission for conducting events etc.</td><td></td></tr>
<tr><td>5</td><td colspan="2">Getting Workplace Ready</td><td>06</td></tr>
<tr><td></td><td colspan="2">After completing this module, students will be able to:<ul><li>Understand importance of dressing and grooming in formal situations.</li><li>Differentiate between resume and CV and customize the same.</li><li>Evaluate and select suitable formats, language styles, and professional etiquette to draft formal letters.</li></ul></td><td></td></tr>
</table>

| | | | |
|---|---|---|---|
| | 5.1 | Grooming and Professional Etiquette | |
| | 5.2 | Formal dress code, Cubicle Etiquette,Dining and social etiquette | |
| | 5.3 | Resume writing & Job interview :<br>Resume and CV: structure, formatting, and customization Understanding job descriptions and role requirements, Common resume mistakes<br>Meaning and purpose of interviews ,types of interviews: HR, Technical, Behavioral, Panel, Telephonic, Video Interview, process and stages of interview, Employer expectations and selection criteria | |

| | | | |
|---|---|---|---|
| | **Self-Learning Topics:** Watch mock interviews and make a list of documents required for a job interview. | | |
| **6** | **Presentation Skills** | | **05** |
| | After completing this module, students will be able to:<br>● Understand the role of voice modulation and speech clarity while delivering presentations.<br>● Understand various ways to overcome stage fears and anxiety.<br>● Ability design presentations by using AI tools | | |
| | 6.1 | Presentation Skills :Voice modulation and speech clarity | |
| | 6.2 | Overcoming stage fear and anxiety and Structuring and delivering impactful presentations | |
| | 6.3 | Creating presentation by using AI tools and visual aid tip | |
| | **Self-Learning Topics:** Prepare a PPT on a technical topic | | |
| | **TOTAL** | | **36** |

**List of Activities**

| Activity No. | Title of the Activity |
|---|---|
| 1. | Listening to Audio passage, a podcast clip for details and gist.<br>**Learning Objective:**<br>To listen to an audio passage and answer questions related to it.<br>**Learning Outcome:**<br>Students will be able to understand active listening by responding appropriately and learn about tone, intention from verbal and non verbal cues. |
| 2. | Write and deliver a Public speech on given topics. Impromptu Speeches.<br>**Learning Objective:**<br>To deliver a Public speech on a given topic.<br>**Learning Outcome:**<br>Students will be able to organize ideas into introduction, body, and conclusion and develop coherence and logical flow. |
| 3. | Reading short stories and technical articles.<br>**Learning Objective:**<br>To read a comprehension and answer questions related to it.<br>**Learning Outcome:**<br>Students will be able to understand the contextual meaning of unfamiliar words and explain and identify the objectives of summarization. |
| 4. | Role play activity in given formal situations.<br>**Learning Objective:**<br>To act out the particular roles given according to the situation.<br>**Learning Outcome:**<br>Students will be able to analyze different communication contexts and use appropriate vocabulary for the situation. |
| 5. | Test on grammar and vocabulary ( TOEFL, IELTS level)<br>**Learning Objective:**<br>To test their understanding of grammar.<br>**Learning Outcome:**<br>Students will be able to analyze different communication contexts and use appropriate vocabulary for the situation. |
| 6. | Using AI tools to create presentations.<br>**Learning Objective:**<br>To enable them to use AI tools for creating presentations.<br>**Learning Outcome:**<br>Students will be able to create coherent slides using AI assistance and develop logical sequencing of ideas. |
| 7. | Conversion of information from the given graphic organizers to a paragraph.<br>**Learning Objective:**<br>To be able to convert the given information. |

| | |
|---|---|
| | **Learning Outcome:**<br>Students will be able to identify key ideas from flowcharts, tables, mind maps, or diagrams and maintain clarity and unity in paragraph structure. |
| 8. | Conducting a podcast on a given topics.<br>**Learning Objective:**<br>To be able to conduct a podcast.<br>**Learning Outcome:**<br>Students will be able to use conversational yet coherent language and maintain clarity and relevance of content. |
| 9. | Group Discussions on Technical/Current Topics.<br>**Learning Objective:**<br>To participate in a group discussion.<br>**Learning Outcome:**<br>Students will be able to express ideas clearly and confidently and contribute relevant points in the discussion. |
| 10. | Deliver presentations on given topics.<br>**Learning Objective:**<br>To be able to deliver a presentation.<br>**Learning Outcome:**<br>Students will be able to define presentation objectives based on audience and purpose and learn to organize content logically using introduction, body, and conclusion. |

## Assignments

1. Case study on Barriers to communication.
2. Write a detailed note on listening.
3. Write a public speech on given topics.
4. Written record of Podcast activity. (Script writing)
5. Draft any two formal letters prescribed in the syllabus.

**Text Books:**

1. Communication Skills by Sanjay Kumar & Pushp Lata

2. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi

**Reference Books:**

1. Business Communication with Writing Improvement Exercises. Hemphill, McCormick and Hemphill

2. Business Communication: Building Critical Skills by Locker, Kitty O.Kaczmarek, Stephen Kyo

3. Effective Business Communication by Herta Murphy

4. Technical Communication: Principles and Practice by Raman and Sharma

5. Word Power Made Easy by Norman Lewis

**Useful Links:**

1. https://bbclearningenglish.org
2. https://www.bbc.co.uk/learningenglish

## Assessment Methodology:

| Type of Assessment | Assessment Tools |
|---|---|
| Continuous Assessment (CA) (25 marks) | ● CA I will be of assignments – 10 Marks<br>● CA II will be of activities and MCQ test - 10 Marks<br>● Active Participation and Timely Submission -5Marks |
| Practical and OralS(25 marks) | ● Presentation – 15 marks<br>● Public Speech -10 marks |

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| 25IL2LLC03 | Creative Visual Art | | 2 | | | 1 | | 1 |

| | | Assessment Methods | | | | Total Marks | Total Credits |
|---|---|---|---|---|---|---|---|
| | | Mentor Assessment | Course Attendance | Cultural Fest Participation | Technical Fest Participation | | |
| | Creative Visual Art | 30 | 5 | 10 | 5 | 50 | 1 |

| Pre-Requisites: | Nil |
|---|---|

Course Overview

This course is designed to provide students with a comprehensive understanding of both traditional artistic practices and contemporary digital media skills. It integrates creative expression with practical application through modules on mural art, eco-art, craft, resume writing, and digital media tools. The course also emphasizes the development of professional communication skills and personal branding. Overall, it aims to foster creativity, technical competence, and sustainability-oriented thinking among learners.

**Module No 1**
Overview:
**Module 1 :**Mural Art-1
This module introduces students to the fundamentals of mural art, including charcoal painting, chalk art, mandala art, and basic sketching techniques. It aims to develop foundational drawing skills and enhance understanding of both traditional and contemporary artistic styles, thereby preparing students for more advanced creative work

**Module No 2**
Overview:
**Module 2 :** Resume Writing -Introduction

This module focuses on the principles of effective resume writing and the development of professional profiles on digital platforms. It covers structuring resumes, optimizing LinkedIn profiles, and understanding personal branding. The objective is to enhance students' employability by enabling them to present themselves effectively in professional and digital environments

**Module No 3**

Overview:

**Mural Art – II**

This module builds upon foundational skills by introducing clay-based mural techniques, particularly Lipan art. Students will explore mural composition using clay, along with the application of textures and traditional motifs. The module emphasizes the creation of three-dimensional artworks and the integration of cultural elements with modern design approaches.

**Module No 4**

Overview:

**Craft and Eco Art**

This module encourages sustainable artistic practices through the use of recycled and waste materials. It includes the creation of decorative items, recycled art projects, and handmade crafts. The focus is on promoting environmental awareness and fostering creativity through eco-friendly and resource-efficient methods

**Module No 5**

Overview:

**Software Tools for Creative Media**

**Blender** is a free, open-source software used for creating **3D graphics and animations**. It's widely used in creative media because it combines multiple tools into one platform—so you can model, animate, render, and even edit videos without switching software

**Module No 6**

Overview:

**Digital Art and Media**

This module focuses on digital design and illustration techniques. Students will learn to create posters and visual content using Canva

**Course Objectives:**

1. To introduce students to the fundamentals of art and design.
2. To develop observation, visualization, and creative expression skills.
3. To explore traditional, contemporary, and digital art media.
4. To promote cultural understanding through indigenous art and craft techniques.
5. To guide students in building a personal art portfolio reflecting originality and growth.

| | | |
|---|---|---|
| **Course Outcomes** | After successful completion | |
| | CO1 | Recall the essential elements and principles of art and design. (Remember) |
| | CO2 | Explain various traditional, contemporary, and digital art media and their applications. (Understand) |
| | CO3 | Apply drawing, painting, craft, and digital tools to express creative ideas. (Apply) |

| | | |
|---|---|---|
| | | |
| | CO4 | Analyze Indian art forms, craft techniques, and commercial design practices. (Analyse) |
| | CO5 | Evaluate creative outputs based on originality, technique, and sustainability. (Evaluate) |
| | CO6 | Create a comprehensive art portfolio showcasing conceptual development and artistic expression. (Create) |

**Syllabus:**

| Module No. | Unit No. | Topics | Hours |
|---|---|---|---|
| . | | | |
| **1** | | Mural Art-1 | **10** |
| | | After completion, the student will be able to:<br>● Identify the basic materials used in charcoal painting, chalk art, and mandala art.<br>● Explain the importance of shading, coloring, blending, and symmetry in mural art.<br>● Demonstrate simple strokes and sketching techniques in practical exercises.<br>● Differentiate between traditional and contemporary mural styles.<br>● Create a final artwork that integrates charcoal, chalk, mandala, and sketching techniques. | |
| | 1.1 | Charcoal painting techniques, | |
| | 1.2 | Chalk art | |
| | 1.3 | Mandala art | |
| | 1.4 | Basic sketching techniques. | |
| Self Learning: Learn the basic materials used in charcoal painting, chalk art, and mandala art.<br>● Practice simple strokes like shading, coloring, and drawing patterns.<br>● Focus on improving techniques such as blending, color use, and symmetry.<br>● Create a final artwork by combining all the skills you have learned. | | | |
| | | | |
| **2** | | Resume Writing | **02** |
| | | After completion, the student will be able to:<br>● Recall the essential components of a professional resume.<br>● Explain the significance of personal branding in professional and digital environments.<br>● Draft a resume including personal details, education, and skills.<br>● Evaluate the effectiveness of different resume structures.<br>● Build a LinkedIn profile with a professional photo, headline, summary, and experience. | |
| | 2.1 | LinkedIn Profile Building | |
| | | | |

| | | | |
|---|---|---|---|
| Self Learning :<br>• Create a Resume Draft,<br>Write your basic resume with personal details, education, and skills Build Your LinkedIn Profile:<br>Add profile photo, headline, summary, and experience | | | |
| | | | |
| **3** | | Mural Art – II | **06** |
| | | After completion, the student will be able to:<br>● List the tools and materials required for clay-based mural art.<br>● Describe the cultural significance of Lipan art and traditional motifs.<br>● Practice clay handling and create textures using tools or fingers.<br>● Compare two-dimensional mural techniques with three-dimensional clay compositions.<br>● Design a small clay mural incorporating Lipan art patterns and textures. | |
| | 3.1 | Clay art – Lipan art techniques, Introduction to mural compositions using clay. | |
| | 3.2 | Application of texture and traditional motifs. | |
| Self- learning: Learn basic clay handling and tools. , Practice Lipan art techniques and traditional patterns. Create small mural compositions with clay, Experiment with textures using tools or fingers. | | | |
| . | | | |
| **4** | | Craft and Eco Art | **05** |
| | | After completion, the student will be able to:<br>● Identify recyclable and waste materials suitable for craft projects.<br>● Explain the role of eco-art in promoting sustainability.<br>● Create decorative items using recycled materials.<br>● Assess the environmental impact of traditional vs. eco-friendly art practices.<br>● Develop innovative handmade crafts that combine creativity with sustainability. | |
| | 4.1 | Decorations from waste materials, Recycled art projects, Sustainable art practices, | |
| | 4.2 | Creative handmade craft exploration. | |
| Self-Learning : Study and investigation of different waste materials which can be reused. | | | |
| **5** | | Software Tools for Creative Media | **05** |
| | | After completion, the student will be able to:<br>● Recognize the basic interface and tools of Blender software.<br>● Explain the functions of modeling, scaling, and rotating objects in 3D design.<br>● Construct simple 3D shapes like cubes, spheres, and cylinders.<br>● Evaluate the accuracy and aesthetics of a basic 3D model.<br>● Design a simple 3D object (e.g., chair or room corner) using Blender. | |
| | 5.1 | Blender software training | **03** |
| Self -learning: Practice adding shapes (cube, sphere, cylinder) ,Move, scale, and rotate them, Create a simple object (chair or room corner) | | | |
| | | | |

| | | | |
|---|---|---|---|
| **6** | | Digital Art and Media | **02** |
| | | After completion, the student will be able to:<br>● Identify Canva's key features such as templates, elements, and text tools.<br>● Explain how digital posters enhance communication and branding.<br>● Customize a Canva template with text, colors, and images.<br>● Compare different design layouts for clarity and visual appeal.<br>● Produce a professional poster or digital design using Canva. | |
| | 6.1 | Training on Canva - Explore the Interface- Understand templates, elements, text, and uploads | |
| | 6.2 | Create a Design<br>Choose a template and customize text, colors, and images | |
| Self -Learning: Add Visual Elements<br>Insert icons, photos, shapes, and backgrounds | | | |

**Reference Books :**

- Eco Craft: Recycle, Recraft, Restyle – Susan Wasinger, Edition: 1st Edition Publisher: Lark Crafts
- Inspirations for Graphic Design from India – Jaya Jaitly, Edition: 1st Edition (2023) Publisher: Arthshila Trust
- Crafts Atlas of India- Jaya Jaitly, 2025 Edition, Publisher: Niyogi Books.

**Suggested Activities for Creative Visual Art Course :**

- Create a charcoal or mandala mural artwork
- Prepare a professional resume and optimized LinkedIn profile
- Design a small Lipan-inspired clay mural
- Create a decorative item using recycled materials
- Produce a short, edited video with basic animation elements
- Design a digital poster or illustration using any software tool

**Useful Links :**

- **https://www.canva.com**
- **http://www.kunst4alle.com/blog**
- **http://www.reelmind.ai/blog/mandala-art-for-beginners-guide-users-with-reelmind-s-ai-art-tutorials**
- **http://www.linkedin.com/learning/creativity-tips-for-all**
- **https://www.youtube.com/results?search_query=lipan+art+tutorial**
- **https://www.google.com/search?q=kutch+mud+mirror+art+DIY**

- **http://www.linkedin.com/top-content/design/digital-illustration-process**

**Assessment Methodology:**

| **Type of Assessment** | **Assessment Tools** |
|---|---|
| **Continuous Assessment (50 Marks)** | • **Active Participation & Timely Submission = 10 marks**<br>• **Instructor Assessment of the Activity carried out by student = 30 marks**<br>• Cultural Fest Participatio = 5 Marks<br>• Technical Fest Participation = 5 Marks |

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| 25IL2LLC02 | LLC – Sports & Fitness | | 2 | | | 1 | | 1 |

| | | Assessment Methods | | | | Total Marks | Total Credits |
|---|---|---|---|---|---|---|---|
| | | Mentor Assessment | Course Attendance | Cultural Fest Participation | Technical Fest Participation | | |
| | LLC – Sports & Fitness | 30 | 5 | 10 | 5 | 50 | 1 |

**Course Objectives:**

- Inspire students to actively engage in both indoor and outdoor sports as a means to enhance physical health and mental balance.
- Cultivate teamwork, leadership qualities, and a spirit of fair play through collaborative sporting activities.
- Encourage the adoption of regular physical exercise as a pathway to a healthier, stress-free lifestyle.
- Build awareness of fundamental fitness routines and recreational sports that support long-term well-being.

**Course Outcomes:**

- **CO1:** Demonstrate awareness of the significance of fitness and healthy living habits. *(Remembering)*
- **CO2:** Illustrate understanding of the basic rules governing indoor and outdoor sports. *(Understanding)*
- **CO3:** Perform simple fitness drills and warm-up routines effectively. *(Applying)*
- **CO4:** Show active involvement and cooperation in team sports activities. *(Analyzing)*
- **CO5:** Monitor and reflect on personal fitness progress through regular participation. *(Evaluating)*
- **CO6:** Nurture a sustained passion for sports and physical well-being. *(Creating)*

**Course and Module Overview:**

The *Sports & Fitness* course is designed to inspire students to actively participate in both indoor and outdoor sports, fostering physical health, mental balance, and lifelong well being. Through structured practice sessions, fitness routines, and team-based activities, students will develop essential skills in sportsmanship, leadership, and collaboration. The course emphasizes consistency in physical exercise, awareness of fitness principles, and engagement in recreational sports as a means of stress management and holistic development.

Module 1 introduces students to the fundamentals of sports and fitness, emphasizing the importance of physical activity as a foundation for overall well being. It covers the essential components of fitness, the role of warm-up routines in injury prevention, and the significance of team formation exercises in building collaboration and group dynamics.

Module 2 focuses on developing foundational fitness through structured conditioning routines while emphasizing safety and injury prevention. Students will engage in stretching exercises, endurance-building activities, and light strength training to improve flexibility, stamina, and muscular strength. Alongside physical practice, the module highlights precautionary measures to minimize risks and ensure safe participation in sports and fitness activities.

Module 3 focuses on the practice and mastery of indoor sports, combining theoretical knowledge of rules with practical skill development. Students will engage in structured sessions for badminton, table tennis, chess, and carom, emphasizing both individual performance and strategic thinking. The module aims to enhance coordination, concentration, and technical proficiency while fostering a spirit of fair play and healthy competition.

Module 4 emphasizes active participation in outdoor sports, focusing on both individual performance and team collaboration. Students will engage in cricket, football, volleyball, basketball, kho-kho, and kabaddi, learning the rules, techniques, and strategies of each sport. The module highlights teamwork, communication, and tactical planning, helping students develop physical endurance, coordination, and a competitive spirit.

Module 5 explores the interpersonal and ethical dimensions of sports, focusing on leadership roles, discipline, and fair play. Students will learn how team dynamics influence performance, the responsibilities of a captain, and the importance of managing both victories and defeats with integrity. The module emphasizes sportsmanship values, preparing students to contribute positively to team environments and uphold ethical standards in competitive situations.

Module 6 highlights the role of recreational sports and wellness practices in promoting stress management and lifelong fitness. It introduces students to activities that balance physical health with mental well being, encouraging participation in recreational games and wellness routines. The module culminates in a semester-end sports activity, providing an opportunity to showcase skills, teamwork, and holistic development.

**Syllabus**

| Sr. No. | Name of Module | Detailed Content | Hours |
|---|---|---|---|
| 1 | Foundations of Physical Fitness & Team Formation | Overview of sports and fitness; components of fitness; importance of warm- up; team formation exercises<br><br>Self learning topic - Participate in a team-building exercise (e.g., group sports drill) and write a reflection on teamwork and leadership. | 05 |
| 2 | Basic Fitness Conditioning & Injury Prevention | Stretching routines; endurance activities; light strength training; safety and injury prevention measures.<br><br>Self learning topic - Explore endurance-building activities like jogging, cycling, or skipping. | 04 |
| 3 | Skill Development in Indoor Sports | Practice and rules of badminton, table tennis, chess, and carom; focus on skill improvement.<br><br>Self learning topic - Record or demonstrate a basic skill drill (e.g., badminton serve, chess puzzle solution, carrom strike). | 06 |
| 4 | Skill Development in Outdoor Sports | Participation in cricket, football, volleyball, basketball, kho- kho, and kabaddi; emphasis on teamwork and strategy.<br><br>Self learning topic - Watch professional matches or tutorials to observe techniques and strategies. | 06 |
| 5 | Team Dynamics, Leadership & Sports Ethics | Role of captain; discipline and fair play; managing victories and defeats; sportsmanship values.<br><br>Self learning topic - Learn about fair play principles and codes of conduct in sports. | 05 |
| 6 | Recreational Sports, Wellness & Lifelong Fitness | Recreational sports for stress management; introduction to wellness practices; semester- end sports activity.<br><br>Self learning topic - Explore basic wellness routines such as yoga, meditation, breathing exercises, and mindfulness | 05 |

**Suggested Activities for the Course**

1. **Regular Sports Engagement** – Participate in weekly sports sessions to build consistency and fitness.

2. **Team Practice Sessions** – Conduct structured practice matches to enhance coordination and teamwork.

3. **Pre- Game Fitness Routine** – Perform warm- up and basic exercises before every sporting activity.

4. **Inter- Team Competitions** – Engage in friendly matches between teams to develop competitive spirit.

5. **Semester- End Sports Meet** – Showcase skills and teamwork through a culminating sports event.

6. **Participation Tracking** – Maintain individual records of attendance and involvement in activities.

**Reference Books**

| | |
|---|---|
| 1. | **Sports & Fitness: Designed as per NEP 2020 Guidelines** Dr. Nirlep Kaur Deol, Dr. Suresh Kumar Daroch – Comprehensive text aligned with NEP 2020, covering fitness fundamentals, sports rules, and wellness practices. |
| 2. | **Science of Sports Training** Dr. Hardayal Singh – Classic book on principles of training, conditioning, and injury prevention. |
| 3. | **Fundamentals of Physical Education** Friends Publications – Covers basics of physical education, fitness components, and exam preparation for UGC-NET and teaching positions. |
| 4. | **Scientific Principles of Sports Training** Various Authors – Explains physiological foundations of training methods, endurance, and strength development. |
| 5. | **Physical Education and Sports Studies** Dr. Ajmer Singh & Team – A widely used reference for rules, techniques, and pedagogy in both indoor and outdoor sports. |
| 6. | **Wellness and Fitness Education** Dr. B. K. Nayak – Focuses on lifelong fitness, recreational sports, and stress management practices. |

**Useful Links:**

https://www.topendsports.com/index.htm

https://www.who.int/news-room/fact-sheets/detail/physical-activity

https://www.olympics.com/athlete365

https://www.nsca.com/

https://sportscienceinsider.com/

https://coachdirect.in/

**Assessment Methodology:**

| Assessment Tools | Marks Distribution |
|---|---|
| **Term Work (50 Marks)** | Mentor Assessment = 30 Marks<br>Course Attendance = 5 Marks<br>Cultural Fest Participatio = 10 Marks<br>Technical Fest Participation = 5 Marks |

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| 25IL2LLC05 | Social Service Responsibilities | | 2 | | | 1 | | 1 |

| | | Assessment Methods | | | | Total Marks | Total Credits |
|---|---|---|---|---|---|---|---|
| | | Mentor Assessment | Course Attendance | Cultural Fest Participation | Technical Fest Participation | | |
| | Social Service Responsibilities | 30 | 5 | 10 | 5 | 50 | 1 |

**Course Objectives:**

- To develop understanding of social service and community engagement through interdisciplinary learning.
- To construct knowledge through experiential and problem-based learning approaches.
- To relate classroom knowledge to daily life and societal needs.
- To develop critical thinking, reflective thinking, and effective reasoning skills.
- To foster creativity, empathy, professionalism, and responsible citizenship through NSS activities.

**Course Outcomes:**

- CO1: Recall the principles, objectives, and structure of NSS and social service activities. (Remember)
- CO2: Explain interdisciplinary knowledge related to social science, environment, health, and education in community contexts. (Understand)
- CO3: Apply problem-solving skills in planning and executing community-based NSS projects. (Apply)
- CO4: Analyse social issues through case studies and field observations. (Analyse)
  CO5: Evaluate the effectiveness of social service initiatives through reflection and peer feedback. (Evaluate)
- CO6: Design and implement a community-oriented project addressing a real-life social problem. (Create)

**Syllabus**

| Sr. No. | Name of Module | Detailed Content | Hours |
|---|---|---|---|
| 1 | Introduction to NSS and Social Responsibility | Introduction to NSS and course objectives, Role of NSS in nation building, Interdisciplinary knowledge (social science, environment, health, education), Linking classroom knowledge to NSS fieldwork. | 05 |
| 2 | Community Engagement and Problem Solving | Identification of community issues through surveys and field visits, Problem-based learning, Group brainstorming for solutions, Collaborative project planning. | 05 |
| 3 | Reflective Thinking and Empathy | Reflection exercises on NSS activities, Journaling and self-assessment, Role-play to understand community perspectives, Empathy development. | 05 |
| 4 | Communication and Professional Skills | Effective verbal and written communication, Reporting and documentation of NSS activities, Debates and discussions on social issues, Professional behaviour in community engagement. | 05 |
| 5 | Technology and Innovation in Social Service | Use of digital tools (Canva, MS Office, Google Suite), Social media awareness campaigns, Digital reporting and content creation for NSS projects. | 05 |
| 6 | Project Implementation and Presentation | Planning and execution of NSS service projects, Final project presentation, Reflection on learning outcomes, Evaluation and feedback. | 05 |

Suggested Activities for Social Service Responsibilities Course

- NSS Orientation and teamwork ice-breaker session
- Community survey and problem identification activity
- Reflective journaling workshop on NSS experience
- Communication workshop and case study discussion
- Create a digital awareness campaign poster/video
- Presentation of community project proposal and outcomes

**Course and Module Overview**

The course on National Service Scheme (NSS) and Community Engagement is designed to develop a comprehensive understanding of social service, civic responsibility, and community participation among students. It emphasizes interdisciplinary learning and experiential approaches to bridge the gap between classroom knowledge and real-life societal needs. Through active involvement in NSS activities, students are encouraged to cultivate critical thinking, reflective abilities, empathy, creativity, and a sense of professionalism, thereby shaping them into responsible citizens.

The course begins with an introduction to the concept, history, and objectives of NSS. Students are familiarized with the structure and functioning of NSS at various levels, along with its motto, symbol, and guiding principles. This foundational knowledge enables learners to recall and understand the significance of voluntary service and the role of youth in nation-building. By grounding students in these basic concepts, the course aligns with the first learning outcome of remembering key aspects of NSS and social service.

Moving forward, the course adopts an interdisciplinary perspective by exploring the concept of community and community development. It integrates knowledge from social sciences, environmental studies, health, and education to help students understand the multifaceted nature of societal issues. Topics such as environmental sustainability, public health, sanitation, and literacy are discussed in relation to community contexts. This approach enables students to comprehend how different disciplines contribute to improving the quality of life in society, thereby fulfilling the objective of developing a deeper understanding of community engagement.

The course also focuses on the practical application of knowledge through the planning and execution of NSS activities. Students learn how to identify community needs, conduct surveys, and design appropriate interventions. They are trained in project planning, teamwork, and leadership, which are essential for successfully implementing community-based initiatives. Participation in NSS camps and field activities provides hands-on experience, allowing students to apply problem-solving skills in real-life situations and enhancing their ability to translate theoretical knowledge into practice.

In addition, the course encourages students to analyse various social issues such as poverty, unemployment, gender inequality, and environmental degradation. Through case studies and field observations, learners gain insights into the root causes and impacts of these problems. They also study the role of non-governmental organizations and government schemes in addressing such challenges. This analytical approach helps students develop a critical understanding of societal issues and equips them with the skills needed to interpret and evaluate real-world situations.

Reflection and evaluation form another important component of the course. Students are required to maintain reflective journals and participate in peer discussions to assess their learning experiences. By evaluating the effectiveness of social service initiatives, they develop the ability to think critically about their actions and outcomes. This process not only enhances their reasoning skills but also instills ethical values and a sense of accountability in their work.

The final stage of the course involves the design and implementation of a community-oriented project. Students are encouraged to identify a real-life social problem and develop inno-

vative solutions to address it. This stage emphasizes creativity, planning, execution, and impact assessment. By working on such projects, students gain confidence and a deeper understanding of their role in society, ultimately achieving the highest level of learning—creation.

# Weekly Lesson Plan – Total 8 Weeks (10 Hours Theory)

| Week | Topic / Module | Activities | Learning Resources |
|---|---|---|---|
| Week 1 | Introduction to NSS and Course Objectives | Orientation lecture and ice-breaker activity on teamwork | NSS Manual, Course Syllabus |
| Week 2 | Interdisciplinary Knowledge and NSS | Lecture on interdisciplinary topics (e.g., sociology and environmental science). Group activity: Connecting knowledge to NSS fieldwork. | Case studies, Multimedia presentations |
| Week 3 | Community Engagement and Problem Solving | Field visit to identify community issues. Group brainstorming for solutions. | Community surveys and NSS project guidelines |
| Week 4 | Reflective Thinking and Empathy | Reflection journaling workshop. Role-playing exercises to understand community perspectives. | Writing guides, real-life examples |
| Week 5 | Communication Skills for NSS Activities | Workshop on effective verbal and written communication (e.g., reporting NSS activities). | Communication toolkits |
| Week 6 | Technology in NSS | Training on using technology for NSS projects (e.g., Canva, MS Office, social media for campaigns). | Online tools |
| Week 7 | Goal Setting and Professionalism | Activity: Prepare a personal development plan. | Goal-setting frameworks |
| Week 8 | Final Project – Implementation and Presentation | Students present their NSS project proposals and reflect on outcomes. | PPTs, videos, presentation tools |

# Teaching Tools and Strategies

- **Interactive Teaching:** Case studies, multimedia lectures, brainstorming sessions
- **Collaborative Learning:** Group discussions, role-playing, team-based problem solving
- **Experiential Learning:** Field visits, NSS service projects, reflective journaling
- **Digital Tools:** Canva, MS Office, Google Suite for project reporting and presentations

# Evaluation Plan

| Outcome | *Assessment Method* |
|---|---|
| Effective communication | *Written reports and oral presentations* |
| Use of technology | *Digital content creation and project reports* |
| Goal setting & personal growth | *Reflection essays and personal development plans* |
| Empathy & professionalism | *Peer and instructor feedback* |

| Outcome | *Assessment Method* |
|---|---|
| Critical & reflective thinking | *Case study analysis & reflective journaling* |

# Learning Outcomes Mapped to Activities

| Course Outcome | Related Activities |
|---|---|
| Communicate effectively | Workshops on communication, fieldwork reports, presentations |
| Effective use of technology | Training on digital tools, awareness campaigns |
| Develop personal & professional goals | Goal-setting exercises, mentorship |
| Seek guidance for academic success | Self-assessment workshops |
| Manage personal affairs & demonstrate empathy | Role-play, reflection journaling |
| Demonstrate professionalism | Peer-led community projects |

# Syllabus– 30 Hours Program **(10 Hours Classroom Sessions + 40 Hours Practical)**

## 10 Hours Classroom Sessions

| Sr. No. | Name of Activity | Venue | Hours | Students | Resource Person / NGO |
|---|---|---|---|---|---|
| 1 | NSS Subject Orientation | Classroom | 2 hrs | All Students | NSS Program Officer / District Coordinator |
| 2 | Road Safety Awareness | College Campus | 5–10 hrs (sessions & practical) | All | Mr. Rohit Dalvi – United Way NGO |
| 3 | Technical Session | College | 2 hrs | All | Social Worker |
| 4 | Stigma & Discrimination on HIV/AIDS | College Campus | 2 hrs (Min. 2-3 sessions) | All Students | MDACS, BMC – Technical Experts |

## 40 Hours Practical / Field Work

| Sr. No. | Activity | Venue | Hours | Students | Contact Person / NGO |
|---|---|---|---|---|---|
| 1 | Beach Cleanup Drive | Versova Beach | 5 hrs (2 visits) | All (**Mandatory**) | Mr. Santosh – Afroz Shah Foundation |
| 2 | Educational Activities / Teaching/Oratory | Adopted Schools / Community | 10 hrs | Class-wise | NSS Unit |

| Sr. No. | Activity | Venue | Hours | Students | Contact Person / NGO |
|---|---|---|---|---|---|
| 3 | Field Visits / Nature Trail / Mangroves Visit | Various Locations | 5 hrs | Group wise | Vanrai / Godrej / Stree Mukti Sanghatana |
| 4 | Cleanliness Drive | College Campus | 5 hrs | All | NSS Unit |
| 5 | Blood Donation/ Publicity Campaign | College Campus | 5 hrs | Interested students | NSS Unit |
| 6 | Anti-Plastic Campaign | Campus / Adopted Area | 5 hrs | All | NSS Unit |
| 7 | Technical Projects on Social Problems | College Campus | 5 hrs | Interested students | Domain Faculty |
| 8 | Awareness Programs- Road Safety/ Disaster Safety | Adopted Area | 5 hrs | Interested students | NSS Unit |
| 9 | Eco-Garden Activity | Campus / Adopted Area | 3–5 hrs | Interested | NSS Unit |
| 10 | Participation in Leadership camp | Karjat | 15 hrs | Interested | NSS Unit |
| 11 | Participation in Euphoria | College | 10 hrs | All **(Mandatory)** | Mandatory |
| 12 | Participation in Colossium | College | 10 hrs | All **(Mandatory)** | |

# Important Guidelines for SSR Activities

- Maximum **10 hours** can be allocated to a single activity per student.
- Each student must participate in **minimum 3 or more projects**.
- Maximum **5 hours per day** for field/practical work.
- Activities must receive **approval from the Principal**.
- No activities shall be aligned with **political, religious or fundraising agendas**.
- Technology-based initiatives aligned with institute needs are encouraged.
- Faculty coordinators may add practical activities that enhance learning outcomes.

The Bombay Salesian Society

**Don Bosco Institute of Technology, Kurla**

**Practical WORK REPORT OF LLC-SSR Subject- Sem II- AY 2025-26**

| | |
|---|---|
| **Photograph of the student with the College seal and Signature of the Principal**<br><br>**Name of the Student**_____<br><br>**Residential Address**_____<br>_____<br><br>**Phone No.** _____<br><br>**Class :** _____ **Div.:** _____<br><br>**Date of Birth** _____**Blood Group** _____<br><br>**Roll Number**_____<br><br>_____ _____<br>**Signature of the Student** **Signature of the Course Faculty** | **YEAR** _____<br><br>**College SS&CS subject Faculty USE ONLY**<br><br>**Report Checked by** _____<br><br>**Date :** _____<br><br>**Total Practical Hours completed by student :-** _____<br><br>_____<br><br>**Comment if any** _____<br><br>_____<br><br>**Seal** **Signature**<br>**Principal** |

**NSS Hours Allocation (30 hours):**

- Theory Classes: 10 hours (classroom sessions, awareness programs, and report submissions)
- Practical Hours: 20 hours (actual work)

**- Suggested Activities: for 20 hours**

‣ Karjat Camp: 10 hours

OR

- Oratory/NGO Work: 10 hours (5 days, 2 hours/day)

**Any one activity for 5 hours**

‣ College Level Activities: 5 hours

- Beach Cleanup: 5 hours (minimum 2 drives)

‣ Blood Donation Camp Publicity: 5 hours

**Mandatory activity**

Road Safety Awareness Program: 5 hours

**Report Writing and Submission:**

**Please submit your reports by end of April 2026.**

**Total: 30 hours.**

**Reporting Formats for the NSS Activity:**

**PRACTICAL WORK REPORT- 5 hours**

| | **Road Safety- Mandatory Activity for 5 hours**<br>**DAILY WORK RECORD**<br>**Name of the Project/Activity : Road Safety. Date of Commencement : _____**<br>**Proposed Schedule of Work-(maximum 5 hours will be allocated)** | | | | |
|---|---|---|---|---|---|
| **Date** | **Nature of Work** | **Online/ Offline** | **Total Hours** | **Supervisor Signature** | **Date** |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Total No. of Hours** | | | | |

**PRACTICAL WORK REPORT- 10 hours**

| | **Karjat camp or Oratory work or NGO work**<br>**DAILY WORK RECORD**<br>**Name of the Project/Activity : _____ Date of Commencement : _____**<br>**Proposed Schedule of Work-(maximum 10 hours will be allocated)** | | | | |
|---|---|---|---|---|---|
| **Date** | **Nature of Work** | **Online/ Offline** | **Total Hours** | **Supervisor Signature** | **Date** |
| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |
| | **Total No. of Hours** | | | | |

## PRACTICAL WORK REPORT- 5 hours

| | College level activities, Beach Cleanup drive and Blood Donation- Any one<br>DAILY WORK RECORD<br>Name of the Project/Activity : _____ Date of Commencement : _____<br><br>Proposed Schedule of Work-(maximum 5 hours will be allocated) | | | | |
|---|---|---|---|---|---|
| **Date** | **Nature of Work** | **Online/ Offline** | **Total Hours** | **Supervisor Signature** | **Date** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | **Total No. of Hours** | | | | |

**Submission Date_____ Time:_____**

1. **Activity Conduction Report (For 10 hours)**

| **Sr. No.** | **Name of the Activity** | |
|---|---|---|
| 1 | Date/s of Activity | |
| 2 | Activity type Outdoor Technical/Social | |
| 3 | Activity objectives | |
| 4 | Place of Activity | |
| 5 | Name of the Association if any | |
| 6 | Activity description in detail | |

| | | |
|---|---|---|
| 8 | Activity Outcomes | |
| 9 | Photos (Geo tagged) | |

**1.1 Activity Conduction Report (For 5 hours)**

| **Sr. No.** | **Name of the Activity** | |
|---|---|---|
| 1 | Date of Activity | Road Safety |
| 2 | Activity type | Social |
| 3 | Activity objectives | |
| 4 | Place of Activity | |
| 6 | Name of the Association | United Way NGO |
| 7 | Activity description in detail | |
| 8 | Activity Outcomes | |
| 9 | Photos (Geo tagged) | |

**1.2 Activity Conduction Report (For 5 hours)**

| **Sr. No.** | **Name of the Activity** | |
|---|---|---|
| 1 | Date of Activity | |
| 2 | Activity type | |
| 3 | Activity objectives | |
| 4 | Place of Activity | |
| 6 | Name of the Association | |
| 7 | Activity description in detail | |

| | | |
|---|---|---|
| 8 | Activity Outcomes | |
| 9 | Photos (Geo tagged) | |

**Your observation/ suggestions regarding the activities/programs organised by the College under the SS&CS- NSS Subject.**

**Name of the project you liked most & why (Specify the reason)**

_____

_____

**Will you Join as a NSS volunteers next year (2026-2028)? If yes then in which project you would like to participate?**

_____

_____

_____

_____

_____

**<u>Evaluation Scheme: (To be filled by Subject Teacher only)</u>**

**Assessment: (Towards term work) Evaluation Pattern for Participation**

| **Sr No** | **Particulars** | **Max marks** | **Marks Obtain** | **Remarks** | **Sign** |
|---|---|---|---|---|---|
| 1 | **Attendance** | **05** (Total 10 sessions) | | | |
| 2 | **Participation in Camps / Oratory (15 hours)** | **30** (Total 30 hours ) | | | |
| | **Field Activities (5 hours)** | | | | |
| | **Mandatory activity (5 hours)** | | | | |
| 3 | **Cultural and Technical Fest Participation** | 10 Marks | | | |
| 4 | **Brief Report** | **5** (Report writing, submission and presentation) | | | |
| | **Total Marks** | **50** | | | |

**Reference Books**


1. **"National Service Scheme Manual"** – Government of India
2. **"Social Work and Community Development"** by Rameshwari Devi & Ravi Prakash
3. **"Community Development in India"** by S. C. Dubey
4. **"Rural Development in India"** by V. C. Sinha
5. **"Social Problems in India"** by Ram Ahuja
6. **"Environmental Studies"** by Erach Bharucha
7. **"Health and Hygiene"** by B. K. Mahajan
8. NSS Programme Officer Handbook (University-level publication)

# Exit Course Guidelines: Computer Engineering (Semester II)

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## 1. First Year Exit Requirements

Students exiting after securing a minimum of **42 credits** will be awarded:

### UG Certificate in Computer Engineering

Subject to completion of:

- **Vocational Course (4 credits)**
- **Internship / Apprenticeship (4 credits)**

**Note:**

- Credits will be uploaded to the **Academic Bank of Credits (ABC)**.
- The exit pathway supports **early employability** in IT service sectors.

## 2. Competency Requirements (NSQF Level 4.5)

Students will develop the following industry-relevant competencies:

### 1. Multidisciplinary Knowledge

- Basics of programming (Python/C)
- Understanding of computer hardware and operating systems
- Awareness of internet and networking fundamentals

### 2. Data & Documentation

- Writing clean, readable code
- Preparing basic technical documentation and reports
- Using spreadsheets (Excel) for data handling

### 3. Entrepreneurial & Digital Skills

- Freelancing basics (portfolio creation, GitHub usage)
- Cost estimation for small IT projects
- Communication skills for clients and teams

### 4. Technical Skills

- Python programming for automation
- Basic web development (HTML, CSS, simple JS)
- Database handling using MySQL / SQLite
- Basic Linux commands

### 5. Workplace & Supervisory Skills

- Working in small teams (Agile basics)
- Debugging and testing applications
- Using version control (Git)

# 3. Suggested Job Profiles

Students can take up roles such as:

1. **Junior Software Developer (Trainee)**
2. **Web Development Intern / Freelancer**
3. **IT Support Executive (Helpdesk / L1 Support)**
4. **Data Entry & Automation Assistant (with Python)**
5. **Database Support Executive**
6. **Technical Support Associate (BPO/KPO sector)**

# 4. Curriculum Scheme and Structure

| Course Code | Course Name | Hours | Credits |
|---|---|---|---|
| 25CO2EX01 | Programming & IT Services Lab | 60 | 4 |
| 25CO2EX02 | Internship / Apprenticeship | 120 (2–3 weeks) | 4 |

# 5. Syllabus (Industry-Oriented)

# Course Outcomes (COs)

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

### CO1 – Remember (Knowledge Level)

**Identify and recall** fundamental concepts of programming, databases, web development, and IT systems.

### CO2 – Understand

**Explain** the working of basic programs, database operations, and web components used in simple applications.

### CO3 – Apply

**Develop** simple automation scripts using Python and **implement** basic database operations using SQL.

### CO4 – Analyze

**Analyze and troubleshoot** common system, software, and network issues using appropriate tools and techniques.

### CO5 – Evaluate

**Evaluate and apply** version control practices using tools such as **GitHub** for effective project management.

### CO6 – Create (Synthesis)

**Design, develop, and present** a complete working solution (web application / automation project) by integrating programming, database, and web technologies.

### Module 1: Programming for Real Applications

- Python basics (focus on practical tasks)
- File handling and automation scripts
- Example: Automating Excel tasks

### Module 2: Data Handling & Basic Analytics

- Working with Excel / CSV files
- Basic Python libraries (Pandas – intro level)
- Data cleaning and simple analysis

### Module 3: Web Development for Small Businesses

- HTML, CSS basics
- Creating simple business websites
- Hosting basics (GitHub Pages / free hosting)

### Module 4: Database Skills

- MySQL basics
- CRUD operations
- Real-life example: Student/Shop database

### Module 5: IT Support & System Skills

- Installing software and OS basics
- Basic Linux commands
- Troubleshooting common system/network issues

### Module 6: Software Practices & Employability

- Git & GitHub basics
- Resume building and portfolio creation
- Interview preparation basics (technical + HR)

## 6. Examination & Assessment

| Course | IA | End Sem | Total |
|---|---|---|---|
| Programming Lab | 50 | 50 | 100 |
| Internship | 50 | 50 | 100 |

# 7. Internship Guidelines

Students may complete internships in:

### 1. Industry Options

- Educational institutes (lab support)

### 2. Suggested Internship Work

- Website development for small business
- Data entry automation using Python
- Database creation for shops/offices
- IT support (hardware/software troubleshooting)

### 3. Assessment Method

| Component | Weightage |
|---|---|
| Industry Mentor Feedback | 20% |
| Daily Work Log | 20% |
| Internship Report | 30% |
| Final Demo & Viva | 30% |

# 8. Assessment Rubrics

### Skill Demonstration

| Level | Description |
|---|---|
| Excellent | Independently completes working project |
| Average | Completes with guidance |
| Poor | Unable to demonstrate |

# 9. Competency Mapping

| Skill | Module | Industry Relevance |
|---|---|---|
| Python | Module 1 | Automation jobs |
| Data Handling | Module 2 | Data entry/analysis |
| Web Dev | Module 3 | Freelancing |
| Database | Module 4 | Office systems |
| IT Support | Module 5 | Helpdesk roles |

# 10. Alignment with National Initiatives

- **Skill India**
- **Digital India**
- **National Skill Qualification Framework**

# The Bombay Salesian Society's
# Don Bosco Institute of Technology
# Department of Electronics and Telecommunication Engineering
# AY 2025-26
# EXIT EVALUATION

**Exit Course Guidelines: Electronics and Telecommunication Engineering**

**Semester II**

**1. First Year Exit Requirements**

Students exiting the First-Year programme after securing a minimum of **42 credits** will be awarded a **UG Certificate in Electronics and Telecommunication** provided they secure an additional **8 credits** through the prescribed vocational course and internship/apprenticeship.

- **Authority to Issue Certificate:** The Institute will issue the certificate based on the completion of the requirements of the credits for the completion of the exit requirements.
- **Credits for the Course:** The credits for the completed courses until the exit will be updated in the Academic Bank of Credits (ABC).

**2. Competency Requirements (NSQF Level 4.5)**

1. **Multidisciplinary Knowledge:** Basic understanding of electronic components, circuit laws, and digital logic.
2. **Data & Documentation:** Ability to read circuit schematics, maintain component inventory, and document testing procedures.
3. **Entrepreneurial Mindset:** Digital literacy, financial literacy for Bill of Materials (BOM), and technical communication skills.
4. **Technical Expertise:** Proficiency in soldering, PCB assembly, and using testing tools like DSOs and Multimeters.
5. **Technical Supervisory Skills:** Managing lab safety protocols, coordinating with assembly line teams, and ensuring quality control.

**3. Suggested Job Profiles**

1. Junior Electronics Technician (Testing & Assembly)
2. Telecommunication Field Associate (Installation & Maintenance)
3. PCB Design & Fabrication Assistant
4. IoT Device Installation Assistant

**4. Curriculum Scheme and Structure: Exit at Semester II**

| Course Code | Course Vertical | Course Name | Teaching Scheme (Contact Hours) | Credits |
|---|---|---|---|---|
| 25ET2EX01 | Vocational | **Electronic System Assembly & Maintenance** | 60 (Practical/Lab) | 04 |
| 25ET2EX02 | Internship | **Industrial Internship / Apprenticeship** | 120 (On-site/online)<br>(2 to 3 week) | 04 |

**5. Detailed Syllabus: 25ET2EX01 – Electronic System Assembly & Maintenance**

**Module 1: Electronic Components & Lab Safety**

- Identification of active/passive components (SMD & Through-hole).
- ESD (Electrostatic Discharge) safety protocols and hand tool mastery.

**Module 2: PCB Design & Fabrication Basics**

- Reading schematics and introduction to EDA tools (KiCad/EasyEDA).
- Manual PCB etching process: Drilling, board cleaning, and track inspection.

**Module 3: Soldering & Hardware Assembly**

- Precision soldering and desoldering techniques (Rework stations).
- Mounting sensors, connectors, and mechanical assembly into enclosures.

**Module 4: Testing & Troubleshooting**

- Signal tracing using DSOs, Function Generators, and Multimeters.
- Troubleshooting common circuit faults (open/short circuits and dry solder).

**Module 5: Active devices handling**

- Understanding fundamentals of BJT and identifying the terminals.
- Basic configuration and switching characteristics of BJT

**Module 6: Documentation & Quality Standards**

- Preparing Bill of Materials (BOM) and reading technical datasheets.
- Introduction to Quality Control (QC) checklists and IPC-A-610 standards.

**6. Examination and Assessment Structure**

| Course Code | Course Name | Internal Assessment (IA) | End Sem (Practical/Viva) | Total |
|---|---|---|---|---|
| 25ET2EX01 | Electronic System Assembly | 50 | 50 | 100 |
| 25ET2EX02 | Industrial Internship | 50 | 50 | 100 |

**7. Assessment Methodology (4-Credit Internship)**

The assessment of the internship (25ET2EX02) shall be based on the following toolset:

1. **Industry Mentor Appraisal (20%):** Evaluation of punctuality, safety compliance, and technical troubleshooting ability at the worksite.
2. **Daily Work Log/Diary (20%):** A weekly record of technical tasks performed, verified by the industry supervisor and linked to ABC requirements.
3. **Technical Internship Report (30%):** A formal report detailing one specific technical workflow or project handled during the 120 hours.
4. **Final Skill Demo & Viva (30%):** A hands-on demonstration (e.g., assembling a circuit or configuring a network) followed by an oral exam by an internal faculty panel.

**The assessment methodology for the vocational course (25ET2EX01) shall remain the same as for other lab-based exams in this syllabus.**

The Bombay Salesian Society's

# Don Bosco Institute of Technology, Mumbai

**(An Autonomous Institute affiliated to University of Mumbai)**

**CURRICULUM STRUCTURE AND SCHEME FOR EXIT COURSE AFTER FIRST YEAR ENGINEERING**

## Department of Mechanical Engineering

**(As per NEP 2020)**

**(Scheme: DB25-V1)**

**Effective from Academic Year 2025 – 2026**

**1. Second Year Exit Requirements:**

Students exiting the **First-Year programme** after securing a minimum of **42 credits** will be awarded a **UG Certificate in Mechanical Engineering** provided they secure an additional **8 credits** through the prescribed vocational course, Skill-based course and internship.

- **Authority to Issue Certificate:** The Institute will issue the Certificate based on the completion of the requirements of the credits for the completion of the exit requirements.
- **Credits for the Course:** The credits for the completed courses until the exit will be updated in the Academic Bank of Credits (ABC).

**2. Curriculum Scheme and Structure: Exit at Semester IV**

| Course Code | Course Vertical | Course Name | Scheme (Contact Hours) | Credits |
|---|---|---|---|---|
| 25ME2EX01 | Vocational | Additive Manufacturing | 30 (Practical/Lab) | 02 |
| 25ME2EX02 | Skill-based | Solid Modeling & Drafting | 30 (Practical/Lab) | 02 |
| 25ME2EX03 | Internship | Industrial Internship / Apprenticeship | 120 (On-site/Online) (2 to 4 weeks) | 04 |

**3. Detailed Syllabus: 25ME2EX01 – Additive Manufacturing**

| Module No. | Unit No. | Topics |
|---|---|---|
| 1 | | **Introduction to Additive Manufacturing** |
| | 1.1 | Overview of AM, classification (FDM, SLA, SLS), applications, lab safety practices |
| 2 | | **CAD Modeling for AM** |
| | 2.1 | 3D modeling using SolidWorks, DfAM principles, geometry creation, STL/AMF export |
| 3 | | **Data Preparation & Slicing** |
| | 3.1 | STL generation, error correction, slicing using Ultimaker Cura, parameter setting, G-code generation |
| 4 | | **3D Printing Process (FDM)** |
| | 4.1 | Printer components, setup & calibration, printing basic/functional parts, material handling (PLA/ABS) |
| 5 | | **Process Optimization & Defect Analysis** |
| | 5.1 | Parameter effects, defects (warping, stringing), troubleshooting, dimensional accuracy measurement |
| 6 | | **Post-Processing & Applications** |
| | 6.1 | Support removal, finishing techniques, case studies, mini-project (functional component) |

**4. Detailed Syllabus: 25ME2EX02 – Solid Modeling & Drafting**

| Module No. | Unit No. | Topics |
|---|---|---|
| 1 | **Introduction to CAD & Sketching** | |
| | **1.1** | Introduction to CAD concepts, Interface of SolidWorks |
| | **1.2** | Sketching tools (line, circle, arc), geometric constraints, dimensioning techniques |
| 2 | **2D Drafting & Drawing Standards** | |
| | **2.1** | Creation of 2D drawings, orthographic projections |
| | **2.2** | Dimensioning standards, section views, use of layers and annotations |
| 3 | **Part Modelling – Basic Features** | |
| | **3.1** | 3D part modeling using features like extrude, revolve, cut, fillet, chamfer, hole |
| | **3.2** | Feature-based modeling approach |
| 4 | **Advanced Part Modelling** | |
| | **4.1** | Sweep, loft, rib, shell features; pattern tools (linear, circular), |
| | **4.2** | Mirror operations, design modifications |
| 5 | **Assembly Modelling** | |
| | **5.1** | Assembly creation, mates and constraints |
| | **5.2** | Interference detection, exploded views, basic motion study |
| 6 | **Drafting & detailing from 3D Models** | |
| | **6.1** | Generation of 2D drawings from 3D models, dimensioning, tolerances, |
| | **6.2** | Bill of materials (BOM), printing and plotting |

**5. Examination and Assessment Structure:**

| Course Code | Course Name | End Sem (Practical/Oral) | Total |
|---|---|---|---|
| 25ME2EX01 | Additive Manufacturing | 25 | **25** |
| 25ME2EX02 | Solid Modeling & Drafting | 25 | **25** |
| 25ME2EX03 | Solid Modeling & Drafting | 25 | **25** |
| | | **Total** | **75** |

**6. Assessment Methodology (4-Credit Internship)**

The assessment of the internship (25ME4EX03) shall be based on the following toolset:

1. **Industry Mentor Appraisal (20%):** Evaluation of technical competence observed by the industry mentor
2. **Daily Work Log/Diary (20%):** A weekly record of technical tasks performed
3. **Technical Internship Report (30%):** A formal report detailing one specific technical workflow or project/task handled during the 120 hours.
4. **Final Skill Demo & Viva (30%):** A hands-on demonstration (e.g., verifying the skills learnt) followed by an oral exam.

The assessment methodology for the vocational course (25ME2EX01), skill-based course (25ME2EX02) shall remain the same as for other lab-based exams in this syllabus.

**राष्ट्रीय शैक्षणिक धोरण-२०२० च्या राज्यातील अंमलबजावणीच्या अनुषंगाने अभियांत्रिकी पदवी अभ्यासक्रम आराखडा, श्रेयांक आराखडा याबाबत मार्गदर्शक सूचना...**

# महाराष्ट्र शासन
## उच्च व तंत्र शिक्षण विभाग
**शासन निर्णय क्रमांक : एनईपी-२०२२/ (६७/२३) /तांशि-२**

मंत्रालय, मुंबई -४०० ०३२

दिनांक : ४ जुलै, २०२३

**संदर्भ :** १) शासन निर्णय, उच्च व तंत्र शिक्षण विभाग, क्रमांक -एनईपी-२०२२/प्र.क्र.१०५/विशि-३, दि.६/१२/२०२२

२) शासन निर्णय, उच्च व तंत्र शिक्षण विभाग, क्रमांक-एनईपी-२०२२/प्र.क्र.०९/विशि-३/शिकाना, दि.२६/१२/२०२३

३) शासन निर्णय, उच्च व तंत्र शिक्षण विभाग, क्रमांक-एनईपी-२०२२/प्र.क्र.०९/विशि-३/शिकाना, दि.२०/४/२०२३

३) तंत्र शिक्षण संचालनालयाचे पत्र क्र. १७/तंशिसं/राशैधो/२०२३/१६८,दि. २८ जून, २०२३

**प्रस्तावना :**

भारताला ज्ञान महासत्ता बनविण्यासाठी, विद्यार्थ्यांमध्ये आवश्यक कौशल्य व ज्ञानप्राप्ती आणि विज्ञान, तंत्रज्ञान, शिक्षण आणि औद्योगिक क्षेत्रामधील मनुष्यबळाची कमतरता दूर करण्यासाठी, भारतातील लोकसंख्येला गुणवत्तापूर्ण शिक्षण, नाविन्यपूर्ण शिक्षण व संशोधनाच्या सुविधा उपलब्ध करुन देण्यासाठी भारत सरकारने नवीन राष्ट्रीय शैक्षणिक धोरण-२०२० लागू केलेले आहे. नवीन शैक्षणिक धोरणामध्ये सर्वांगीण आणि बहुविद्याशाखीय शिक्षण प्रणालीचा अंतर्भाव करण्यात आला असून, ज्याचा उद्देश मानवाच्या सर्व क्षमतांचा नैतिक-एकात्मिक पध्दतीने विकास करणे आहे.

याअनुषंगाने शासनाच्या संदर्भाधीन दि. ६ डिसेंबर २०२२ रोजीच्या शासन निर्णयाद्वारे राष्ट्रीय शैक्षणिक धोरण-२०२० ची सन २०२३-२४ पासून प्रभावी व एकसमान अंमलबजावणी करण्याच्या दृष्टीने सर्व अकृषि विद्यापीठे, अभिमत विद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे व समुह विद्यापीठे आणि सर्व शैक्षणिक संस्थांसाठी निर्देश जारी केलेले आहेत. तसेच टास्क फोर्सच्या अहवालातील शिफारशींच्या अंमलबजावणीसंदर्भात आढावा घेऊन, अंमलबजावणी करताना उद्भवणाऱ्या समस्यांचे निराकरण करण्यासाठी शासनाच्या संदर्भाधीन दिनांक २६ डिसेंबर, २०२२ च्या आदेशान्वये डॉ. नितीन करमळकर यांच्या अध्यक्षतेखाली सुकाणू समितीची स्थापना करण्यात आलेली आहे. तसेच दि. २० एप्रिल २०२३ रोजीच्या शासन निर्णयाद्वारे राज्यामध्ये राष्ट्रीय शैक्षणिक धोरण २०२० च्या अंमलबजावणीच्या अनुषंगाने गठीत केलेल्या सुकाणू समीतीच्या शिफारशीनुसार अभ्यासक्रम व श्रेयांक आराखड्याची राज्यामध्ये एकसमान प्रमाणात अंमलबजावणी होण्यासाठी पहिल्या टप्प्यात कला, वाणिज्य व विज्ञान शाखेतील पदवी व पदव्युत्तर अभ्यासक्रमांसाठी (AICTE, PCI, BCI, CoA, NCTE इ. सारख्या नियामक संस्थांची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) सुधारित मार्गदर्शक सूचना निर्गमित केलेल्या आहेत.

उपरोक्त निर्णयाच्या अनुषंगाने दिनांक २३ जून, २०२३ रोजी मा. मंत्री उच्च व तंत्र शिक्षण यांच्या अध्यक्षतेखाली स्वायत्त अभियांत्रिकी महाविद्यालयांकरीता आयोजित करण्यात आलेल्या चर्चासत्रामध्ये साधक बाधक चर्चा होऊन अभियांत्रिकी स्वायत्त संस्थांमधील अभ्यासक्रम व श्रेयांक आराखड्याची राज्यामध्ये एकसमान प्रमाणात अंमलबजावणी होण्यासाठी सर्व (अकृषि विद्यापीठे, अभिमत विद्यापीठे,

स्वयं अर्थ सहाय्यित विद्यापीठे व समुह विद्यापीठे आणि सर्व शैक्षणिक संस्था यामधील) अभियांत्रिकी पदवी अभ्यासक्रमासाठी सूचना व निर्देश जारी करण्याबाबतचा प्रस्ताव शासनाच्या विचाराधिन होता.

**शासन निर्णय :**

शैक्षणिक वर्ष २०२३-२४ पासून पहिल्या टप्प्यात अभियांत्रिकी अभ्यासक्रमाच्या स्वायत्त संस्थांमधील (Autonomous Institutes) पदवी अभ्यासक्रमांसाठी या शासन निर्णयासोबत जोडलेल्या परिशिष्टानुसार, अभ्यासक्रम व श्रेयांक आराखड्या संदर्भात निर्देश जारी करण्यांत येत असून, सदर निर्देशांची अंमलबजावणी शैक्षणिक वर्ष २०२३-२४ पासून करण्यात यावी. तसेच सर्व अकृषि विद्यापीठांनी त्यांच्या अंतर्गत येणाऱ्या सर्व अभियांत्रिकी महाविद्यालयातील पदवी अभ्यासक्रमासाठी या धोरणाची अंमलबजावणी शैक्षणिक वर्ष २०२४-२५ पासून करण्यात यावी.

सदर निर्देश महाराष्ट्र सार्वजनिक विद्यापीठ अधिनियम-२०१६ मधील कलम ५(८१) मधील तरतूदीनुसार निर्गमित करण्यात येत आहेत.

सदर निर्देशाच्या अमलबजावणीबाबतचा आढावा शासनामार्फत सुकाणू समितीच्या माध्यमातून वेळोवेळी घेण्यात येईल.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थाळावर उपलब्ध करण्यात आला असून, त्याचा संकेतांक २०२३०७०४१७४९१९०४०८ असा आहे. हा शासन निर्णय डिजीटल स्वाक्षरीने साक्षांकित करुन काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

SATISH JAGDERAO TIDKE

Digitally signed by SATISH JAGDERAO TIDKE
DN: c=IN, o=GOVERNMENT OF MAHARASHTRA, ou=HIGHER AND TECHNICAL EDUCATION DEPARTMENT, 2.5.4.20=abbed59665277346850 8d937a99472988ebdda28db8c543b79abe527c99646f6, postalCode=400032, st=Maharashtra, serialNumber=BED86CD168D8FBD810E0A53F2B92CE7FD9AB37DD50427E28109CBB133F9887D3, cn=SATISH JAGDERAO TIDKE
Date: 2023.07.04 17:53:22 +05'30'

**(सतीश तिडके)**
**उपसचिव, महाराष्ट्र शासन**

**प्रत :**

१) मा. राज्यपाल यांचे प्रधान सचिव, राजभवन, मुंबई
२) मा. मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई
३) मा. उपमुख्यमंत्री यांचे उप सचिव, मंत्रालय, मुंबई
४) मा. मंत्री, उच्च व तंत्र शिक्षण विभाग यांचे खाजगी सचिव, मंत्रालय, मुंबई
५) मा. कुलगुरु, सर्व अकृषि विद्यापीठे, अभिमत चिद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे, व समुह विद्यापीठे
६) कुलसचिव, सर्व अकृषि विद्यापीठे, अभिमत चिद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे, व समुह विद्यापीठे
७) संचालक, उच्च शिक्षण / तंत्र शिक्षण / कला / ग्रंथालय
८) अध्यक्ष, एनईपी सुकाणू समिती
९) सदस्य सचिव, एनईपी सुकाणू समिती
१०) प्रधान सचिव, उच्च व तंत्र शिक्षण विभाग, यांचे स्वीय सहाय्यक, मंत्रालय, मुंबई
११) उपसचिव (तांशि), उच्च व तंत्र शिक्षण विभाग यांचे स्वीय सहाय्यक, मंत्रालय, मुंबई
१२) निवडनस्ती (तांशि-२)

शासन निर्णय क्रमांक : एनईपी-२०२२/( ६७/२३) /तांशि-२, दिनांक : ४ जुलै, २०२३
सोबतचे परिशिष्ट

**DIRECTIVES (निर्देश)**

## 1. Implementation of Four Year UG Engineering Curriculum in First Phase with effect from Academic Year 2023-24:

The Credit and Multidisciplinary Curricular Framework, designed on the lines of the National Credit Framework and AICTE Approval Process Handbook, is to be made applicable in first phase to the AICTE-regulated UG (B.E./B.Tech. or equivalent) Engineering/ Technology Programs conducted **in Autonomous Engineering Colleges and State University Campuses in Maharashtra** with effect from Academic Year 2023-24.

## 2. Credit Framework under Four-Years UG Engineering Programme with Multiple Entry and Multiple Exit options:

The Four-year Bachelor's Multidisciplinary Engineering Degree Programme allows the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning in different institutions. The minimum and maximum credit structure for different levels under the Four-year Bachelor's Multidisciplinary Engineering UG Programme with multiple entry and multiple exit options are as given below**:**

**Credit Framework**

| **Levels** | **Qualification Title** | **Credit Requirements** | | **Semester** | **Year** |
|---|---|---|---|---|---|
| | | **Minimum** | **Maximum** | | |
| **4.5** | One Year UG Certificate in Engg./ Tech. | 40 | 44 | 2 | 1 |
| **5.0** | Two Years UG Diploma in Engg./ Tech. | 80 | 88 | 4 | 2 |
| **5.5** | Three Years Bachelor's Degree in Vocation (B. Voc.) or B. Sc. (Engg./ Tech.) | 120 | 132 | 6 | 3 |
| | 4-Years Bachelor's degree | | | | |

| Levels | Qualification Title | Credit Requirements | | Semester | Year |
|---|---|---|---|---|---|
| | | Minimum | Maximum | | |
| **6.0** | (B.E./ B.Tech. or Equivalent) in Engg./ Tech. with Multidisciplinary Minor | 160 | 176 | 8 | 4 |
| **6.0** | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors and Multidisciplinary Minor | 180 | 194 | 8 | 4 |
| **6.0** | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Honors with Research and Multidisciplinary Minor | 180 | 194 | 8 | 4 |
| **6.0** | 4-Years Bachelor's degree (B.E./ B.Tech. or Equivalent) in Engg./ Tech.- Major Engg. Discipline with Double Minors (Multidisciplinary and Specialization Minors) | 180 | 194 | 8 | 4 |

**(a)** Credits offered per Semester will be a Minimum 20 and a Maximum 22. While minimum credits are mandatory as per National Credit Framework, the Universities and Autonomous Engineering Colleges can evolve the mechanism for providing Semester/ Level wise credit attainment flexibility within the broad framework.

**(b)** With effect from Academic Year 2023-24, the first year of 4-Years Multidisciplinary Bachelor's Degree in Engg./ Tech. Program (B.E./ B.Tech. or

Equivalent) will be introduced. Thus, the Fourth Year of Bachelor's Engg./ Tech. Degree (Level 6.0) with various options- Bachelor's Engg./ Tech. Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (160-176 credits), OR Bachelor's Engg./ Tech. Honours Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits) OR Bachelor's Engg./ Tech. Honours with Research Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits) OR Bachelor's Engg./ Tech. Degree in chosen Major Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialisation Minor, 180-194 credits) will begin with effect from Academic Year 2026-27.

**(c)** Under Bachelor's Engg./ Tech. Honours with Research Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits), the students will work on a research project or dissertation for 18 credits in the fourth year in the respective Major Engg./ Tech. Discipline. The decision regarding the distribution of 18 credits for Research Project in Semesters VII and VIII of the Fourth Year will be taken by Academic Authorities of University/ Autonomous Engineering Colleges. These 18 Credits will be over and above the min.160-max.176 Credits prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech. Program.

**(d)** The Bachelor's Engg./ Tech. Honours Degree in chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits) enables students to take up five-six additional courses in the same Engg./ Tech. discipline of 18 to 20 credits distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

**(e)** Under Bachelor's Engg./ Tech. Degree in chosen Major Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialisation Minor, 180-194 credits), students would take up five-six additional courses of 18 to 20 credits in another Engg./ Tech. discipline/ Emerging Areas Specialization distributed over semesters III to VIII. The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are over and above the min.160-max.176 Credits prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./

Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

**(f)** The NEP 2020 Four Year Multidisciplinary Engineering Curriculum Framework offers:

i. The flexibility to move from one discipline of study to another.

ii. The opportunity for learners to choose the courses of their interest in all disciplines.

iii. The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured.

iv. The flexibility for learners to move from one institution to another to enable them to have multi and/or interdisciplinary learning.

v. Mandatory One Semester Internship/ On Job Training (OJT).

vi. Provision of Vocational and Skill Enhancement Courses (VSEC), Indian Knowledge System (IKS), Community Engagement Project (CEP)/Field Project (FP) in Major Discipline Degree.

vii. Horizontal and Vertical mobility with multiple entry and exit options at each Level.

viii. Provision of NSQF compliant Skill-based Courses and internships for Exits at different Levels.

ix. Credits for Co-curricular and Extra-Curricular Activities as Curricular activities besides provision of credits for the Ability Enhancement Courses (AEC) and Value Education Courses (VEC).

x. Interdisciplinary or Multidisciplinary education through Single and Double Minors and Open Electives (OE).

xi. The flexibility to switch to alternative modes of learning (offline, ODL, and Online learning, and hybrid modes of learning).

## 3. Distribution of Credits across Four Years Engg./Tech. Degree Programmes:

In general, for the four years' bachelor's degree programme, the distribution of credits will be as follows:

**(a)** Major (Core) Subject comprising Mandatory and Elective Courses:

i. Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses offered in all Four years;
ii. Elective courses of Major will be offered in the third and/or final year.
iii. Vocational Skill Courses, Internship/ Apprenticeship, Community Engagement Project (CEP)/ Field Projects (FP), Research Projects connected to Major

**(b)** Compulsory Multidisciplinary Minor Subject: 14 Credits

i. The Minor subjects may be from the different disciplines of the Engineering faculty, or they can be from different faculty altogether.
ii. The credits of compulsory Minor subjects shall be completed from the second year to the final year of UG Programme.

**(c)** Generic/ Open Elective Courses (OE): 08 credits

i. It is to be offered in Second and/or Third year
ii. Faculty-wise baskets of OE shall be prepared by University/ Autonomous Engineering Colleges.
iii. OE is to be chosen compulsorily from faculty other than that of the Major Discipline.

**(d)** Vocational and Skill Enhancement Courses (VSEC): 08 credits

- Vocational Skill Courses (VSC): 04 credits, including Hands on Training corresponding to the Major and/or Minor Subject:

i. To be offered in first three years;
ii. Wherever applicable vocational courses will include skills based on advanced laboratory practicals of Major.

- Skill Enhancement Courses (SEC) : 04 credits

i. To be offered in first three years;
ii. To be selected from the basket of Skill Courses approved by University/ Autonomous Engineering Colleges

**(e)** Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): 10 Credits

- AEC: 04 credits

i. To be offered in First and Second year
ii. English: 02 Credits

iii. Modern Indian Language: 02 credits

iv. To be offered from the Basket approved by University / Autonomous College;

The focus for both languages should be on linguistic and communication skills.

- IKS: 02 Credits

i. To be offered in First Year

ii. Courses on IKS to be selected from the basket of IKS courses approved by

iii. University/ Autonomous Colleges or as per UGC Guidelines on IKS.

- VEC: 04 Credits

i. To be offered in Second year

ii. Value Education Courses (VEC) such as Understanding India, Environmental Science/Education, and Digital and Technological Solutions.

**(f)** Field Projects/ Internship/ Apprenticeship/ Community Engagement Projects corresponding to the Major (Core) Subject, Co-curricular Courses (CC).

- Internship/Apprenticeship corresponding to the Major (Core) Subject: 12 Credits. Internship of One Semester duration shall be offered either in the VII or VIII semesters. Courses offered during the Internship Semester shall be offered in online mode.
- Field Projects/Community Engagement Projects corresponding to the Major (Core) Subject: minimum 02 credits
  - To be offered in Second year of UG Degree Programmes.
- Co-curricular Courses (CC) such as Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts: 04 credits
  - To be offered in First year

**(g)** Additional Credits for Bachelor's Degree- with Double Minor OR Honours: 18-20 Credits

- These are additional credits to be offered from the second year to the final year and will be offered as an option to students.

**(h)** Additional Credits for Bachelor's Degree- Honours with Research: Minimum 18 Credits

- These are additional credits to be offered in the final year and will be offered as an option to students.

The UGC Regulations, 2021 permit up to 40% of the total courses being offered in a particular programme in a semester through the **Online Learning Courses** offered through the **SWAYAM** platform and/or other State Level Common Platforms which can be developed in due course with the participation of different Universities/ HTEIs.

## Illustrative Semester wise Credit distribution structure for Four Year UG Engineering Program - One Major, One Minor

| **Semester** | | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | **Total Credits** |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Science Course | BSC/ESC | 06-08 | 08-10 | | -- | -- | -- | -- | -- | 14-18 |
| Engineering Science Course | | 10-08 | 06-04 | | -- | -- | -- | -- | -- | 16-12 |
| Programme Core Course (PCC) | Program Courses | -- | 02 | 08-10 | 08-10 | 10-12 | 08-10 | 04-06 | 04-06 | 44-56 |
| Programme Elective Course (PEC) | | -- | -- | -- | -- | 04 | 08 | 02 | 06 | 20 |
| Multidisciplinary Minor (MD M) | Multidisciplinary Courses | | - | 02 | 02 | 04 | 02 | 02 | 02 | 14 |
| Open Elective (OE) Other than a particular program | | -- | -- | 04 | 02 | 02 | -- | -- | -- | 08 |
| Vocational and Skill Enhancement Course (VSEC) | Skill Courses | 02 | 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 | -- | -- | -- | -- | 04 |
| Research Methodology | Experiential Learning Courses | -- | -- | -- | -- | -- | -- | | 04 | 04 |
| Comm. Engg. Project (CEP)/Field Project (FP) | | -- | -- | 02 | -- | -- | -- | - | - | 02 |
| Project | | -- | -- | -- | -- | -- | -- | | 04 | 04 |
| Internship/ OJT | | -- | --- | | | -- | -- | 12 | - | 12 |
| Co-curricular Courses (CC) | Liberal Learning Courses | 02 | 02 | | -- | -- | -- | -- | - | 04 |
| **Total Credits (Major)** | | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **20-22** | **160-176** |

**Abbreviations**: Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Indian Knowledge System: IKS; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship;

Field projects: FP; Community engagement project: CEP; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP, Liberal Learning Course: Lib. Learn, Courses on Humanities, Social Science, and Management: HSSM

**Note**: The Credit Distribution Table given above is illustrative only. The Universities/ Autonomous Colleges may suitably modify within the broader framework of credit distribution across seven verticals and as per the AICTE rules and regulation.

## 4. Choice of Major and Minor Subjects/ Discipline

### (a) Major (Core) Subject

**Major (Core) Subject** is the Engineering/ Technology discipline or subject of main focus and the degree will be awarded in that discipline/ Subject. Students should secure a minimum 50% of total credits through Core Courses (mandatory courses, electives, vocational courses, Internship/ Field Projects/ Apprenticeship/ Community Engagement Projects, Seminars, and Group Discussions). In addition, for the award of Bachelor's Degree- with Double Minor OR Honours students shall have to earn additional 18-20 credits by opting for courses of Emerging Specialisations or the Same Discipline, respectively. For the award of Bachelor's Degree- Honours with Research, students shall have to earn additional 18-20 credits through Research Project or Dissertation.

In addition, from the perspective of promoting Multidisciplinary and Interdisciplinary Thinking, the Academic of Autonomous Engineering Colleges and Universities can exercise the design of Major Subjects on the lines of Multidisciplinary or School, Interdisciplinary, Double Major besides Department Specific Major Subjects such as Civil Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering etc Refer Prof R D Kulkarni Committee Report- Chapter II, section 2.2, P. No. 20-23 for further details on design of different categories of Major/ Core Subjects.

**(b)** Students shall select a 'Major (Core) Subject' and a 'Minor Subject' from the lists of various Subject Combinations and Options provided by the State Universities/ Autonomous Colleges.

## 5. Courses on Indian Knowledge System (IKS)

The concerned academic authorities, while defining the curriculum for modules/ courses on IKS, may take the support of the Indian Knowledge System (IKS)

Cell under the Ministry of Education (MoE) at AICTE, New Delhi which is established to promote interdisciplinary research on all aspects of IKS, preserve and disseminate IKS for further research and societal applications. The IKS Cell has established multiple IKS Centers at different Institutes in various parts of the country to act as a catalyst for initiating research, education, and outreach activities. In addition, the list of courses may be developed and offered in online or offline mode by the parent university or the specialized HEIs.

The courses to be developed under the Indian Knowledge Systems (IKS) are as follows:

**I. Generic IKS Course:** These are expected to contain basic knowledge of the IKS subject. It should contain introductory information to the IKS. The student should be able to acquire basic knowledge after completion of the course.

**II. Subject-Specific IKS Courses:** These courses should contain advanced information pertaining to the subject as these will be considered as a part of the major credit. The student should have completed the Generic level as a prerequisite before enrolling in the discipline-related course.

The Autonomous Institutes/ Universities may evolve their own IKS subject-related courses by following UGC guidelines in this regard.

## 6. Credit Specifications

i. Theory Courses: 13-15 hours of teaching per credit is required in a semester.

ii. Laboratory Course: 26-30 hours in laboratory activities per credit is required in a semester.

iii. Studio activities: Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic-focused experiential work. A minimum of 26-30 hours in studio activities per credit in a semester is required.

iv. Workshop-based activities: Courses involving workshop-based activities require the engagement of students in hands-on activities related to work/vocation or professional practice. Every student is engaged in performing a skill-based activity. Related to specific learning outcome(s). 26-30 hours of workshop-based activities per credit in a semester is required.

v. Seminar/ Group Discussion: 13-15 hours of participation in seminar/ Group Discussion activity per credit in a semester is required.

vi. Internship: Credits for internship shall be one credit per two weeks of

internship (or 36-40 hours of engagement), The internship shall be monitored jointly by the faculty and Industry/ Organisation Mentor. Internship of One Semester duration shall be offered either in the VII or VIII semesters. Courses offered during the Internship Semester shall be offered in online mode.

vii. Field-based Learning/ Practices: These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. A minimum of 26-30 hours of learning activities per credit in a semester is required.

viii. Community Engagement Projects: These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. 26-30 hours of contact time per credit in a semester along with 13-15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study with 2 credit course.

## 7. ABC, Admission System, Multiple Entry and Exit Path and Lateral Entry:

**(a)** Enrolment of Students and Registration of Colleges on ABC

All State Universities/ Autonomous Institutes must promote registering on ABC. Since Credits awarded to a student for one programmes from an institution may be transferred/redeemed by another institution upon the student's consent through ABC, it is essential that all students should get enrolled on ABC, create ABC ID, and share these ABC IDs with Academic Institutions where they are enrolled. Credits Earned by the student will reflect in the student's ABC account.

Multi-institutional learning permission: The student shall be allowed to earn some credits from institutions/colleges other than the Main/ Parent College i.e. a college where students earn all their major credits (more than 50%) including credits for the core subject. Students enrolled in the degree programmes may avail of other elective credits from two different

colleges affiliated with the same University and/or online courses available within the 40% cap mentioned by UGC.

**(b)** Multiple Exits: Students will have the flexibility to enter a programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.

- Students exiting the First Year programme after securing minimum 40 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 8 credits in work-based vocational courses or internship / Apprenticeship offered during summer vacation in addition to 4 credits from skill-based courses earned during the first and second semester.
- Students exiting the Second Year Programme after securing minimum 80 credits will be awarded UG Diploma in the relevant Discipline /Subject provided they secure additional 8 credits in skill-based vocational courses (skill-based courses, internship, mini projects etc) offered during summer vacation after the second year.
- Students exiting the 3-year UG program will be awarded B.Voc. in the relevant Discipline /Subject upon securing minimum 120 credits with additional 8 credits in skill-based vocational courses (skill-based courses, internship, mini projects etc.) offered during summer vacation after the sixth semester.
- Exit options shall be provided with Certification, Diploma and B. Vocational degrees to the students at the end of the second, fourth and sixth semester, respectively, in the four-year degree programme. Students will receive a Bachelor's degree with the single minor on successfully completing all eight semesters of the UG Programmes either at a stretch or with opted exits and re-entries. In addition to this, student will receive a Bachelor's degree with Double Minor/Honours/ Research subject to earning additional 18 credits.

**(c)** Re-entry or Lateral Entry: Students, opting for exits at any level, will have the option to re-enter the programme from where they had left off, in the same or in a different higher education institution within four years of exit and complete the degree programme within the stipulated maximum period of

eight years from the date of admission to first year UG. Re-entry at various levels for lateral entrants in academic programmes shall be based on the earned and valid credits as-deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher & Technical Education Institutions (RHTEI) and proficiency test records. Lateral entry into the programme of study leading to the UG Diploma/ B. Vocational/ UG Bachelor's Degree with single minor/ UG Bachelor's Degree with Double Minor/ Honours /Research will be based on the validation of prior learning outcomes achieved and subject to availability based on intake capacity.

**(d)** Eligibility for admission to the UG Bachelor's Degree with Double Minor/ Honours /Research as per UGC guidelines: Minimum CGPA/CPI of 7.5 or minimum 75% after second semester for UG Bachelor's Degree with Double Minor/ Honours and Minimum CGPA/CPI of 7.5 or minimum 75% after sixth semester for UG Bachelor's Degree with Research.

## 8. Directives for State Universities and Autonomous Colleges

**(a)** Execution as per Statutory Provisions: The Maharashtra Public Universities Act 2016, Sections 32 and 33 (Academic Council), 34 and 35 (Faculty), 36 and 37 (Board of Deans), 38 and 39 (Board of Sub-campuses), 40 and 41(Board of Studies), 42 and 43 (Board of University Departments and Interdisciplinary studies), and 44 (Board of Post-Graduate Education in Colleges), describes the mechanism of curriculum development, upgradation/ revisions and reforms and the course syllabi, course structures and evaluation schemes of various courses so as to ensure that the university becomes a vibrant hub for the promotion of teaching and learning, skill development, research and development, interactions and linkages with industries, cultivation of intellectual property rights and entrepreneurship and incubation of knowledge linked industries. The Autonomous Colleges, in line with UGC Regulations 'UGC (Conferment of Autonomous Status upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) dated April 03, 2023, can develop new degree programme(s) at undergraduate and postgraduate levels with the approval of the Academic Council of the college and concerned Statutory Council(s), wherever required, provided the

nomenclature of the degree is in consonance with UGC Notification. Thus, these statutory authorities are advised accordingly for the execution of rigorous research-based specialization and opportunities for multidisciplinary work and interdisciplinary thinking through the design and implementation of curricular framework with effect from ACADEMIC YEAR 2023- 24 for the Graduate Level Education based on the recommendations given by Steering Committee and Directives issued by Higher and Technical Education Department, Government of Maharashtra.

**(b)** Learning Outcome Based Curriculum: To be designed in accordance with the international best practices and the current recommendations of NHEQF and National Credit Framework. Minimum learning hours will be 35 per week. The Board of Studies (BoS) and Academic Council (AC) of Universities as well as those of Autonomous Colleges shall adopt Learning Outcomes-based Approach to Curriculum Planning and Development, Teaching, Learning, and Assessment Methods and Practices based on Key Qualification Descriptors and Graduate attributes given by NHEQF. In addition, the respective BoS of Universities should initiate the development of learning materials for effective teaching and learning at different levels of the 4 years UG Curricular Programme. Accordingly, the Universities/ Autonomous Colleges should initiate the training of all faculties on the Learning Outcomes-based Approach, promote wider consultation of Industry Peers and Experts in framing the Curriculum and undertake dissemination of the same amongst all stakeholders including Students.

The Evaluation should be continuous, with more focus on students learning outcomes and as per the requirements of the course.

**(c)** Strengthening of Industry-Academic Linkages: Field projects/ Internship/ Apprenticeship/ Community Engagement and Service will have a huge role to play in institutionalizing the Curriculum Framework for Industry-Academia Linkage and to increase the employability of the students. Moreover, Internships/Apprenticeships have an enormous potential to combine work-based learning with theoretical knowledge of related disciplines/ subjects. In view of this, the Universities are advised to strengthen the Industry-Institute Linkages. Universities and Autonomous Colleges shall hold interactive meetings with representatives of Industry

Associations, MSME, Professional Organisations, Banks and Financial Institutions, NGOs, Sector Skill Councils etc for the facilitation of involvement of Industries in the smooth conduct of Internships/Apprenticeships programmes for all students.

**(d)** KRA: Besides transformation as Multidisciplinary HEI, the State Universities and their Affiliated Colleges should undertake the execution of relevant Key Result Areas (KRA) as a part of the successful implementation of NEP 2020.

**(e)** IDP: All Higher and Technical Education Institutions (HTEIs) will develop an Institutional Development Plan (IDP) to assess human resources requirements, in terms of faculty and administrative staff, physical infrastructural facilities, ICT-related technology requirements, Learning infrastructures such as Laboratories, Libraries, CPD requirements, Student Support related areas and Teaching infrastructure as well as the projection of growth and transformations in line with NEP. The HTEIs must be committed to the holistic development of students and faculty training and should work on the establishment of a quality learner support system, infrastructure upgradation, and end-to-end digitization.

**(f)** Sensitization of Stakeholders: The Universities/ Autonomous Colleges must devise, articulate and execute the rigorous plan for the sensitization of stakeholders in the immediate future on effective implementation of the new curricular framework with effect from Academic Year 2023-24.

## 9. Action Plan by Autonomous Colleges with Timelines

1. Establishment of NEP Implementation Cell at University (headed by PVC) and Autonomous Colleges (headed by Principal/Director): July 15, 2023
2. Adoption of NEP -2020 aligned curriculum by conducting a special Meeting of the Academic Council -July 20, 2023
3. Autonomous Colleges to decide and inform to University on the adoption of NEP 2020- July 31, 2023
4. To develop, statutorily adopt and release for implementation of faculty-wise Baskets of all 7 verticals viz. - i. Major; ii. Multidisciplinary Minor; iii. Generic/ Open Elective Courses; iv. Vocational and Skill Enhancement Courses (VSEC); v. Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value

Education Courses (VEC); vi. Field projects/ internship/ apprenticeship/ community engagement projects corresponding to the Major Subject, Co-curricular Courses and Project vii. Basic and Engineering Science Courses and their Combinations to be offered in Mission Mode: July 31, 2023

5. Sensitization of stakeholders on effective implementation of new curricular framework on a continuous basis till the beginning of Academic Year 2023-24
6. Submission of ATR by 31st July 2023, on the above-mentioned action points of this GR, by the Directorate of Technical Education to the Govt. of Maharashtra.

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**राष्ट्रीय शैक्षणिक धोरण, २०२० ची राज्यातील अंमलबजावणीच्या अनुषंगाने गठीत करण्यात आलेल्या सुकाणू समितीच्या शिफारशींनुसार अभ्यासक्रम आराखडा, श्रेयांक आराखडा बाबत सुधारित मार्गदर्शक सूचना.**

## महाराष्ट्र शासन
## उच्च व तंत्र शिक्षण विभाग
**शासन निर्णय क्रमांक: एनईपी-२०२२/प्र.क्र.०९/विशि-३/शिकाना**

मंत्रालय, मुंबई ४०० ०३२,
दिनांक: २० एप्रिल, २०२३

**संदर्भः-** १. शासन निर्णय क्रमांक: एनईपी-२०२२/प्र.क्र.१०५/विशि-३, दि.०६.१२.२०२२
२. शासन निर्णय क्रमांक: एनईपी-२०२२/प्र.क्र.०९/विशि-३/शिकाना,
दिनांक २६.१२.२०२२

**प्रस्तावना-**

भारताला ज्ञान महासत्ता बनविण्यासाठी, विद्यार्थ्यांमध्ये आवश्यक कौशल्य व ज्ञानप्राप्ती आणि विज्ञान, तंत्रज्ञान, शिक्षण आणि औद्योगिक क्षेत्रामधील मनुष्यबळाची कमतरता दूर करण्यासाठी, भारतातील लोकसंख्येला गुणवत्तापूर्ण शिक्षण, नाविन्यपूर्ण शिक्षण व संशोधनाच्या सुविधा उपलब्ध करुन देण्यासाठी, भारत सरकारने नवीन राष्ट्रीय शैक्षणिक धोरण- २०२० लागू केलेले आहे. नवीन शैक्षणिक धोरणामध्ये सर्वांगीण आणि बहुविद्याशाखीय शिक्षण प्रणालीचा अंतर्भाव करण्यात आला असून ज्याचा उद्देश मानवाच्या सर्व क्षमतांचा नैतिक - एकात्मिक पद्धतीने विकास करणे आहे.

दि.२६.०४.२०२२ च्या शासन निर्णयान्वये गठीत करण्यात आलेल्या डॉ. रविंद्र कुलकर्णी, माजी प्र-कुलगुरु, मुंबई विद्यापीठ, मुंबई यांच्या अध्यक्षतेखालील उपसमितीने सादर केलेल्या अहवालाच्या अनुषंगाने अभ्यासक्रम व श्रेयांक आराखड्या संदर्भात दि.०६.१२.२०२२ च्या शासन निर्णयान्वये निर्देश जारी करण्यात आले आहेत.

राष्ट्रीय शैक्षणिक धोरण, २०२० ची राज्यातील अंमलबजावणीच्या अनुषंगाने गठीत उपसमित्यांच्या अहवालातील शिफारशींच्या अंमलबजावणीसंदर्भात आढावा घेऊन येणा-या अडचणी निवारणासाठी उपाययोजना सुचविण्यासाठी व मार्गदर्शन करणेसाठी दि. २६.१२.२०२२ च्या शासन निर्णयान्वये स्थापन करण्यात आलेल्या सुकाणू समितीने अभ्यासक्रम व श्रेयांक आराखड्यासंदर्भात अंतरिम अहवाल सादर केला होता. सदर अंतरिम अहवालावर दि. १९ व २० एप्रिल, २०२३ रोजी मा. मंत्री, उच्च व तंत्रशिक्षण यांच्या अध्यक्षतेखाली आयोजित करण्यात आलेल्या चर्चासत्रामध्ये साधकबाधक चर्चा होऊन सदर अहवालाच्या अनुषंगाने अभ्यासक्रम व श्रेयांक आराखड्याची राज्यामध्ये एकसमान प्रमाणात अंमलबजावणी होण्यासाठी सर्व अकृषि विद्यापीठे, अभिमत विद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे व समूह विद्यापीठे आणि सर्व शैक्षणिक संस्थांसाठी सुधारित सुचना व निर्देश जारी करण्याची बाब शासनाच्या विचाराधीन होती.

**शासन निर्णय:-**

शैक्षणिक वर्ष २०२३-२४ पासून पहिल्या टप्प्यात, कला, वाणिज्य आणि विज्ञान शाखेतील पदवी व पदव्युत्तर अभ्यासक्रमांसाठी व इतर अभ्यासक्रमांसाठी **(AICTE, PCI, BCI, CoA, NCTE इ. सारख्या नियामक संस्थांची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून)** सोबत जोडलेल्या परिशिष्टानुसार, अभ्यासक्रम व श्रेयांक आराखड्या संदर्भात सुधारित निर्देश जारी करण्यात येत असून सदर निर्देशांची वर्ष २०२३-२४ पासून अंमलबजावणी करण्यात यावी.

सदर निर्देश महाराष्ट्र सार्वजनिक विद्यापीठ अधिनियम, २०१६ मधील कलम ५ (८१) मधील तरतूदीनुसार निर्गमित करण्यात येत आहेत.

सदर निर्देशांच्या अंमलबजावणीबाबतचा आढावा शासनामार्फत सुकाणू समितीच्या माध्यमातून वेळोवेळी घेण्यात येईल.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करण्यात आला असून त्याचा सांकेतांक २०२३०४२०१९२५२६६९०८ असा आहे. हा शासन निर्णय डिजीटल स्वाक्षरीने साक्षांकित करून काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नांवाने,

AJIT MADHUKARRAO BAWISKAR

Digitally signed by AJIT MADHUKARRAO BAWISKAR
DN: c=IN, o=GOVERNMENT OF MAHARASHTRA, ou=HIGHER AND TECHNICAL EDUCATION DEPARTMENT, 2.5.4.20=deb45560979b6c7f30e7f1f9a8360c0f8600a542859e8fe229d6ea333415e8d, postalCode=400032, st=Maharashtra, serialNumber=99EB92802BDF71EB0FCD2898E209D499192AD3899261FEAD42F7D38A3141AB69, cn=AJIT MADHUKARRAO BAWISKAR
Date: 2023.04.21 18:16:28 +05'30'

**( अजित बाविस्कर )**

उप सचिव, महाराष्ट्र शासन

**प्रत,**

१. मा. राज्यपाल यांचे प्रधान सचिव, राजभवन, मुंबई,
२. मा. मुख्यमंत्री यांचे प्रधान सचिव, मंत्रालय, मुंबई,
३. मा. उपमुख्यमंत्री यांचे उप सचिव, मंत्रालय, मुंबई,
४. मा. मंत्री, उच्च व तंत्र शिक्षण विभाग, यांचे खाजगी सचिव, मंत्रालय, मुंबई,
५. मा. कुलगुरु, सर्व अकृषि विद्यापीठे, अभिमत विद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे व समूह विद्यापीठे.
६. कुलसचिव, सर्व अकृषि विद्यापीठे, अभिमत विद्यापीठे, स्वयं अर्थसहाय्यित विद्यापीठे व समूह विद्यापीठे.
७. संचालक, उच्च शिक्षण/ तंत्रशिक्षण/ कला/ ग्रंथालय.
८. अध्यक्ष,एनईपी सुकाणू समिती.
९. सदस्य सचिव, एनईपी सुकाणू समिती.
१०. प्रधान सचिव, उच्च व तंत्र शिक्षण विभाग, यांचे स्वीय सहाय्यक, मंत्रालय, मुंबई,
११. उप सचिव (विशि), उच्च व तंत्र शिक्षण विभाग, यांचे स्वीय सहाय्यक, मंत्रालय, मुंबई,
१२. निवडनस्ती (विशि-३).

शासन निर्णय क्रमांक: एनईपी-२०२२/प्र.क्र.०९/विशि-३ शिकाना, दिनांक २० एप्रिल, २०२३
सोबतचे परिशिष्ट

**DIRECTIVES (निर्देश)**

## 1. NEP Implementation in First Phase:

The credit and curricular framework is to be made applicable, in the first phase, to the following programs (other than those regulated by AICTE, PCI, BCI, CoA, NCTE etc) with effect from Academic Year 2023-24:

UG: B.A., B.Sc., B.Com. and all Non-AICTE professional UG degree programs.

PG: M.A., M.Sc., M.Com. and all Non-AICTE professional PG degree programs.

## 2. Credit Framework under Three/Four-Years UG Programme with Multiple Entry and Multiple Exit options:

The structure of the Three/Four-year bachelor's degree programme allows the opportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per their choices and the feasibility of exploring learning in different institutions. The minimum and maximum credit structure for different levels under the Three/Four -year UG Programme with multiple entry and multiple exit options are as given below**:**

**Credit Framework**

| **Levels** | **Qualification Title** | **Credit Requirements** | | **Semester** | **Year** |
|---|---|---|---|---|---|
| | | **Minimum** | **Maximum** | | |
| **4.5** | UG Certificate | 40 | 44 | 2 | 1 |
| **5.0** | UG Diploma | 80 | 88 | 4 | 2 |
| **5.5** | Three Year Bachelor's Degree | 120 | 132 | 6 | 3 |
| **6.0** | Bachelor's Degree-Honours **Or** Bachelor's Degree-Honours with Research | 160 | 176 | 8 | 4 |

**(a)** Credits offered per Semester will be a Minimum 20 and a Maximum 22. While minimum credits are mandatory as per National Credit Framework, the Universities can evolve the mechanism for providing Semester/ Levelwise credit attainment flexibility within the broad framework.

**(b)** With effect from Academic Year 2023-24, three years/four years Degree Program will be introduced. Thus, the Fourth year Honours/ Honours with Research program (Level 6.0) will begin with effect from Academic Year 2026-27.

**(c)** Under four-year UG Degree (Honours with Research), the students will work on a research project or dissertation of 12 credits in the fourth year in the respective Major Subject. The decision regarding the distribution of 12 credits in Semester VII and VIII of fourth year will be taken by Academic Authorities of University/ Autonomous Colleges.

**(d)** The fourth year of the four-year UG programme will not be granted to any such college as 'natural growth'. The affiliated colleges conducting 3-year UG degree programme will seek permission to commence fourth year UG programme as extension by following the prevailing statutory procedures. However, Colleges already having permission and recognition for the PG degree programme along with UG degree programme in the same Major shall be automatically allowed to continue PG degree programme and conduct the fourth year of UG Honors Degree programme without undergoing any additional procedures. Similarly, the colleges with approved PG programme and Ph.D. Research Centre shall be automatically allowed to continue PG Degree programme and start the fourth year of UG Honors with Research Degree programme without undergoing any additional procedures. For students of Colleges running only three year UG Degree Programme, the University shall evolve suitable mechanisms for admission to fourth-year honours program in other Colleges.

**(e)** The NEP 2020 curriculum framework offers

i. The flexibility to move from one discipline of study to another;

ii. The opportunity for learners to choose the courses of their interest in all disciplines;

iii. The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

iv. The flexibility for learners to move from one institution to another to enable them to have multi and/or interdisciplinary learning;

v. The flexibility to switch to alternative modes of learning (offline, ODL, and Online learning, and hybrid modes of learning).

## 3. Distribution of Credits across Four Years Degree Programmes:

In general, for the four years' bachelor's degree programme, the distribution of credits will be as follows:

(a) Major (Core) Subject comprising Mandatory and Elective Courses:

i. Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses offered in all Four years;

ii. 2 credit course on Major Specific IKS shall be included under Major;

iii. Elective courses of Major will be offered in the third and/or final year.

iv. Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects connected to Major

(b) Minor Subject: 18-20 Credits

i. The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether.

ii. The credits of Minor subjects shall be completed in the first three years of UG Programme.

(c) Generic/ Open Elective Courses (OE): 10-12 credits

i. It is to be offered in I and/or II year

ii. Faculty-wise baskets of OE shall be prepared by University/ Autonomous Colleges.

iii. OE is to be chosen compulsorily from faculty other than that of the Major.

(d) Vocational and Skill Enhancement Courses (VSEC): 14-16 credits

- Vocational Skill Courses (VSC): 8-10 credits, including Hands on Training corresponding to the Major and/or Minor Subject:
  i. To be offered in first three years;
  ii. Wherever applicable vocational courses will include skills based on advanced laboratory practicals of Major
- Skill Enhancement Courses (SEC) : 06 credits
  i. To be offered in I and II year;
  ii. To be selected from the basket of Skill Courses approved by University/ Autonomous Colleges

(e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): 14 Credits

- AEC: 08 credits

i. To be offered in I and II year
ii. English: 04 Credits
iii. Modern Indian Language: 04 credits
iv. To be offered from the Basket approved by University / Autonomous College;

The focus for both languages should be on linguistic and communication skills.

- IKS: 2 Credits
  i. To be offered in I Year
  ii. Courses on IKS to be selected from the basket of IKS courses approved by University/ Autonomous Colleges
- VEC: 04 Credits
  i. To be offered in I year
  ii. Value Education Courses (VEC) such as Understanding India, Environmental Science/Education, and Digital and Technological Solutions.

(f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

- Internship/Apprenticeship corresponding to the Major (Core) Subject: 8 Credits
- Field Projects/Community Engagement and Service corresponding to the Major (Core) Subject: minimum 4-6 credits
  - To be offered in II, and III years of UG Degree Programmes.
- Co-curricular Courses (CC) such as Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts: 8 credits
  - To be offered in I and/or II year
  - Research Projects: 12 credits
  - To be offered in the final year for 4 year Honours with Research UG Degree

The UGC Regulations, 2021 permit up to 40% of the total courses being offered in a particular programme in a semester through the **Online Learning Courses** offered through the **SWAYAM** platform and/or other State Level Common Platforms which can be developed in due course with the participation of different Universities/ HEIs.

## Illustrative Credit distribution structure for three/ four year Honours/ Honours with Research Degree Programme with Multiple Entry and Exit options

| Level | Semester | Major | | Minor | OE | VSC, SEC (VSEC) | AEC, VEC, IKS | OJT, FP, CEP, CC, RP | Cum. Cr./ Sem. | Degree/ Cum. Cr. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mandatory | Electives | | | | | | | |
| 4.5 | I | 4- 6 (4+2) | | - | 2+2 | VSC:2, SEC:2 | AEC:2, VEC:2,IKS:2 | CC:2 | 20-22 | UG Certificate 40-44 |
| | II | 4- 6 (4+2) | | 2 | 2+2 | VSC:2, SEC:2 | AEC:2, VEC:2 | CC:2 | 20-22 | |
| | Cum Cr. | 8-12 | - | 2 | 8 | 4+4 | 4+4+2 | 4 | 40-44 | |
| Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor | | | | | | | | | | |
| 5.0 | III | 6(4+2)-8(2*4) | | 4 | 2 | VSC:2, | AEC:2 | FP:2 CC:2 | 20-22 | UG Diploma 80-88 |
| | IV | 6(4+2)-8(2*4) | | 4 | 2 | SEC:2 | AEC:2 | CEP: 2 CC:2 | 20-22 | |
| | Cum Cr. | 20-28 | | 10 | 12 | 6+6 | 8+4+2 | 8+4 | 80-88 | |
| Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor | | | | | | | | | | |
| 5.5 | V | 8(2*4)-10 (2*4 +2) | 4 | 4-6 | | VSC: 2-4 | | FP/CEP: 2 | 20-22 | UG Degree 120-132 |
| | VI | 8(2*4)-10 (2*4 +2) | 4 | 4 | | | | OJT :4 | 20-22 | |
| | Cum Cr. | 36-48 | 8 | 18-20 | 12 | 8-10 +6 | 8+4+2 | 8+6+4 | 120-132 | |
| Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor | | | | | | | | | | |
| 6.0 | VII | 12-14 (2*4 +2*2 or 3*4+2) | 4 | RM:4 | | | | | 20-22 | UG Honours Degree 160-176 |
| | VIII | 12-14 (2*4 +2*2 or 3*4+2) | 4 | | | | | OJT:4 | 20-22 | |
| | Cum Cr. | 60-76 | 16 | 18-20 +4 | 12 | 8-10 +6 | 8+4+2 | 8+6+8 | 160-176 | |
| Four Year UG Honours Degree in Major and Minor with 160-176 credits | | | | | | | | | | |
| 6.0 | VII | 8-10 (2*4 +2 or 2*4) | 4 | RM:4 | | | | RP: 4 | 20-22 | UG Honours with Research Degree 160-176 |
| | VIII | 8-10 (2*4 +2 or 2*4) | 4 | | | | | RP: 8 | 20-22 | |
| | Cum Cr. | 52-68 | 16 | 18 -20 +4 | 12 | 8-10 +6 | 8+4+2 | 8+6+4+ 12 | 160-176 | |
| Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits | | | | | | | | | | |

**Abbreviations:** Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Indian Knowledge System: IKS; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community engagement and service: CEP; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP

**Note:** The Credit Distribution Table given above is illustrative only. The Universities/ Autonomous Colleges may suitably modify within the broader framework of credit distribution across six verticals.

## 4. Choice of Major and Minor Subjects/ Discipline

**(a) Major (Core) Subject** is the discipline or subject of main focus and the degree will be awarded in that discipline/ Subject. Students should secure a minimum 50% of total credits through Core Courses (mandatory courses, electives, vocational courses, Internship/ Field Projects/ Apprenticeship/ Community Engagement Projects, Seminars, and Group Discussion. In addition, Entrepreneurship, IPR and Research Project shall be offered in case of Honours with Research Degree) in Three /Four Years for the award of Major Degree.

**(b)** Every faculty shall offer different categories of Major (core) Subjects of study:

- ✓ Department Specific Core (DSC)
- ✓ School Specific Core (SSC)

**Refer Prof R D Kulkarni Committee Report- Chapter II, section 2.2, P. No. 20-23 for further details on design of different categories of Major/ Core Subjects.**

**(c)** The Steering Committee recommends that to begin with, the SSC concept shall be implemented for the University Campus.

Autonomous Colleges shall have the freedom of choosing between SSC and DSC concepts either fully or faculty wise

The DSC concept shall be implemented at non-autonomous affiliated colleges.

In meantime, the Steering Committee will develop detailed guidelines on the creation of the School structure.

**(d)** The fourth year of four years honors UG degree shall be identical in structure to the first year of two year PG programmes offered after three year UG programmes.

**(e)** Students shall select a 'Major (Core) Subject' and a 'Minor Subject' from the lists of various Subject Combinations and Options provided by the State Universities/ Autonomous Colleges.

For students of non-autonomous affiliated colleges, these options will be provided by concerned academic authorities of the respective Universities.

For the award of Minor Degree, the student shall declare the choice of the minor stream at the end of the second semester, after exploring various courses.

## 5. Courses on Indian Knowledge System (IKS)

The concerned academic authorities, while defining the curriculum for modules/ courses on IKS, may take the support of the Indian Knowledge System (IKS) Cell under the Ministry of Education (MoE) at AICTE, New Delhi which is established to promote interdisciplinary research on all aspects of IKS, preserve and disseminate IKS for further research and societal applications. The IKS Cell has established multiple IKS Centers at different Institutes in various parts of the country to act as a catalyst for initiating research, education, and outreach activities. In addition, the list of courses may be developed and offered in online or offline mode by the parent university or the specialized HEIs.

The courses to be developed under the Indian Knowledge Systems (IKS) are as follows

**I. Generic IKS Course:** These are expected to contain basic knowledge of the IKS subject. It should contain introductory information to the IKS. The student should be able to acquire a basic knowledge after completion of the course.

**II. Subject Specific IKS Courses:** These courses should contain advanced information pertaining to the subject as these will be considered as a part of the major credit. The student should have completed the Generic level as a prerequisite before enrolling in the discipline related course.

The universities may evolve their own IKS subject-related courses.

## 6. Credit Specifications

As per NCrF, the learner engaged time for 40 credits is 1200 hours.

i. Theory Courses: A minimum of 15 hours of teaching per credit is required in a semester.

ii. Laboratory Course: A minimum of 30 hours in laboratory activities per credit is required in a semester.

iii. Studio activities: Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic-focused experiential work. A minimum of 30 hours in studio activities per credit in a semester is required.

iv. Workshop-based activities: Courses involving workshop-based activities require the engagement of students in hands-on activities related to work/vocation or professional practice. Every student is engaged in performing a skill-based activity

related to specific learning outcome(s). A minimum of 30 hours of workshop-based activities per credit in a semester is required.

v. Seminar/ Group Discussion: A minimum of 15 hours of participation in seminar/ Group Discussion activity per credit in a semester is required.

vi. Internship: Credits for internship shall be one credit per one week of internship (or 30 hours of engagement), subject to a maximum of six credits per Semester. The internship shall be monitored jointly by the faculty and Industry/ Organisation Mentor.

vii. Field-based Learning/ Practices: These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. A minimum of 30 hours of learning activities per credit in a semester is required.

viii. Community engagement and service: These are the courses requiring students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. 30 hours of contact time per credit in a semester along with 15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study. Thus, the total learner engaged time would be 180 hours for a 4-credit course.

## 7. ABC, Admission System, Multiple Entry and Exit Path and Lateral Entry:

**(a) Enrolment of Students and Registration of Colleges on ABC**

Steering Committee noted that all State Universities have registered on ABC. Now they must promote all affiliated autonomous colleges to register on ABC. Since Credits awarded to a student for one programmes from an institution may be transferred/redeemed by another institution upon the student's consent through ABC, it is essential that all students should get enrolled on ABC, create ABC ID and share these ABC ID with Academic Institutions where they are enrolled. Credits Earned by the student will reflect in the student ABC account.

**(b) Multi-institutional learning permission:** The student shall be allowed to earn some credits from the institutions/college other than the Main/ Parent College i.e. a college where students earn all their major credits (more than 50%) including credits for the core subject. Students enrolled in the three/four year degree programmes may avail of other

elective credits from two different colleges affiliated to the same University and/or online courses available within the 40% cap mentioned by UGC.

**(c) Multiple Exits:** Students will have the flexibility to enter a programme in odd semesters and exit a programme after the successful completion of even semesters as per their future career needs.

- ✓ Students exiting the First Year programme after securing minimum 40 credits will be awarded UG Certificate in the relevant Discipline /Subject provided they secure 4 credits in work based vocational courses or internship / Apprenticeship offered during summer vacation in addition to 6 credits from skill-based courses earned during first and second semester.
- ✓ Students exiting the Second Year Programme after securing minimum 80 credits will be awarded UG Diploma in the relevant Discipline /Subject provided they secure additional 4 credits in skill based vocational courses offered during summer vacation after first year or second year.
- ✓ Students exiting the 3-year UG programme will be awarded UG Degree in the relevant Discipline /Subject upon securing minimum 120 credits.
- ✓ Exit options shall be provided with Certification, Diploma and basic Bachelor's degrees to the students at the end of the second, fourth and sixth semester, respectively, in the four-year degree programme. Students will receive a Bachelor's degree with Honors/ Honors with Research on successfully completing all eight semesters of the UG Programmes either at a stretch or with opted exits and re-entries.

**(d) Re-entry or Lateral Entry:** Students, opting for exits at any level, will have the option to re-enter the programme from where they had left off, in the same or in a different higher education institution within three years of exit and complete the degree programme within the stipulated maximum period of seven years from the date of admission to first year UG. Re-entry at various levels for lateral entrants in academic programmes shall be based on the earned and valid credits as-deposited and accumulated in the Academic Bank of Credits (ABC) through Registered Higher Education Institutions (RHEI) and proficiency test records. Lateral entry into the programme of study leading to the UG Diploma/ Three year UG Degree/ four-year Bachelor's Degree with Honors /Research will be based on the validation of prior learning outcomes achieved and subject to availability based on intake capacity.

**(e)** Eligibility for admission to the fourth year of four year Honours with Research Degree Programmes as per UGC guidelines: Minimum CGPA of 7.5 or minimum 75% at three year degree.

## 8. Design of PG / Master's programmes

The Universities/ Autonomous Colleges will have the flexibility to offer the following PG Degree Options:

**(a)** A two-year PG programme with one exit option for those who have completed the three-year Bachelor's Degree Programme: Level 6.5, Minimum of 80 and Maximum of 88 credits.

The students, after successful completion of a minimum 40 and maximum of 44 credits in the first year of two-year PG programme may opt for exit. Such students will be awarded the PG Diploma in that relevant subject.

**(b)** A one-year Master's programme for students who are completing a four-year Bachelor's programme with honours or honours with Research: Level 6.5, minimum of 40 and Maximum of 44 credits.

One Year PG Programme will be introduced by all the Universities with effect from ACADEMIC YEAR 2027-28.

**(c)** A one-year/two-semester Post-Graduate Diploma programme builds on a three-year Bachelor's degree and requires a minimum of 40 and a maximum of 44 credits: Level 6.0

**(d)** An integrated five-year Master's programme with multiple entry and exit options at different levels e.g., the student may exit at the end of the third year with a Bachelor's degree, with an entry to a Master's programme in another HEI. A 5-year Integrated Bachelor's and Master's programmes shall have minimum of 200 and maximum of 220 credits.

**(e)** University and Autonomous Institutes will design curriculum for Two Year PG programs – M.Sc., M. A. and M. Com. as per the guidelines of NEP2020 for commencement with effect from Academic Year 2023-24. This will be offered to the students who have completed their 3 years of UG degree programmes. The PG credit framework will have to be modified as per the guidelines which shall be provided in due course of time.

**(f)** To begin with, in Academic Year 2023 -24, the specializations in PG Programmes will be based on DSC only. The curricular design of first year of two-year PG Programme will be aligned to that of fourth-year of four year Honors UG

Degree Programmes. Research Methodology (aligned with seventh semester of fourth year of Honors and Honors with Research Degree of four year UG Programmes) and Internship of 4 credits (aligned with the eighth semester of the fourth year of Honors Degree of four year UG Programmes) shall be introduced in the first semester and in the second semester, respectively of first year of Two Year PG Programmes. Second Year PG Programmes will include Research Projects of 10-12 Credits divided uniformly over the third and fourth semester.

## 9. Directives for State Universities and Colleges

**(a) Execution as per Statutory Provisions:** The Maharashtra Public Universities Act 2016, Sections 32 and 33 (Academic Council), 34 and 35 (Faculty), 36 and 37 (Board of Deans), 38 and 39 (Board of Sub-campuses), 40 and 41(Board of Studies), 42 and 43 (Board of University Departments and Interdisciplinary studies), and 44 (Board of Post-Graduate Education in Colleges), describes the mechanism of curriculum development, upgradation/ revisions and reforms and the course syllabi, course structures and evaluation schemes of various courses so as to ensure that the university becomes a vibrant hub for the promotion of teaching and learning, skill development, research and development, interactions and linkages with industries, cultivation of intellectual property rights and entrepreneurship and incubation of knowledge linked industries. The Autonomous Colleges, in line with UGC Regulations 'UGC (Conferment of Autonomous Status upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) dated April 03, 2023, can develop new degree programme(s) at undergraduate and postgraduate levels with the approval of the Academic Council of the college and concerned Statutory Council(s), wherever required, provided the nomenclature of the degree is in consonance with UGC Notification. Thus, these statutory authorities are advised accordingly for the execution of rigorous research-based specialization and opportunities for multidisciplinary work and interdisciplinary thinking through the design and implementation of curricular framework with effect from ACADEMIC YEAR 2023-24 for the Graduate, and Master's level Education based on the recommendations given by Steering Committee and Directives issued by Higher and Technical Education Department, Government of Maharashtra.

**(b) Learning Outcome Based Curriculum**: In accordance with the international best practices and the current recommendations of NHEQF and National Credit Framework, the framework proposes that the number of credits per year for 1200

learning hours will be 40. The Board of Studies (BoS) and Academic Council (AC) of Universities as well as those of Autonomous Colleges shall adopt Learning Outcomes-based Approach to Curriculum Planning and Development, Teaching, Learning, and Assessment Methods and Practices based on Key Qualification Descriptors and Graduate attributes given by NHEQF. In addition, the respective BoS of Universities should initiate the development of learning materials for effective teaching and learning at different levels of the 3/4 years UG Curricular Programme. Accordingly, the Universities should initiate the training of all faculties on the Learning Outcomes-based Approach, promote wider consultation of Industry Peers and Experts in framing the Curriculum and undertake dissemination of the same amongst all stakeholders including Students.

**(c) Strengthening of Industry-Academic Linkages:** Field projects/ Internship/ Apprenticeship/ Community Engagement and Service will have a huge role to play in institutionalizing the Curriculum Framework for **Industry-Academia Linkage** and to increase the employability of the students. Moreover, Internships/Apprenticeships have an enormous potential to combine work-based learning with theoretical knowledge of related disciplines/ subjects. In view of this, the Universities are advised to strengthen the Industry-Institute Linkages. Universities and Autonomous Colleges shall hold the interactive meetings with representatives of Industry Associations, MSME, Professional Organisations, Banks and Financial Institutions, NGOs, Sector Skill Councils etc for facilitation of involvement of Industries in smooth conduct of Internships/Apprenticeships programmes for all students. To facilitate further, the Steering Committee will hold interactions with representatives of Industry Associations, Professional Organisations, and Sector Skill Councils.

**(d) KRA:** Besides transformation as Multidisciplinary HEI, the State Universities and their Affiliated Colleges should undertake the execution of relevant **Key Result Areas (KRA)** as a part of the successful implementation of NEP 2020.

**(e) IDP:** All Higher Education Institutions (HEIs) will develop an **Institutional Development Plan (IDP)** to assess human resources requirements, in terms of faculty and administrative staff, physical infrastructural facilities, ICT-related technology requirements, Learning infrastructures such as Laboratories, Libraries, CPD requirements, Student Support related areas and Teaching infrastructure as well as the projection of growth and transformations in line with NEP. The HEIs must be committed to the holistic development of students and faculty training and should

work on the establishment of a quality learner support system, infrastructure upgradation, and end-to-end digitization.

**(f) Sensitization of Stakeholders:** The Universities must devise, articulate and execute the rigorous plan for the sensitization of stakeholders in the immediate future on effective implementation of the new curricular framework with effect from Academic Year 2023-24.

**10. Action Plan by Universities and Autonomous Colleges with Timelines**

1. Establishment of NEP Implementation Cell at University (headed by PVC) and Autonomous Colleges (headed by Principal): April 30, 2023
2. Adoption of Govt Regulation and Directions through organisation of Emergent and Special Meeting of the Academic Council -April 30, 2023
3. Autonomous Colleges to decide and inform to University on the adoption of SSC and/or DSC Major Option- April 30, 2023
4. To develop, statutorily adopt and release for implementation of faculty-wise Baskets of all 6 verticals viz. - i. Major; ii. Minor; iii. Generic/ Open Elective Courses; iv. Vocational and Skill Enhancement Courses (VSEC); v. Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC); vi. Field projects/ internship/ apprenticeship/ community engagement and service corresponding to the Major Subject, Co-curricular Courses and Research Project and their Combinations to be offered in Mission Mode: May 31, 2023
5. Sensitization of stakeholders on effective implementation of new curricular framework on a continuous basis till the beginning of Academic Year 2023-24
6. Submission of ATR on above-mentioned action points within 10 days of the deadline of same to the Directorate of Higher Education, Govt. of Maharashtra.