AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
An Autonomous Institute Affiliated with
Savitribai Phule Pune University
Accredited by NAAC with "A+" Grade | NBA - 7 UG Programmes

**Savitribai Phule Pune University**

**All India Shri Shivaji Memorial Society's**

# COLLEGE OF ENGINEERING, PUNE

**(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)**

## Faculty of Science and Technology


## National Education Policy (NEP) Compliant Curriculum

## S.Y.B. Tech. Robotics and Automation Engineering

## (2025 Pattern)

(With effect from Academic Year 2026-27)

www.aissmscoe.com

# Institute Vision and Mission

## Vision

Service to society through quality education

## Mission

- Generation of national wealth through education and research
- Imparting quality technical education at the cost affordable to all strata of the society
- Enhancing the quality of life through sustainable development
- Carrying out high-quality intellectual work
- Achieving the distinction of the highest preferred engineering college in the eyes of the stakeholders

# Department Vision and Mission

## Vision

To produce responsible professionals in the field of Robotics and Automation Engineering

## Mission

- Impart state of art technical education in Robotics and Automation Engineering.
- Inculcate sustainable skills in automation technologies, research and learning attitudes.
- Committed to fulfil the needs of society in the manufacturing and service sector.
- Prepare individuals with the ability to fulfil social responsibilities.

# Knowledge and Attitude Profile (WK)

| WK Code | Description |
|---|---|
| **WK1** | Systematic theory-based understanding of natural sciences applicable to the discipline and awareness of relevant social sciences. |
| **WK2** | Mathematics, numerical analysis, statistics and computing concepts supporting modelling and analysis in engineering. |
| **WK3** | Engineering fundamentals required for the engineering discipline. |
| **WK4** | Specialist engineering knowledge providing theoretical frameworks for practice areas in the discipline. |
| **WK5** | Knowledge supporting engineering design including sustainability, efficient resource use and environmental considerations. |
| **WK6** | Knowledge of engineering practice and technologies in the discipline. |
| **WK7** | Knowledge of the role of engineering in society including sustainability and public safety. |
| **WK8** | Engagement with current research literature and application of critical thinking to emerging issues. |
| **WK9** | Professional ethics, inclusive behaviour, responsibilities and norms of engineering practice. |

# Program Outcomes (POs)

| POs | Description |
|---|---|
| **PO1** | **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems. |
| **PO2** | **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4) |
| **PO3** | **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5) |
| **PO4** | **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8). |
| **PO5** | **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6) |
| **PO6** | **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7). |
| **PO7** | **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9) |
| **PO8** | **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams. |
| **PO9** | **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences |
| **PO10** | **Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments. |
| **PO11** | **Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8) |

## Program Specific Outcomes (PSOs)

A Robotics and Automation Engineering graduate will be able to:

**PSO1.** Graduates will be able to design and implement robotic systems that meet specified performance criteria.

**PSO2.** Graduates will be able to analyze and optimize automation processes in manufacturing, healthcare, and other industries.

**PSO3.** Graduates will be able to communicate effectively in interdisciplinary teams, working collaboratively with professionals from diverse fields such as mechanical engineering, computer science, electrical and electronics engineering.

## Program Educational Objectives (PEOs)

**PEO1.** Graduates will have a deep understanding of the principles, theories, and practices in robotics and automation engineering. They will have the skills necessary to create, design, and manage complex robotic systems. Graduates will also have a solid foundation in mechanical, electrical and electronics engineering, as well as computer science.

**PEO2.** Graduates will be prepared to design and implement robotic systems that are not only technically proficient but also socially responsible.

**PEO3.** Graduates will have an understanding of the ethical considerations involved in the use of robotic systems, such as privacy, safety, and security. They will also be aware of the social implications of robotics and automation, such as job displacement, and be equipped to address these issues in their work.

# B.Tech. Degree Options as per NEP 2020

**A.** B.Tech. Robotics and Automation Engineering Degree with **Multidisciplinary Minor** (160–176 credits).

**B.** B.Tech. **Honours Degree in the chosen major Engineering/Technology discipline with Multidisciplinary Minor (180–194 credits)**:

- Enables students to take up **five to six additional courses** in the same Engineering/Technology discipline, amounting to **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.

**C.** B.Tech. **Honours with Research Degree in the chosen major Engineering/Technology 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.** B.Tech. Degree in the chosen major Engineering/Technology 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.

**Note:**

- *The **B.Tech. Degree with Multidisciplinary Minor (Option a)** shall be the **default degree pathway** for all students.*
- *Students may **opt for any one** of the following additional degree options:*

  ***(b) B.Tech. Honours**,*

  ***(c) B.Tech. Honours with Research**, or*

  ***(d) B.Tech. Degree with Double Minor**.*
- *The options under **(b), (c), and (d) are mutually exclusive**, and a student shall be allowed to **choose only one option**.*
- *Students who do not opt for options (b), (c), or (d) shall **continue under the default pathway (Option a)**.*

# Academic Regulations and Evaluation Scheme

## A. Definition of Credit:

| Course Component | Weekly Contact Hours | Credits |
|---|---|---|
| Lecture (L) | 1 Hour / Week | 1 |
| Tutorial (T) | 1 Hour / Week | 1 |
| Practical (Lab) | 2 Hours / Week | 1 |

## B. Range of credits:

A student must earn a total of **160 to 176 credits** to be eligible for the award of an **Undergraduate Degree in Engineering**, which includes Multidisciplinary Minor(s) comprising **14 credits** within the prescribed credit range.

In addition to the core credit requirements, a student may obtain:

- **Undergraduate Degree** with **Honors** by earning an additional **18 to 20 credits**,

  **Or**
- **Undergraduate Degree** with **Honours with Research** by earning research project/dissertation of **18 credits across Semesters VII and VIII**.

  **Or**
- **Double Minor** by completing an additional **18 to 20 credits**, and/or

  These additional qualifications are awarded only upon successful completion of the specified extra credits beyond the minimum degree requirement.

## C. Multiple Entry and Exit

A student shall be eligible to receive a **Diploma in the Robotics and Automation Engineering** upon successful completion of the **Second Year (S.Y. B.Tech.) in Robotics and Automation Engineering**, along with completion of an **internship of 8 credits** during the summer term in the relevant discipline.

## D. General Guidelines for Examination (CCA)

The examination shall be conducted in THREE parts viz. Continues Comprehensive Assessment (CCA), In Semester Examination (ISE) and End Semester Examination (ESE).

**(i) Continuous Comprehensive Assessment (CCA): 20 Marks (Any TWO)**

CCA focuses on continuously assessing a student's performance throughout the semester. Apart from classroom and laboratory learning, CCA activities can be undertaken to accelerate the attainment of the various outcomes in the course: The significance of CCA lies in its ability to provide a more accurate and all-round understanding of a student's abilities, skills, and knowledge. CCA promotes experiential learning, participatory learning, collaborative learning, active learning, self-learning, peer to peer learning, etc. As part of the CCA framework, students are required to undertake ANY TWO ACTIVITIES from the prescribed set Guidelines: To be evaluated based on rubrics.

**(ii) In-semester Examination (ISE): 30 Marks**

In-semester examination will be of 30 marks based on Unit I and II.

| Course Content | Questions | Marks | Total Marks | Duration |
|---|---|---|---|---|
| Unit I | Q.1 or Q.2 | 15 | 30 | 1 Hour |
| Unit II | Q.3 or Q.4 | 15 | | |

**(iii) End-semester Examination (ESE)**

Examination will be carried out on unit III, IV and V carrying following marks weightage:

| Course Content | Questions | Marks | Total Marks | Duration |
|---|---|---|---|---|
| Unit III | Q.1 or Q.2 | 16 | 50 | 2 Hours |
| Unit IV | Q.3 or Q.4 | 17 | | |
| Unit V | Q.5 or Q.6 | 17 | | |

## ABBRAVIATIONS

| Sr No | Abbreviation | Full Form |
|---|---|---|
| 1 | BSC | Basic Science courses |
| 2 | ESC | Engineering Science courses |
| 3 | PCC | Programme Core Courses |
| 4 | PEC | Programme Elective courses |
| 5 | MDM | Multidisciplinary Minor |
| 6 | OEC | Open Elective other than particular Programme |
| 7 | VSE | Vocational and Skill Enhancement Course |
| 8 | AEC | Ability Enhancement Course |
| 9 | HSM | Humanities Social Science and Management |
| 10 | IKS | Indian Knowledge System |
| 11 | VEC | Value Education Course |
| 12 | ELC | Experiential Learning Courses |
| 13 | CCC | Liberal Learning Courses |
| 14 | CCA | Continuous Comprehensive Assessment |
| 15 | ISE | In-semester Examination |
| 16 | ESE | End-semester Examination |

# B. Tech. Robotics and Automation Engineering (2025 Pattern)

## Semester-wise Credit Distribution across Programme Domains

| Sr. No | Domains | Code | SEM-I | SEM-II | SEM-III | SEM-IV | SEM-V | SEM-VI | SEM-VII | SEM-VIII | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **BSC/ESC** | | | | | | | | | | |
| | Basic Science courses | BSC | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | **16** |
| | Engineering Science courses | ESC | 9 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | **15** |
| 2 | **Program Courses (PC)** | | | | | | | | | | |
| | Programme Core Courses | PCC | 0 | 3 | 12 | 12 | 8 | 8 | 8 | 0 | **51** |
| | Programme Elective Courses | PEC | 0 | 0 | 0 | 0 | 4 | 8 | 4 | 4 | **20** |
| 3 | **Multidisciplinary Courses (MDM)** | | | | | | | | | | |
| | Multidisciplinary Minor | MDM | 0 | 0 | 2 | 2 | 4 | 2 | 2 | 2 | **14** |
| | Open Elective other than particular Programme | OEC | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | **6** |
| 4 | **Skill Courses** | | | | | | | | | | |
| | Vocational and Skill Enhancement Course | VSE | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | **8** |
| 5 | **Humanities Social Science and Management (HSSM)** | | | | | | | | | | |
| | Ability Enhancement Course | AEC | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | **4** |
| | Entrepreneurship/Economics/Management courses | HSM | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | **4** |
| | Indian Knowledge System | IKS | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| | Value Education Course | VEC | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | **3** |
| 6 | **Experiential Learning Courses (ELC)** | | | | | | | | | | |
| | Research Methodology | ELC | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | **4** |
| | CEP | ELC | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **1** |
| | Project | ELC | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | **4** |
| | Internship | ELC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | **12** |
| 7 | **Co-curricular Courses (CC)** | | | | | | | | | | |
| | Liberal Learning Courses | CCC | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| | | **Total** | **22** | **22** | **22** | **22** | **20** | **22** | **20** | **18** | **168** |

## Multidisciplinary Minor: Artificial Intelligence and Machine Learning

| Semester | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| **SEM-III** | **25AIMDM201E** | **Object Oriented Programming** | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| **SEM-IV** | **25AIMDM202E** | **Fundamentals of Data Structure** | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| SEM-V | 25AIMDM301E | Foundation of AI and ML | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-V | 25AIMDM301LE | Foundation of AI and ML Lab | - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 01 |
| SEM-VI | 25AIMDM302E | Fundamentals of Data Science | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| SEM-VII | 25AIMDM401E | Basics of Deep Learning | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| SEM-VIII | 25AIMDM402E | MDM Mini Project | - | 4 | - | - | - | - | - | 50 | 50 | 100 | - | 2 | - | 02 |
| | | | **11** | **6** | **00** | **100** | **150** | **250** | **-** | **50** | **75** | **625** | **11** | **3** | **-** | **14** |

## Open Elective Baskets

| BASKET NO | BASKET | SEM-III | SEM-IV | SEM-V |
|---|---|---|---|---|
| **1** | **Leadership, Management & Innovation** | Principles of Management and Organizational Behaviour | Leadership and Team Dynamics | Supply Chain Management |
| **2** | **Sustainability and Green Technologies** | Circular Economy for Sustainable Development | Green Practices and ESG Frameworks | Sustainable Technologies and Carbon Management |
| **3** | **Entrepreneurship & Business** | Start-up Management and Venture Creation | Innovation and Business Strategy | Digital Marketing |
| **4** | **Holistic Development & Well-Being** | Health and Nutrition for Professionals | Stress Management and Mental Well-Being | Lifestyle Management and Preventive Healthcare |
| **5 (A)** | **Global Languages** | French Language Module – I | French Language Module – II | French Language Module – III |
| **5 (B)** | | German Language Module – I | German Language Module – II | German Language Module – III |
| **5 (C)** | | Japanese Language Module -I | Japanese Language Module -II | Japanese Language Module -III |

# Honor offered by Robotics and Automation Engineering: Intelligent Automation & Robotic Systems

| Semester | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| SEM-III | 25RAHNR201 | Fundamentals of Intelligent Automation Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-III | 25RAHNR201L | Fundamentals of Intelligent Automation Systems Lab | - | - | 1 | - | - | - | - | - | 25 | 25 | - | - | 1 | 01 |
| SEM-IV | 25RAHNR202 | Embedded & Control Systems for Automation & Robotics | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-IV | 25RAHNR202L | Embedded & Control Systems for Automation & Robotics Lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| SEM-V | 25RAHNR301 | Industrial Robotics & Automation Integration | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-V | 25RAHNR301L | Industrial Robotics & Automation Integration Lab | - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 01 |
| SEM-VI | 25RAHNR302 | AI & Data-Driven Automation Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-VI | 25RAHNR302L | AI & Data-Driven Automation Systems Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| SEM-VII | 25RAHNR401 | Mini Project | - | 2 | 1 | - | - | - | - | 50 | 50 | 100 | | 1 | 1 | 02 |
| | **Total** | | **12** | **8** | **2** | **80** | **120** | **200** | **25** | **75** | **75** | **600** | **12** | **04** | **02** | **18** |

# Double Minor: Robotics and Automation

| Semester | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| SEM-III | 25RAMNR201 | Fundamentals of Robotics and Automation | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-III | 25RAMNR201L | Fundamentals of Robotics and Automation Lab | - | - | 1 | - | - | - | 25 | - | - | 25 | - | - | 1 | 01 |
| SEM-IV | 25RAMNR202 | Programming for Robotics | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-IV | 25RAMNR202L | Programming for Robotics Lab | | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| SEM-V | 25RAMNR301 | Sensors and Actuators in Robotic Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-V | 25RAMNR301L | Sensors and Actuators in Robotic Systems Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| SEM-VI | 25RAMNR302 | Introduction to Robot Kinematics | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| SEM-VI | 25RAMNR302L | Introduction to Robot Kinematics Lab | - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 01 |
| SEM-VII | 25RAMNR401 | Robot Simulation and Application | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| | | | **14** | **06** | **01** | **100** | **150** | **250** | **50** | **25** | **25** | **600** | **14** | **3** | **1** | **18** |

# Double Minors offered by Each Department

| Offering Department | Double Minor Offered | Sem-III | Sem-IV | Sem-V | Sem-VI | Sem-VII |
|---|---|---|---|---|---|---|
| **AI &ML Engineering** | **Blockchain Technology** | Fundamentals of Blockchain Technology | Smart Contracts and Decentralized Applications | Blockchain Security and Cryptography | Decentralized AI and Web3 Technologies | Blockchain Applications and Emerging Trends |
| **Chemical Engineering** | **Environmental Engineering** | Air Pollution Control | Wastewater Treatment | Solid Waste Management | Climate Change and Sustainability | Mini Project |
| | **Energy Engineering** | Introduction of Energy | Bio-energy | Electrochemical Energy | Hydrogen Fuel | Mini Project |
| **Civil Engineering** | **Infrastructure Engineering** | Introduction to Infrastructure Engineering | Fundamentals of Infrastructure Engineering | Smart Transportation & Urban Infrastructure | Sustainable & Resilient Infrastructure Systems | Emerging Technologies in Infrastructure Engineering |
| **Computer Engineering** | **Cybersecurity Engineering** | Introduction to Cybersecurity | Cryptography and Network Security | Ethical Hacking | Digital Forensics | Cryptography & Data Protection |
| **Electrical Engineering** | **Renewable Energy systems** | Renewable Energy Sources for Sustainable Development | Solar Photovoltaic Systems | Wind Energy Conversion Systems | Power Electronics and Control for RES | Renewable Energy: Policies, Planning & Audit |
| **E&TC Engineering** | **Communication Engineering** | Analog Communication | Digital Communication | Cellular Networks | Mobile Computing | Optical & Microwave Communication |
| **VLSI D&T Engineering** | **Semiconductor IC Design** | Digital Electronics | System Design using Verilog | Digital CMOS Design | Analog CMOS Design | AI for VLSI |
| **Mechanical Engineering** | **Mechanical Systems Engineering** | Fundamentals of Manufacturing | Fundamentals of Engineering metallurgy | Fundamentals of Thermal Engineering | Fundamentals of Machine Design | Sustainable and Solar Engineering |
| **Mechanical Sandwich Engineering** | **Mechanical Systems Engineering** | Fundamentals of Manufacturing | Fundamentals of Engineering metallurgy | Fundamentals of Thermal Engineering | Fundamentals of Machine Design | Sustainable and Solar Engineering |
| **Robotics and Automation Engineering** | **Robotics and Automation Engineering** | Fundamentals of Robotics and Automation | Programming for Robotics | Sensors and Actuators in Robotic Systems | Introduction to Robot Kinematics | Robot Simulation and Application |

# S.Y.B. Tech. Robotics and Automation Engineering (2025 Pattern)

**(w.e.f. Academic Year: 2026-2027)**

## Curriculum Structure: Semester III

| Course Category | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| PCC | 25RAPCC201 | Fundamentals of Robotics and Automation Engineering | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC202 | Industrial Electronics and Electrical Machines | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC203 | Statistics and Probability | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| *MDM* | *25AIMDM201E* | *Multidisciplinary Minor-I* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| *OEC* | *25OEC201* | *Open Elective Course-I* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| PCC(L) | 25RAPCC201L | Computer Graphics for Robotics lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC202L | Industrial Electronics and Electrical Machines lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC203L | Robot Operating System | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| *VSEC* | *25RAVSE201* | *Vocational and Skill Enhancement Course-I* | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| *HSSM* | *25HSM201* | *Entrepreneurship/Economics/ Management Course-I* | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| VEC | 25VEC201 | Universal Human Values | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| ELC | 25RAELC201 | Community Engagement Project | - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 01 |
| | **Total** | | **13** | **10** | **04** | **100** | **150** | **250** | **75** | **25** | **125** | **725** | **13** | **05** | **04** | **22** |

***L:*** *Lecture,* ***P:*** *Practical,* ***T:*** *Tutorial*

***CCA:*** *Comprehensive Continuous Assessment;* ***ISE:*** *In-semester Examination;* ***ESE:*** *End Semester Examination;*

***PR:*** *Practical Examination,* ***OR:*** *Oral Examination,* ***TW:*** *Term Work*

**Multidisciplinary Minor-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AIMDM201E | Object Oriented Programming |

**Open Elective-I**

| Basket No. | Course Code | Course Name |
|---|---|---|
| 1 | 25OEC201A | Principles of Management and Organizational Behaviour |
| 2 | 25OEC201B | Circular Economy Sustainable Development |
| 3 | 25OEC201C | Start-up Management and Venture Creation |
| 4 | 25OEC201D | Health and Nutrition for Professionals |
| 5 (A) | 25OEC201E | French Language Module-I |
| 5 (B) | 25OEC201F | German Language Module-I |
| 5 (C) | 25OEC201G | Japanese Language Module-I |

**Vocational and Skill Enhancement Course-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25RAVSE201 | Programming Lab |

**Entrepreneurship/Economics/Management Courses (HSSM)-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25HSM201A | Engineering Economics |
| 2 | 25HSM201B | Entrepreneurship Development and IPR |
| 3 | 25HSM201C | Project Management and Business Planning |
| 4 | 25HSM201D | Financial Management for Engineers |

# S.Y.B. Tech. Robotics and Automation Engineering (2025 Pattern)

## (w.e.f. Academic Year: 2026-2027)

## Curriculum Structure: Semester IV

| Course Category | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| PCC | 25RAPCC204 | Design of Machine Elements | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC205 | Control Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC206 | Hydraulic and Pneumatic Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| *MDM* | *25AIMDM202E* | *Multidisciplinary Minor-II* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| *OEC* | *25OEC202* | *Open Elective Course-II* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| PCC(L) | 25RATPCC204L | Design of Machine Elements Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCCC205L | Control Systems Lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC206L | Hydraulic and Pneumatic Systems Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| VSEC | 25RAVSE202 | Computer Aided Design Lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| *ACE* | *25AEC201* | *Modern Indian Language (MIL)* | 2 | - | - | - | - | - | - | 25 | 25 | 50 | 2 | - | - | 02 |
| *HSSM* | *25HSM202* | *Entrepreneurship/Economics/ Management Course-II* | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| VEC | 25VEC202 | Indian Constitution and Governance | - | - | 1 | - | - | - | - | - | 25 | 25 | - | - | 1 | 01 |
| | **Total** | | **15** | **08** | **03** | **100** | **150** | **250** | **50** | **75** | **100** | **725** | **15** | **04** | **03** | **22** |

***L:*** *Lecture,* ***P:*** *Practical,* ***T:*** *Tutorial*
***CCA:*** *Comprehensive Continuous Assessment;* ***ISE:*** *In-semester Examination;* ***ESE:*** *End Semester Examination;*
***PR:*** *Practical Examination,* ***OR:*** *Oral Examination,* ***TW:*** *Term Work*

**Multidisciplinary Minor-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AIMDM202E | Fundamentals of Data Structure |

**Open Elective-II:**

| Basket No. | Sr. No. | Course Code | Course Name |
|---|---|---|---|
| 1 | 1 | 25OEC202A | Leadership and Team Dynamics |
| 2 | 2 | 25OEC202B | Green Practices and ESG Frameworks |
| 3 | 3 | 25OEC202C | Innovation and Business Strategy |
| 4 | 4 | 25OEC202D | Stress Management and Mental Well-Being |
| 5 (A) | 5 | 25OEC202E | French Language Module-II |
| 5 (B) | 6 | 25OEC202F | German Language Module-II |
| 5 (C) | 7 | 25OEC202G | Japanese Language Module-II |

**Vocational and Skill Enhancement Course-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25RAVSE202 | Computer Aided Design Lab |

**Entrepreneurship/Economics/Management Courses (HSSM)-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25HSM202A | Business Fundamentals for Entrepreneurs |
| 2 | 25HSM202B | Entrepreneurship and Start-ups |
| 3 | 25HSM202C | Fundamentals of Accounting and Finance |
| 4 | 25HSM202D | Business Intelligence and Analytics |

**Modern Indian Language (MIL)**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AEC201A | Marathi |
| 2 | 25AEC201B | Sanskrit |

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Savitribai Phule Pune University
Accredited by NAAC with "A+" Grade | NBA - 7 UG Programmes

# S.Y.B. Tech. Robotics and Automation Engineering

# (2025 Pattern)

## Curriculum Structure: Semester III

(With effect from Academic Year 2026-27)

## S.Y.B. Tech. Robotics and Automation Engineering (2025 Pattern)

### Curriculum Structure: Semester III

| Course Category | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| PCC | 25RAPCC201 | Fundamentals of Robotics and Automation Engineering | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC202 | Industrial Electronics and Electrical Machines | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC203 | Statistics and Probability | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| *MDM* | *25AIMDM201E* | *Multidisciplinary Minor-I* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| *OEC* | *25OEC201* | *Open Elective Course-I* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| PCC(L) | 25RAPCC201L | Computer Graphics for Robotics lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC202L | Industrial Electronics and Electrical Machines lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC203L | Robot Operating System | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| *VSEC* | *25RAVSE201* | *Vocational and Skill Enhancement Course-I* | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| *HSSM* | *25HSM201* | *Entrepreneurship/Economics/ Management Course-I* | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| VEC | 25VEC201 | Universal Human Values | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| ELC | 25RAELC201 | Community Engagement Project | - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 01 |
| | **Total** | | **13** | **10** | **04** | **100** | **150** | **250** | **75** | **25** | **125** | **725** | **13** | **05** | **04** | **22** |

**Multidisciplinary Minor-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AIMDM201E | Object Oriented Programming |

**Open Elective-I**

| Basket No. | Course Code | Course Name |
|---|---|---|
| 1 | 25OEC201A | Principles of Management and Organizational Behaviour |
| 2 | 25OEC201B | Circular Economy Sustainable Development |
| 3 | 25OEC201C | Start-up Management and Venture Creation |
| 4 | 25OEC201D | Health and Nutrition for Professionals |
| 5 (A) | 25OEC201E | French Language Module-I |
| 5 (B) | 25OEC201F | German Language Module-I |
| 5 (C) | 25OEC201G | Japanese Language Module-I |

**Vocational and Skill Enhancement Course-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25RAVSE201 | Programming Lab |

**Entrepreneurship/Economics/Management Courses (HSSM)-I:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25HSM201A | Engineering Economics |
| 2 | 25HSM201B | Entrepreneurship Development and IPR |
| 3 | 25HSM201C | Project Management and Business Planning |
| 4 | 25HSM201D | Financial Management for Engineers |

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC): Fundamentals of Robotics and Automation Engineering** | | | | | | | | | | **Course Code: 25RAPCC201** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

1. Basic knowledge of Engineering Mathematics (matrices, coordinate geometry)
2. Fundamentals of Physics (mechanics, motion, force)
3. Basic understanding of Electrical and Electronics Engineering
4. Introduction to Programming concepts

**Course Objectives:**

1. **To introduce** the fundamental concepts, history, and classification of robots and automation systems.
2. **To develop understanding** of robot kinematics, coordinate transformations, and workspace analysis for basic manipulators.
3. **To familiarize students** with robot dynamics, actuators, sensors, and end effectors used in robotic systems.
4. **To impart knowledge** of control systems and basic programming techniques used in robotics and automation.
5. **To provide exposure** to industrial automation systems, PLC fundamentals, and integration of robotics in modern manufacturing.

**Course Outcomes:**

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

**CO1.** Explain the basic concepts, classification, and applications of robotics and automation systems.

**CO2.** Apply robot kinematics to determine position, orientation, and workspace of simple manipulators.

**CO3.** Identify and analyze the role of actuators, sensors, and end effectors in robotic systems.

**CO4.** Demonstrate basic understanding of control systems and implement simple robot programming concepts.

**CO5.** Explain industrial automation, PLC operation, and robotic integration in manufacturing.

**Course Contents**

| **Unit I** | **Introduction to Robots** | **08 Hours** |
|---|---|---|

Definition and Need of Robots, History and Evolution of Robotics, Robot Anatomy, Robot Specifications, Classification of Robots based on configuration, application, and control system. Components of a Robot, Robot Degrees of Freedom (DOF) and Work Envelope, Applications of Robots: Industrial and Non-Industrial applications.

| **Unit II** | **Robot Kinematics and Mechanisms** | **08 Hours** |
|---|---|---|

Basics of Robot Kinematics, Robot Mechanisms and Linkages, Forward Kinematics, Concept and importance of inverse kinematics, Work Envelope and Manipulator Configurations, Denavit–Hardenberg (D-H) Representation, Workspace Analysis

| **Unit III** | **Dynamics, Actuators & Sensors** | **08 Hours** |
|---|---|---|

Introduction to Robot Dynamics, Basic Dynamic Elements, Actuators in Robotics, Drive Systems, Sensors in Robotics, Types of Sensors

| **Unit IV** | **Control Systems & Programming in Robotics** | **08 Hours** |
|---|---|---|

Introduction to Control Systems, Basic Control Strategies, Components of Robot Control System, Robot Programming Fundamentals, Programming Languages and Tools, Safety and Error Handling in Robotics

| **Unit V** | **Industrial Automation & Emerging Trends** | **08 Hours** |
|---|---|---|

Introduction to Automation, Industrial Automation Components, PLC Fundamentals, Industrial Automation Systems, Integration of Robotics and Automation, Emerging Trends in Automation

| | **Total Hours** | **40** |
|---|---|---|

**Course Activities for Continuous Comprehensive Assessment (CCA):**
*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Robot Classification and Application Study**
   Students shall study the history and evolution of robotics, robot anatomy, specifications, and classification based on configuration, application, and control systems. They will analyze robot components, degrees of freedom (DOF), and work envelopes. The activity may include a comparative study of industrial and non-industrial robots with suitable examples. A report and presentation shall be submitted.
2. **Robot Kinematics and Workspace Analysis of a Manipulator**
   Students shall develop a kinematic model or simulation of a simple robotic manipulator and analyze its motion using forward kinematics and D-H parameters.
   They will study robot linkages, manipulator configurations, and workspace characteristics. The activity may include software-based simulation or a case study of an industrial robot. A report and presentation demonstrating the analysis and findings shall be submitted.

| **CCA2** | **10 Marks** |
|---|---|

3. **Technical Seminar / Presentation**
   Students shall prepare and present a seminar on robot dynamics, actuators, drive systems, and sensors used in robotic systems, highlighting their working principles and applications in robotics.
4. **Research Article Review and Presentation**
   Students shall review a recent research article related to robot control systems, robot programming, control strategies, or safety in robotics and present the key findings, methodologies, and applications through a technical presentation.
5. **Group Discussion and Report Writing**
   Students shall participate in a group discussion on industrial automation systems, PLC applications, robotics integration, and emerging automation trends, followed by the submission of a concise report summarizing the key insights and conclusions.

**Text Books**


1. “Industrial Robotics: Technology, Programming and Applications” by Mikell P. Groover
2. “Robotics: Control, Sensing, Vision and Intelligence” by K. S. Fu, R. C. Gonzalez, and C. S. G. Lee
3. “Introduction to Robotics: Mechanics and Control” by John J. Craig

4. “Automation, Production Systems, and Computer-Integrated Manufacturing” by Mikell P. Groover

**Reference Books**

1. “Robotics Engineering: An Integrated Approach” by R D. Klafter, T A. Chmielewski, and M Negin
2. “Principles of Robot Motion” by Howie Choset
3. “Programmable Logic Controllers” by Frank D. Petruzella

**Online References**

1. Robotics by Prof. D. K. Pratihar (IIT Kharagpur)
   (Covers fundamentals of robots, kinematics, dynamics, control, and applications)
   https://nptel.ac.in/courses/112105249
2. Robotics and Control: Theory and Practice by Prof. N. Sukavanam & Prof. M. F Orlando (IIT Roorkee)
   (Focuses on modeling, control, and system design in robotics)
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_me49
3. Mechanism and Robot Kinematics by Prof. Anirvan DasGupta, IIT Kharagpur (NPTEL)
   (Provides strong foundation in kinematics, transformations, and motion analysis of robots)
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_me53
4. Advanced Robotics Applications by Prof. Ashish Dutta (IIT Kanpur)
   (Covers robot design, control, and practical implementation for industrial applications)
   https://nptel.ac.in/courses/112104620
5. Control Engineering for Robotics by Prof. Chayan Bhawal, IIT Guwahati (NPTEL)
   (Includes PID control, state-space methods, and controller design for robotic systems)
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee02

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC):**<br>**Industrial Electronics and Electrical Machines** | | | | | | | | | | **Course Code:**<br>**25RAPCC202** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

1. Basic Electrical Engineering
2. Basic Electronics.

**Course Objectives:**

1. Introduce fundamental concepts of Industrial Electronics for automation.
2. Familiarize students with embedded systems using Arduino for automation tasks.
3. Provide knowledge of DC motors, their characteristics.
4. Provide fundamental understanding of AC motors, starters and SROAD control methods.
5. Expose students to special purpose motors and actuators essential in robotics.

**Course Outcomes:**

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

**CO1.** Explain the working of basic semiconductor devices and apply them in simple industrial automation circuits.

**CO2.** Develop embedded solutions using Arduino for sensor interfacing and automation applications.

**CO3.** Evaluate and select suitable DC motors for automation applications.

**CO4.** Analyze AC motor characteristics and apply appropriate control strategies.

**CO5.** Select and integrate suitable special purpose motors into robotic applications.

**Course Contents**

| **Unit I** | **Fundamentals of Industrial Electronics** | **08 Hours** |
|---|---|---|

Introduction, scope and applications of Industrial Electronics. Semiconductor Devices: Diodes, BJTs, SCR, MOSFET, IGBT (Characteristics & applications). Rectifiers (half-wave & full-wave; Numerical on efficiency & ripple factor), Relay logic and simple relay-based circuits.

| **Unit II** | **Embedded Systems for Automation** | **08 Hours** |
|---|---|---|

Introduction to embedded systems & Arduino platform. Arduino UNO programming (GPIO, Analog/Digital I/O). Serial Communication basics (UART, SPI, $I^2C$). Sensor Interfacing: LM35, Ultrasonic, LDR. Simple Arduino automation examples.

| **Unit III** | **DC Machines** | **08 Hours** |
|---|---|---|

Construction, working principle of D.C. generator, DC motor: Construction, torque & SROAD relations (Numerical on torque-SROAD & back EMF). Types of DC Motors: Shunt, series, compound

(characteristics & applications). Starters: 3-point, 4-point (working and diagrams). SROAD control methods: PWM, voltage control (Numerical on PWM frequency & duty-cycle).

| **Unit IV** | **AC Machines** | **08 Hours** |
|---|---|---|

Three-phase induction motor: construction, slip & torque-slip characteristics (Numerical on slip & torque calculations). Motor starters: DOL, Star-Delta, Auto-transformer (operation & circuits). SROAD control: VFD & V/f method (conceptual). Single-phase induction motor – Construction, types and applications.

| **Unit V** | **Special Purpose Motors** | **08 Hours** |
|---|---|---|

Stepper Motors: Types, step angle calculation (Numerical on step-angle & RPM), driver circuits. Servo Motors: Principle, feedback & closed-loop control. BLDC Motors: Working principle, role of Electronic SROAd Controller (ESC), and typical industrial and consumer applications. Universal Motors: Basic construction, working principle, and common applications.

| | **Total Hours** | **40** |
|---|---|---|

**Course Activities for Continuous Comprehensive Assessment (CCA):**

*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Industrial Electronics Devices and Applications Study**
   Students shall study the characteristics, working principles, and industrial applications of semiconductor devices such as Diodes, BJTs, SCRs, MOSFETs, and IGBTs.
   They will compare the operating features and applications of these devices in industrial automation systems. The activity may include analysis of rectifier circuits, relay logic circuits, and industrial control examples. A report and presentation shall be submitted.
2. **Arduino-Based Automation System Development**
   Students shall develop a simple automation system using Arduino UNO and suitable sensors such as LM35, Ultrasonic Sensor, or LDR.
   They will perform sensor interfacing, data acquisition, and control of an output device such as LED, buzzer, relay, or motor. The activity may include implementation of serial communication techniques and demonstration of a practical automation application. A report, program code, circuit diagram, and presentation shall be submitted.

| **CCA2** | **10 Marks** |
|---|---|

3. **Technical Seminar / Presentation on Electrical Machines**
   Students shall prepare and deliver a technical seminar on DC motors, AC induction motors, starters, speed control methods, or special purpose motors used in robotics and industrial automation.
   The seminar shall focus on construction, working principles, characteristics, advantages, limitations, and practical applications. A presentation and seminar report shall be submitted.
4. **Research Article Review and Presentation**
   Students shall review a recent research article related to industrial electronics, motor control systems, embedded automation, smart actuators, electric drives, BLDC motors, servo systems, or robotics applications.
   They shall identify the objectives, methodology, results, and industrial significance of the research work and present their findings through a technical presentation and report.
5. **Group Discussion and Report Writing**
   Students shall participate in a group discussion on emerging trends in industrial automation and electrical machines, such as Industry 4.0, intelligent motor drives, energy-efficient motors, electric vehicles, IoT-based automation, smart factories, or robotic actuation systems.

The discussion shall encourage critical analysis of technological advancements, challenges, and future opportunities. A concise report summarizing key observations, conclusions, and learning outcomes shall be submitted.

**Text Books**


1. Muhammad Rashid "Power Electronics" Pearson
2. Ashfaq Husain "Electrical Machines" Dhanpat Rai & Sons
3. Thomas L. Floyd "Electronic Devices" (9th Edition) Pearson
4. I. J. Nagrath & D. P. Kothari "Electrical Machines" Tata McGraw-Hill Publishing Co. Ltd.
5. Warwick Smith "C Programming with Arduino" Elektor Publication


**Reference Books**


1. D. Patrnabis "Sensors and Transducers" (2nd Edition) PHI
2. Smarajit Ghosh "Electrical Machines" Pearson Education, New Delhi
3. Massimo Banzi and Michael Shiloh "Started with Arduino" Maker Media, Inc
4. A. E. Fitzgerald, Charles Kingsley, Stephen D. Umans "Electrical Machines" (Fifth Edition) Tata McGraw-Hill Publication Ltd.


**Online References**

1. **Electrical Machines – I** By Prof. Tapas Kumar Bhattacharya, IIT Kharagpur (NPTEL) https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee60
2. **Industrial Automation and Control,** By Prof. Alokkanti Deb, IIT Kharagpur (NPTEL) https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee47

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC): Statistics and Probability** | | | | | | | | | **Course Code: 25RAPCC203** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

1. Basics of Mathematics

**Course Objectives:**

The course aims to

1. Understand basic statistical methods for data analysis.
2. Understand correlation and regression for analyzing relationships between variables.
3. Learn fundamental concepts of probability.
4. Study discrete and continuous probability distributions.
5. Understand sampling methods and hypothesis testing.

**Course Outcomes:**

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

**CO1.** Apply descriptive statistics for data analysis.

**CO2.** Analyze relationships using correlation and regression.

**CO3.** Apply probability rules to engineering problems.

**CO4.** Use probability distributions to model data.

**CO5.** Perform basic statistical inference using sampling and hypothesis testing.

**Course Contents**

| **Unit I** | **Descriptive Statistics and Data Analysis** | **08 Hours** |
|---|---|---|

Introduction to statistics and its role in engineering. Types of data: qualitative and quantitative data. Methods of data presentation: frequency tables, bar charts, histograms. Measures of central tendency: mean, median, and mode. Measures of dispersion: range, variance, and standard deviation. Coefficient of variation and interpretation. Conceptual overview of skewness and kurtosis with simple examples.

| **Unit II** | **Correlation and Regression Analysis** | **08 Hours** |
|---|---|---|

Scatter plots and identification of relationships between variables. Concept and types of correlation: positive, negative, and zero correlation. Pearson's correlation coefficient and its interpretation. Covariance and its relationship with correlation. Introduction to regression analysis and its importance in engineering applications. Simple linear regression equation. Least squares method for determining regression line. Coefficient of determination and practical engineering applications.

| **Unit III** | **Fundamentals of Probability** | **08 Hours** |
|---|---|---|

Introduction to probability and engineering applications. Classical definition of probability.

Frequentist and axiomatic definitions of probability. Addition rule of probability. Multiplication rule of probability. Conditional probability and independence of events. Law of Total Probability. Bayes' theorem and its basic applications.

| **Unit IV** | **Random Variables and Probability Distributions** | **08 Hours** |
|---|---|---|

Concept of random variables and their classification. Discrete random variables and probability mass function.

Cumulative distribution function and its interpretation. Expectation and variance of random variables. Binomial distribution and its characteristics. Poisson distribution and engineering applications. Continuous distributions: probability density function and normal distribution with standardization.

| **Unit V** | **Sampling and Hypothesis Testing** | **08 Hours** |
|---|---|---|

Introduction to sampling and importance in statistical analysis. Sampling techniques: random, stratified, and systematic sampling. Sampling distributions and concept of Central Limit Theorem. Introduction to hypothesis testing. Null and alternative hypotheses. Type I and Type II errors in hypothesis testing. Z-test, t-test, and Chi-square test (conceptual understanding and basic examples).

| | **Total Hours** | **40** |
|---|---|---|

**Course Activities for Continuous Comprehensive Assessment (CCA):**

*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Data Collection, Statistical Analysis, and Interpretation**
   Students shall collect data related to any topic of their interest (e.g., daily expenses, study hours, mobile usage, rainfall, sports performance, etc.) consisting of at least 20 observations. They shall organize the data, present it using appropriate charts/graphs, compute descriptive statistical measures, and interpret the findings. Additionally, students shall identify a second related variable and analyze the relationship between the two variables using correlation and regression techniques.
2. **Survey-Based Data Analysis and Prediction**
   Students shall conduct a small survey among classmates or community members on a chosen topic. The collected data shall be summarized using descriptive statistical tools and graphical representations. Students shall then investigate the relationship between two selected variables using correlation and regression analysis and use the developed model to make predictions and draw conclusions.

| **CCA2** | **10 Marks** |
|---|---|

3. **Technical Seminar / Presentation**
   Students shall present how probability, probability distributions, sampling, and hypothesis testing are used in practical applications such as quality control, risk assessment, healthcare studies, market research, weather forecasting, reliability analysis etc.
4. **Research Article Review and Presentation**
   Students shall review a published research article that uses probability, distributions, sampling, or hypothesis testing. They shall summarize the methodology, explain the statistical techniques used, and present the key findings.
5. **Group Discussion and Report Writing**
   Students shall compare different sampling techniques, discuss their advantages and limitations, identify suitable applications, and submit a short report summarizing the discussion and conclusions.

**Text Books**

1. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons

2. Douglas C. Montgomery, Applied Statistics and Probability for Engineers, Wiley

**Reference Books**

1. Sheldon Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier
2. Jay Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning

**Online References**

1. NPTEL Course on Introduction to probability and Statistics By Prof. G. Srinivasan, IIT Madras. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg10
2. NPTEL Course on Probability and Statistics by Prof. Somesh Kumar, IIT Kharagpur. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ma49
3. NPTEL Course on Engineering Statistics By Prof. Manjesh Kumar Hanawal, IIT Bombay https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ge25

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (Multidisciplinary Minor-I): Object Oriented Programming** | | | | | | | | | **Course Code: 25AIMDM201 E** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

1. Programming and problem-solving skills

**Course Objectives:**

1. To introduce basic programming concepts and OOP principles.
2. To develop problem-solving skills using objects and classes.
3. To understand key OOP concepts like encapsulation, inheritance, and polymorphism.
4. To implement real-world problems using an OOP language (e.g., C++/Java/Python).
5. To build simple applications using OOP concepts.

**Course Outcomes:**

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

**CO1.** Understand and apply OOP concepts.

**CO2.** Design classes and objects for real-world problems.

**CO3.** Implement inheritance and polymorphism.

**CO4.** Handle exceptions and basic file operations.

**CO5.** Apply exception and file handling to build robust OOP applications.

**Course Contents**

| **Unit I** | **Introduction to OOP & Programming Basics** | **06 Hours** |
|---|---|---|

Basics of programming, structure of a program, variables and data types, operators (arithmetic, relational, logical), **control structures (if-else, switch, loops: for, while, do-while)**, arrays and strings (basic idea), limitations of procedural programming, need of OOP, features of OOP (class, object, encapsulation, inheritance, polymorphism, abstraction), advantages of OOP, overview of OOP languages

| **Unit II** | **Classes, Objects & Encapsulation** | **06 Hours** |
|---|---|---|

Class definition and syntax, object creation and memory allocation, data members and member functions, access specifiers (public, private, protected), constructors and types (default, parameterized, copy concept), destructor, “this” keyword, static members (basic idea), encapsulation and data hiding, basic input/output operations.

**Case Study:** Develop a *Bank Account System* with balance, deposit, withdraw using encapsulation

| **Unit III** | **Abstraction & Inheritance** | **06 Hours** |
|---|---|---|

Concept of abstraction, abstract classes, interfaces (basic idea), base and derived class, types of inheritance (single, multilevel, hierarchical, hybrid concept), constructor in inheritance, method overriding, use of super/base keyword, access control in inheritance.

**Case Study:** Create a *Vehicle Management System* (Car, Bike, Truck) using inheritance hierarchy.

| Unit IV | Polymorphism | 06 Hours |
|---|---|---|
| Concept of polymorphism, types of polymorphism, compile-time polymorphism (function overloading, operator overloading), runtime polymorphism (method overriding), dynamic binding, virtual functions (basic idea), early vs late binding,<br>**Case Study:** Implement a *Shape Calculator* (Circle, Rectangle, Triangle) demonstrating method overloading and overriding. | | |
| **Unit V** | **Exception Handling, File Handling** | **06 Hours** |
| Exception handling concepts, types of errors, try-catch, multiple catch, finally, throw and throws (basic idea), user-defined exceptions (basic), basics of file handling, file operations (open, read, write, append, close), integration of OOP concepts in applications,<br>**Case Study:** Develop a *Library Management System* with file storage and exception handling for issue/return operations | | |
| | **Total Hours** | **30** |

**Course Activities for Continuous Comprehensive Assessment (CCA):**

*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| CCA1 | 10 Marks |
|---|---|

1. **Study of OOP Concepts and Real-Life Applications**
   Students shall study the fundamental concepts of Object-Oriented Programming including classes, objects, encapsulation, inheritance, polymorphism, and abstraction.
   They will identify real-life examples where OOP concepts are applied and explain the advantages of OOP over procedural programming. A report and presentation shall be submitted.
2. **Development of a Simple OOP-Based Application**
   Students shall develop a simple application using classes and objects such as a Bank Account System, Student Management System, or Employee Management System.
   The application shall demonstrate the use of data members, member functions, constructors, and encapsulation. A report, source code, and presentation shall be submitted.

| CCA2 | 10 Marks |
|---|---|

3. **Technical Seminar / Presentation on OOP Concepts**
   Students shall prepare and present a seminar on topics such as Encapsulation, Abstraction, Inheritance, Polymorphism, Constructors, or Object-Oriented Design.
   The seminar shall explain the concepts, advantages, and practical applications with suitable examples. A presentation and seminar report shall be submitted.
4. **Case Study Implementation and Demonstration**
   Students shall implement any one of the case studies prescribed in the syllabus such as:
   - Bank Account System using Encapsulation
   - Vehicle Management System using Inheritance
   - Shape Calculator using Polymorphism
   - Library Management System using Exception and File Handling

   The implementation shall demonstrate the appropriate OOP concepts and include a program demonstration, report, and presentation.
5. **Group Discussion and Report Writing**
   Students shall participate in a group discussion on the importance of Object-Oriented Programming in software development, automation systems, mobile applications, web applications, or robotics.
   A concise report summarizing the discussion, key learning points, and conclusions shall be submitted.

**Text Books**

1. Object Oriented Programming– E. Balagurusamy
2. The C++ Programming Language – Bjarne Stroustrup
3. Object-Oriented Programming– Robert Lafore

**Reference Books**

1. Object-Oriented Analysis and Design – Grady Booch
2. Design Patterns: Elements of Reusable Object-Oriented Software – Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides

**Online References**

NPTEL Courses

1. **Fundamentals of Object-Oriented Programming,** By Prof. Balasubramanian Raman, IIT Roorkee
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_cs34

Coursera Courses

2. **Introduction to Object-Oriented Programming,** by Professor Matthew Yee-King, University of Landon
   https://www.coursera.org/learn/cplusplus-crypto-i
3. Object Oriented Programming Specialization, by Professor Matthew Yee-King, University of Landon
   https://www.coursera.org/specializations/object-oriented-programming-s12n

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 1): Principles of Management and Organizational Behaviour** | | | | | | | | | **Course Code: 25OEC201A** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

1. Basic knowledge of Engineering Mathematics
2. Fundamentals of Economics and Accounting
3. Analytical and quantitative reasoning skills

**Course Objectives:**

1. To introduce the fundamental concepts, functions, and theories of management.
2. To develop an understanding of organizational behavior and individual dynamics at the workplace.
3. Evaluate leadership styles, communication processes, and team dynamics.
4. Apply decision-making, planning, organizing, and controlling techniques in practical scenarios.
5. Assess organizational culture, change management processes, and conflict resolution strategies.

**Course Outcomes:**

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

**CO1.** Explain core management functions and classical as well as modern management theories.

**CO2.** Analyze individual behavior, personality, perception, and motivation in organizational settings.

**CO3.** Apply capital budgeting methods for evaluating engineering investment decisions.

**CO4.** Evaluate cost of capital and capital structure decisions.

**CO5.** Apply working capital and financial planning concepts for engineering projects..

**Course Contents**

| **Unit I** | **Introduction to Management** | **06 Hours** |
|---|---|---|

Definition and nature of management; functions of management (planning, organizing, staffing, directing, controlling); levels of management; managerial roles and skills; evolution of management thought (classical, behavioral, modern approaches); principles of management.

| **Unit II** | **Planning and Organizing** | **06 Hours** |
|---|---|---|

Planning process; types of plans; decision-making process and techniques; organizing principles; organizational structure (line, functional, matrix); delegation, authority, and responsibility; centralization and decentralization.

| **Unit III** | **Individual Behavior in Organizations** | **06 Hours** |
|---|---|---|

Foundations of organizational behavior; personality and attitudes; perception and attribution; learning theories; motivation theories (Maslow, Herzberg, McGregor, etc.); job satisfaction and employee engagement.

| **Unit IV** | **Group Behavior and Leadership** | **06 Hours** |
|---|---|---|

Group dynamics; team development; communication process and barriers; leadership theories and styles; power and politics; conflict management; negotiation techniques; organizational culture.

| **Unit V** | **Organizational Change and Development** | **06 Hours** |
|---|---|---|

Organizational change and resistance to change; change management models; organizational development; stress management; ethics and corporate social responsibility; contemporary issues in management; digital transformation and innovation in organizations.

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Case Study Analysis**
   Students analyze a real organizational problem related to planning, leadership, motivation, or change management and present solutions.
2. **Group Discussion & Presentation**
   Teams discuss management topics such as leadership styles, organizational culture, or conflict management and deliver presentations.
3. **Role Play / Management Simulation**
   Students perform role plays on manager–employee communication, negotiation, decision-making, or team management scenarios.
4. **Mini Project on Organizational Study**
   Students visit or study an organization/startup and prepare a report on management practices, hierarchy, communication, and work culture.
5. **Hands-on Activity using Planning & Decision Tools**
   Students prepare organizational charts, decision trees, SWOT analysis, project planning schedules, or management process flowcharts using practical examples.

**Text Books**

1. Robbins, S. P. & Coulter, M., Management, Pearson Education.
2. L. M. Prasad, Principles and Practice of Management, Sultan Chand & Sons.

**Reference Books**

1. Robbins, S. P. & Judge, T. A., Organizational Behavior, Pearson Education.
2. Koontz, H. & Weihrich, H., Essentials of Management, McGraw Hill.
3. K. Aswathappa, Organizational Behavior, Himalaya Publishing House.
4. Harold Koontz & Cyril O'Donnell, Principles of Management, McGraw Hill.
5. P. Subba Rao, Management and Organizational Behavior, Himalaya Publishing House.

**NPTEL/MOOCS**

1. NPTEL course on Principles of Management by Prof. Susmita Mukhopadhyay, Prof. S. Srinivasan, IIT Kharagpur.
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg88
2. NPTEL course on Organizational Behaviour by Prof. M. P. Ganesh, IIT Hyderabad.
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg51

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 2): Circular Economy for Sustainable Development** | | | | | | | | | | **Course Code: 25OEC201B** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Entrepreneurship, market survey, innovation.

**Course Objectives:**

1. Understand the fundamentals principles of circular economy, sustainability, environmental systems, and resource cycles.
2. Apply sustainable development goals (SDGs), life-cycle thinking, and circular economy models in real-world contexts.
3. Develop the ability to assess materials, energy, and waste flows in businesses and communities to optimize resource use and reduce environmental impact.
4. Examine environmental governance, global sustainability policies, and circular strategies for industry and society.
5. Foster creative and practical solutions for sustainable consumption, production, and cleaner technologies.

**Course Outcomes:**

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

**CO1.** Explain the fundamental principles of circular economy and sustainable development, and differentiate between linear and circular economic systems.

**CO2.** Analyse global environmental challenges and evaluate the role of Sustainable Development Goals (SDGs) in addressing sustainability issues.

**CO3.** Apply life cycle thinking, material flow analysis, and resource efficiency tools to assess environmental impacts of products and processes.

**CO4.** Design and evaluate circular business models incorporating strategies such as reuse, recycling, remanufacturing, and extended producer responsibility.

**CO5.** Assess sustainability policies, governance mechanisms, and technological interventions to propose practical solutions for sustainable development.

**Course Contents**

| **Unit I** | **Fundamentals of Circular Economy and Sustainable Development** | **06 Hours** |
|---|---|---|

Concept of sustainable development; evolution of sustainability; environmental, social and economic dimensions (Triple Bottom Line); limitations of the linear economy (take–make–dispose model); principles of circular economy; relationship between circular economy and sustainability; planetary boundaries; ecological footprint; overview of global sustainability challenges; introduction to Sustainable Development Goals (SDGs) and their relevance to industry and society.

| **Unit II** | **Resource Efficiency and Life Cycle Approaches** | **06 Hours** |
|---|---|---|

Resource scarcity and resource efficiency; material flow analysis (MFA); life cycle thinking; Life Cycle Assessment (LCA) methodology and stages (goal and scope definition, inventory analysis, impact assessment, interpretation); carbon footprint and water footprint; eco-efficiency and resource productivity indicators; waste hierarchy (reduce, reuse, recycle, recover); strategies for decoupling economic growth from resource consumption

| **Unit III** | **Circular Business Models and Industrial Applications** | **06 Hours** |
|---|---|---|

Circular business model innovation; product life extension strategies; reuse, repair, refurbishment and remanufacturing; recycling technologies; product-as-a-service (PaaS); sharing economy; eco-design and design for environment (DfE); reverse logistics and closed-loop supply chains; Extended Producer Responsibility (EPR); industrial symbiosis; sustainable manufacturing practices.

| **Unit IV** | **Policy, Governance and Sustainable Development Frameworks** | **06 Hours** |
|---|---|---|

Environmental governance and regulatory frameworks; national and international sustainability policies; climate change mitigation and adaptation strategies; green finance and sustainable investment; Environmental, Social and Governance (ESG) reporting; corporate social responsibility (CSR); sustainable procurement practices; role of government, private sector and civil society in promoting circular economy; global environmental agreements and initiatives.

| **Unit V** | **Tools, Technologies and Case Studies in Circular Economy** | **06 Hours** |
|---|---|---|

Emerging technologies enabling circular economy (IoT, Artificial Intelligence, blockchain for traceability); digitalization and smart resource management; sustainable supply chain management; urban circular systems and smart sustainable cities; waste-to-energy and waste-to-resource technologies; sectoral applications (manufacturing, agriculture, construction, energy); case studies of successful circular economy initiatives; challenges and future prospects of sustainable development.

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Waste Audit & Recycling Survey**
   Students conduct a survey of waste generation in campus/home and suggest recycling or reuse strategies based on circular economy principles.
2. **Life Cycle Assessment (LCA) Mini Study**
   Analyze the life cycle of a product (plastic bottle, mobile phone, paper bag, etc.) and identify environmental impacts and sustainability improvements.
3. **Case Study Presentation on Circular Economy Models**
   Teams study companies practicing circular economy, green manufacturing, or sustainable business models and present findings.
4. **Hands-on Eco-Design / Upcycling Activity**
   Students create useful products from waste or redesign an existing product using eco-design and sustainability concepts.
5. **Sustainability Policy & SDG Mapping Project**
   Students map business/industrial activities with Sustainable Development Goals (SDGs) and prepare reports on sustainable practices.

**Text Books**


1. Kirchherr, J., Reike, D., & Hekkert, M. – Conceptualizing the Circular Economy: An overview (Journal/Book compendium)
2. Ellen MacArthur Foundation – Towards the Circular Economy (Vol. 1–3)
3. (Open-access foundation reports widely used in curricula)
4. Pearce, D. & Turner, R. K. – Economics of Natural Resources and the Environment
5. Bruntland Commission Report – Our Common Future (UN document foundational to sustainability thought)

**Reference Books**


1. Bocken, N. M. P., et al. – Product Design and Business Model Strategies for a Circular Economy
2. Geissdoerfer, M., et al. – The Circular Economy: A Critical Literature Review
3. McDonough, W. & Braungart, M. – Cradle to Cradle: Remaking the Way We Make Things
4. UNEP / UN Documents – Global Environmental Outlook Reports (for SDG policy context)
5. Geyer, R., et al. – Industrial Ecology and Circularity


**MOOC / NPTEL Courses**

1. Coursera: Sustainability and Circular Economy, Michael J. Readey, University of Colorado Boulder
   https://www.coursera.org/learn/sustainability-and-the-circular-economy
2. NPTEL, Environment and Development, Prof. By Prof. Ngamjahao Kipgen, IIT Guwahati
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs83
3. NPTEL, Education for Sustainable Development, By Prof. Atasi Mohanty, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_hs61
4. NPTEL, Environmental Planning and Management, By Prof. Sonal K. Thengane, IIT Roorkee
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge08
5. NPTEL5 Corporate social responsibility By Prof. Aradhna Malik, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg54

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 3): Start-up Management &Venture Creation** | | | | | | | | | | **Course Code: 25OEC201C** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Entrepreneurship, market survey, innovation

**Course Objectives:**

1. Understand the fundamentals of startup management and venture creation.
2. Develop the ability to identify, evaluate, and validate startup ideas.
3. Gain knowledge of business models, funding mechanisms, and startup operations.
4. Understand legal, ethical, and IPR aspects related to startups.
5. Build entrepreneurial skills, teamwork, leadership, and lifelong learning orientation.

**Course Outcomes:**

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

**CO1.** Explain concepts, types, and lifecycle stages of start-ups and new ventures.
**CO2.** Identify and analyze start up opportunities using market and customer discovery tools.
**CO3.** Develop suitable business models and assess technical and financial feasibility of ventures.
**CO4.** Apply knowledge of funding, legal, IPR, and government policies for startup creation.
**CO5.** Prepare and present a startup business plan demonstrating teamwork, communication, ethics, and lifelong learning.

**Course Contents**

| **Unit I** | **Introduction to Startups & Venture Creation** | **06 Hours** |
|---|---|---|

Startup: Definition, characteristics, and types, Startup vs MSME vs traditional business, Startup lifecycle and growth stages,Role of startups in innovation and economic development Case studies of successful startups (Indian & global).

| **Unit II** | **Idea Generation, Opportunity & Market Validation** | **06 Hours** |
|---|---|---|

Entrepreneurial mindset and ideation techniques, Problem identification and solution fit, Design Thinking and Lean Startup approach, Customer discovery and validation, Market analysis and value proposition development.

| **Unit III** | **Business Models & Feasibility Analysis** | **06 Hours** |
|---|---|---|

Business Model Canvas and Lean Canvas, Technical, market, and financial feasibility, Cost structures, revenue models, and break-even analysis, Risk analysis and mitigation strategies, Sustainability and ethical considerations in startups

| **Unit IV** | **Startup Ecosystem, Funding & Legal Aspects** | **06 Hours** |
|---|---|---|

Startup ecosystem in India and globally, Government initiatives: Startup India, MSME, SIDBI, DPIIT, Sources of funding: bootstrapping, angel investors, venture capital, crowdfunding, Legal aspects:

company registration, compliance, Intellectual Property Rights (IPR): patents, trademarks, copyrights.

| **Unit V** | **Startup Operations, Scaling & Business Plan** | **06 Hours** |
|---|---|---|

Team formation, leadership, and culture, Operations and scaling strategies, Marketing, branding, and customer acquisition Business plan preparation and pitch deck, Future trends, failure analysis, and lifelong learning for entrepreneurs.

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Startup Idea Pitching Activity**
   Students develop and present innovative startup ideas addressing real-world problems using value proposition concepts.
2. **Business Model Canvas Workshop**
   Hands-on preparation of Business Model Canvas (BMC) for a startup including customer segments, revenue streams, and value proposition.
3. **Market Survey & Customer Validation**
   Students conduct field/online surveys to identify customer needs, validate startup ideas, and analyze market opportunities.
4. **Prototype / Product Demonstration**
   Teams create a basic prototype, mock-up, or digital model of a product/service and demonstrate its functionality and usefulness.
5. **Startup Business Plan Preparation**
   Students prepare a practical business plan including funding requirements, marketing strategy, operational plan, and financial feasibility analysis.

**Text Books**


1. S. S. Khanka – Entrepreneurial Development, S. Chand & Company.
2. Vasant Desai – Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.


**Reference Books**


1. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.
2. Alexander Osterwalder & Yves Pigneur – Business Model Generation, Wiley.
3. Barringer & Ireland – Entrepreneurship: Successfully Launching New Ventures, Pearson.
4. Peter F. Drucker – Innovation and Entrepreneurship, Harper Business.
5. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.


**MOOC / NPTEL Courses**

1. NPTEL1, Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL2, Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ge08
3. NPTEL3, Innovation, Business Models and Entrepreneurship, By Prof. Vinay Sharma, Prof. Rajat Agrawal, IIT Roorkee:
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
4. NPTEL4, Entrepreneurship Essentials, By Prof. Manoj Kumar Mondal, IIT Kharagpur:
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ge03
5. Coursera: Technology & Entrepreneurship Specialization, Brent Sebold, Arizona State University
   https://www.coursera.org/specializations/technology-and-entrepreneurship

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 4): Health and Nutrition for Professionals** | | | | | | | | | | **Course Code: 25OEC201D** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Course Objectives:**

1. To understand the importance of nutrition and healthy lifestyle for professionals.
2. To create awareness about balanced diet and nutritional requirements.
3. To understand lifestyle diseases and their prevention.
4. To develop healthy habits for stress management and productivity.

**Course Outcomes:**

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

**CO1.** Explain the basic concepts of health and nutrition.
**CO2.** Understand nutritional requirements and balanced diet.
**CO3.** Identify lifestyle diseases and preventive measures.
**CO4.** Apply principles of healthy living and stress management.
**CO5.** Analyze the role of nutrition in improving professional productivity.

**Course Contents**

| **Unit I** | **Introduction to Health and Nutrition** | **06 Hours** |
|---|---|---|

Concept of health and wellness
Dimensions of health (physical, mental, social)
Importance of nutrition for professionals
Nutrients and their functions
Macronutrients and micronutrients

| **Unit II** | **Balanced Diet and Nutritional Requirements** | **06 Hours** |
|---|---|---|

Concept of balanced diet
Dietary guidelines
Recommended dietary allowance (RDA)
Nutritional needs during childhood, adolescence, adulthood and old age
Special Nutritional needs for working professionals
Vegetarian vs non-vegetarian diets
Food pyramid and healthy eating habits

| **Unit III** | **Lifestyle Diseases** | **06 Hours** |
|---|---|---|

Causes of lifestyle diseases
Obesity, diabetes, hypertension, heart disease
Role of diet in prevention of diseases
Importance of physical activity
Nutritional management of common diseases
Prevention through healthy diets and lifestyle

| **Unit IV** | **Health Management for Professionals** | **06 Hours** |
|---|---|---|

Work-life balance
Stress and its management
Role of exercise and yoga
Sleep and mental health
Ergonomics and workplace health

| Unit V | Food Safety and Healthy Lifestyle | 06 Hours |
|---|---|---|

Food hygiene and sanitation
Food adulteration
Safe food handling practices
Sustainable and healthy eating habits
Nutrition for long-term health and productivity
Importance of hydration
Healthy snacking options at work

| | Total Hours | 30 |
|---|---|---|

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Balanced Diet Planning Activity**
   Students prepare a daily/weekly balanced diet chart for different age groups or working professionals based on nutritional requirements.
2. **Nutritional Analysis Survey**
   Conduct a survey on eating habits, junk food consumption, hydration, or lifestyle diseases and analyze the collected data.
3. **Healthy Recipe Preparation / Demonstration**
   Students prepare and present nutritious, low-cost, and healthy food recipes promoting balanced nutrition and food safety.
4. **Fitness, Yoga & Stress Management Activity**
   Practical sessions on yoga, exercise routines, meditation, posture correction, and stress management techniques for healthy living.
5. **Food Safety & Awareness Campaign**
   Students create posters, presentations, or awareness drives on food hygiene, adulteration detection, healthy snacking, and lifestyle disease prevention.

**Text Books**


1. Srilakshmi, B., Human Nutrition, New Age International (P) Ltd., Publishers, New Delhi.
2. Joshi, Shubhangini A., Nutrition and Dietetics: With Indian Case Studies, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2021.


**Reference Books**


1. Swaminathan, M., Food and Nutrition, Bangalore Printing & Publishing Co. Ltd., Bangalore.
2. (You may verify the exact edition/year available in your library before finalizing.)
3. Swaminathan, M., Essentials of Food and Nutrition, Vol. I & II, Ganesh & Co., Madras, 1974.


**MOOC / NPTEL Courses /Online Resources:**

1. Adolescent Health and Well-Being: A Holistic Approach by By Prof. Sumana Samanta, Prof. Parmeshwar Satpathy, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge102
2. Diet Management in Health and Disease by By Dr. Vipparti Vijaya Lakshmi, The English and Foreign Languages University: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec25_hc01
3. Food and Nutrition by By Dr. Asna Urooj, University of Mysore: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_ag02

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 5 (A)): French Language Module-I** | | | | | | | | | | **Course Code: 25OEC201E** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Course Objectives:**

1. To strengthen basic communication skills in French.
2. To develop listening, reading, and writing skills in French.
3. To enhance confidence in practical conversations.
4. To apply French vocabulary and expressions in travel and public communication contexts.
5. To prepare students for DELF A1 level competency.

**Course Outcomes:**

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

CO1. Use basic French expressions confidently in familiar situations.

CO2. Interpret simple dialogues and instructions in French.

CO3. Read and write short paragraphs on familiar topics.

CO4. Participate in guGERMANided conversations using appropriate French expressions.

CO5. Apply French language skills in practical and everyday situations.

**Course Contents**

| **Unit I** | **Introduction au français (Introduction to French)** | **06 Hours** |
|---|---|---|

French alphabet and pronunciation
Greetings and introductions
Numbers (1-100), days and months
Classroom expressions

| **Unit II** | **Parler de ses loisirs et de sa famille (Talking about his hobbies and his family)** | **06 Hours** |
|---|---|---|

Talking about a hobby
(Vocab: Activities, expressions + Aimer)
Family and friends
(Grammar: Subject pronouns, ER ending verbs, Family relations)

| **Unit III** | **La France (France)** | **06 Hours** |
|---|---|---|

Reading about French city
Asking simple questions about France
Writing a post card
(Vocab: Information on France and it's cities, interrogative words.)

| **Unit IV** | **Au café! (At the cafe!)** | **06 Hours** |
|---|---|---|

Ordering in French
Fruits and vegetables

Quantities
Expressions of politeness

| Unit V | Faire une invitation (Make an invitation) | 06 Hours |
|---|---|---|

Letter writing
Organising a party
Accepting / refusing an invitation
Role play activities

| | Total Hours | 30 |
|---|---|---|

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Self-introduction in French:** Students introduce themselves using simple French sentences.
2. **Greetings and Classroom Conversation:** Students practice basic greetings and classroom expressions in French.
3. **Listening Comprehension Exercise:** Students listen to short French audio clips and answer simple questions.
4. **Picture Description in French:** Students describe a given picture using basic French vocabulary.
5. **French Culture Presentation:** Students give a short presentation on French culture, food, or festivals.

**Text Books**


1. Alter Ego A1 – Hachette (Goyal Publishers)
2. Latitude 1 – Didier (Goyal Publishers)


**Reference Books**


1. Myrna Bell Rochester, “Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast”, McGraw Hill, ISBN-13 : 978-0071453875
2. Eugene Jackson, Antonio Rubio, Julien J. Lafontant, Pamela Haze, “French Made Simple”, Crown Publication, ISBN-13 : 978-0767918596
3. Claire Miquel, “Communication Progressive du Français A1”, Cle International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
4. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 1, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
5. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) 1., Saraswati House Pvt. Ltd., New Delhi. Second Revised Edition, 2007


**Online Resources**

1. https://www.elearningfrench.com/
2. https://www.laits.utexas.edu/fi/index.html
3. https://blog.rosettastone.com/french-accent-marks/
4. https://www.frenchcircles.ca/online-free-french-resources/
5. Proficiency course in French By Prof. Nirupama Rastogi (Retd): https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_lg04
6. Foundations of French by Ramya Jagannathan: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg73
7. The Complete French Course : Learn French – Beginners : https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
8. Complete French Course: Learn French for Beginners: https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 5 (B)): German Language Module-I** | | | | | | | | | **Course Code: 25OEC201F** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Course Objectives:**

1. To introduce students to basic German pronunciation and vocabulary.
2. To develop elementary communication skills in German.
3. To familiarize students with simple German sentence structures.
4. To enable students to communicate in everyday situations.
5. To develop awareness about German culture and traditions.

**Course Outcomes:**

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

**CO1.** Understand basic German pronunciation and vocabulary.

**CO2.** Communicate using simple expressions.

**CO3.** Read and write elementary German sentences.

**CO4.** Use common phrases in daily situations.

**CO5.** Demonstrate awareness about German culture.

**Course Contents**

| **Unit I** | **Willkommen! (Welcome!)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- Greetings
- Introductions
- Numbers
- Countries & languages

**Grammar**

- Alphabet
- Pronunciation
- Personal pronouns

**Skills**

- Speaking: self-introduction
- Listening: simple conversations
- Reading: name cards, dialogues
- Writing: short introduction paragraph

| **Unit II** | **Familie, Freunde und ich (Family, Friends and I)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- Family members
- Hobby and work

**Grammar**

- Nominative case
- Articles- der, die, das

- • Regular verb conjugation

**Skills**

- Speaking: describe family, ask about profession, introduce others
- Reading: small paragraphs about nuclear and joint families

**Activity**

- Family tree presentation

| Unit III | Orte und Dinge (Places and things) | 06 Hours |
|---|---|---|

**Topics and Vocabulary**

- Household objects
- Classroom objects
- Office equipment
- Nature vocabulary
- Public places

**Grammar**

- Sentence structure
- Definite articles- der, die, das
- Indefinite articles- ein, eine, ein
- Negative markers- kein, keine, kein, nicht

**Skills**

- Speaking: describing surroundings and objects
- Reading: simple descriptive passages and labels
- Writing: short descriptions using simple sentences

**Activities**

- Vocabulary Hunt
- Mystery Object Game
- Picture Description

| Unit IV | Studentenleben & Alltag (Student life & everyday life) | 06 Hours |
|---|---|---|

**Topics and Vocabulary**

- Daily routine
- University life
- Subjects
- Time expressions

**Grammar**

- Time
- Nominative case- personal pronouns
- Nominative case- possessive Pronouns

**Skills**

- Speaking and Writing: daily routine discussion

**Listening:** Schedules at university and at the work place

| Unit V | Revision & Mini Project | 06 Hours |
|---|---|---|

**Integrated Skills**

Students prepare:

- Self-introduction
- Poster
- Dialogue
- Simple presentation

**Suggested Project**

My dream study trip to Germany/ Cultural connectivity between Germany and India/ Any other topic related to German language and culture.

**Assessment**

- Speaking viva
- Listening test
- Vocabulary quiz
- Listening exercises
- Pronunciation practice
- Role play activities

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Self-introduction in German:** Students introduce themselves using simple German sentences.
2. **Greetings and Basic Conversation:** Students practice greetings and everyday expressions in German.
3. **Listening Comprehension Exercise:** Students listen to short German audio clips and answer questions.
4. **Picture Description in German:** Students describe simple pictures using basic German vocabulary.
5. **German Culture Presentation:** Students present topics related to German culture, food, or festivals.

**Text Books**

1. Stefanie Dengler, "Netzwerk A1 (Textbook + Workbook + Glossar)", Hachette , ISBN: 9788183077033, (Goyal Publishers)
2. Monika Reimann Daniela Niebisch , Sylvette Penning-Hiemstra , Angela Pude , Franz Specht , Monika Bovermann, " Schritte international Neu 1: Deutsch als Fremdsprache / Kursbuch + Arbeitsbuch mit Audios online", Hueber Publications, GOYAL Publishers & Distributors Pvt. Ltd, ISBN-13 : 978-3193610829

**Reference Books**

1. Deepak Kushwaha, "German Made Easy Part 1 + German Made Easy Part 2 with Answer", Goyal Publishers
2. Arnold Leitner, "German Made Simple", Crown Publications, Penguin Random House India Pvt Ltd
3. Kurs Und Ubungsbuch, "Studio-D A1 - Combo of 3 (German)", Goyal Publishers & Distributers
4. Funk and Kuhn, "Studio D A1Deutsch Buch ", Cornelsen Verlag (Goyal Publishers India)

**Online Resources**

1. Learn German Language: Complete German Course – Beginners (Udemy): https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/
2. German A1 - German For Complete Beginners! : https://www.udemy.com/course/german-for-complete-beginners/?couponCode=PMNVD2025
3. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
4. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
5. Duolingo German : https://www.duolingo.com/course/de/en/Learn-German

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (OE-1) (Basket No 5 (C)): Japanese Language Module-I** | | | | | | | | | | **Course Code: 25OEC201G** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Course Objectives:**

1. To strengthen basic communication skills in German.
2. To develop listening, reading, and writing skills in German.
3. To enhance confidence in practical conversations.
4. To apply German vocabulary and expressions in travel and public communication contexts.
5. To prepare students for Goethe A1 level competency.

**Course Outcomes:**

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

CO1. Use basic German expressions confidently in familiar situations.

CO2. Interpret simple dialogues and instructions in German.

CO3. Read and write short passages on familiar topics.

CO4. Participate in practical conversations using appropriate German expressions.

CO5. Apply German language skills in everyday situations.

**Course Contents**

| **Unit I** | **Nihongo nyūmon (Introduction to Japanese)** | **06 Hours** |
|---|---|---|

Hiragana and Katakana
Greetings and introductions
Numbers and dates
Pronunciation practice

| **Unit II** | **Kihon-tekina bunpō to goi (Basic Grammar and Vocabulary)** | **06 Hours** |
|---|---|---|

Sentence patterns
Particles
Basic verbs
Pronouns and nouns

| **Unit III** | **Nichijō no komyunikēshon (Everyday Communication)** | **06 Hours** |
|---|---|---|

Self-introduction
Family and hobbies
Daily activities
Asking simple questions
Kanji –Lesson 1 (Textbook 1)

| **Unit IV** | **Dokkairyoku to sakubun nōryoku (Reading and Writing Skills)** | **06 Hours** |
|---|---|---|

Reading simple scripts

Vocabulary exercises
Writing practice
Sentence construction
Kanji –Lesson 2 (Textbook 1)

| **Unit V** | **Risuningu to supīkingu no renshū (Listening and Speaking Practice)** | **06 Hours** |
|---|---|---|

Listening exercises
Pronunciation practice
Role play activities
Guided communication
Kanji –Lesson 3 (Textbook 1)

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Self-introduction in Japanese:** Students introduce themselves using simple Japanese expressions.
2. **Greetings and Classroom Conversation:** Students practice basic greetings and classroom communication in Japanese.
3. **Listening Comprehension Exercise:** Students listen to short Japanese audio clips and answer simple questions.
4. **Picture Description in Japanese:** Students describe pictures using simple Japanese vocabulary.
5. **Japanese Culture Presentation:** Students present topics related to Japanese culture, food, or festivals.

**Text Books**


1. 3A Corporation, “Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary”, ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India
2. Eri Banno, Yoko Ikeda, Yutaka Ohno, Chikako Shinagawa, Kyoko Tokashiki, “Genki 1 Textbook: An Integrated Course in Elementary Japanese”, ISBN-13 : 978-4789014403


**Reference Books**


1. The Japan Foundation, “Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities”, Goyal Publishers
2. The Japan Foundation, “Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences”, Goyal Publishers, ISBN-13: 9788183078047
3. The Japan Foundation, “Marugoto Starter (A1) Katsudoo”, Goyal Publishers
4. “Japanese for Busy People,3rd edition”, Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
5. Tae Kim, “A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar”, Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
6. Nyumon Nihongo- ALC Press, U.K
7. Nihongo Soomatome N5, ASK Publishing, Tokyo


**Online Resources**

1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
2. JF-Japanese e-learning : https://minato-jf.jp/
3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL) : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83

4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC(L)): Computer Graphics for Robotics Lab** | | | | | | | | | | **Course Code: 25RAPCC201L** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Programming for Problem Solving (C / Python)
2. Engineering Mathematics (Matrix Algebra and Coordinate Geometry)
3. Basic Computer Engineering

**Course Objectives:**

1. To understand and implement fundamental computer graphics algorithms.
2. To develop programs for graphical primitives and transformations.
3. To visualize 2D and 3D graphics concepts using programming tools.
4. To implement clipping and viewing techniques.
5. To develop simple graphical applications using computer graphics libraries.

**Course Outcomes:**

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

**CO1.** Apply basic programming concepts to generate graphical primitives such as points, lines, and circles using suitable programming tools.

**CO2.** Apply and analyze 2D and 3D geometric transformations including translation, rotation, scaling, reflection, and shearing

**CO3.** Analyze viewing transformations, window-to-viewport mapping, and clipping techniques in graphical rendering.

**CO4.** Develop and evaluate graphical applications for visualization, simulation, and robotic motion using computer graphics tools.

**CO5.** Evaluate the performance and correctness of implemented computer graphics algorithms through graphical outputs and testing.

**List of Experiments: Perform any 8 of 11 and Mini project is compulsory**

1. Implement Bresenham's and DDA line drawing algorithm (C / Python + matplotlib)
2. Implement transformations on a polygon like translation, rotation, scaling, reflection, shearing for 2D Geometric objects.
3. Apply multiple transformations to a polygon or object and Demonstrate order of transformations.
4. Implement transformations in 3D like Translation, Rotation and Scaling and Simulate 3D object transformation using homogeneous coordinates (Python (numpy + matplotlib 3D))

5. Simulate robot movement in a 2D workspace.
6. Implement: Cohen–Sutherland Algorithm, Liang–Barsky Algorithm
7. 2D Viewing and Window-to-Viewport Transformation- Map world coordinates to viewport coordinates
8. Perform linear and spline interpolation between robotic positions (Python (scipy.interpolate))
9. Implement Bezier and B-Spline curves for path planning (Python or WebGL / p5.js)
10. Bezier Curve Generation Generate Bezier curves using control points.
11. Model a robotic surface patch using Bezier surface techniques (Blender / OpenSCAD / FreeCAD)
12. Mini Project (Mandatory): Simulate a robotic arm motion with transformations and path interpolation (Webots / Blender / Python)

**Virtual Laboratories:**

1. IIIT Hyderabad: https://cse18-iiith.vlabs.ac.in/

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC(L)):**<br>**Industrial Electronics and Electrical Machines Lab** | | | | | | | | | | **Course Code:**<br>**25RAPCC202L** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 1 |

**Course Objectives:**

1. To reinforce understanding of fundamental concepts in industrial electronics and electrical technology through practical experimentation.
2. To impart hands-on experience with microcontroller (Arduino) programming, including sensor and actuator integration for industrial automation.
3. To experimentally analyze and evaluate the performance characteristics of DC and AC electrical machines.
4. To provide practical exposure to control methods of special-purpose motors and actuators used in robotics and automation systems.
5. To develop skills in designing integrated automated systems and foster creativity, teamwork, and problem-solving through a structured mini-project.

**Course Outcomes:**

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

**CO1.** Conduct experiments to characterize and select suitable power electronic devices for industrial applications.

**CO2.** Develop and test Arduino-based embedded systems for sensor interfacing and basic automation tasks.

**CO3.** Experimentally analyze and evaluate the performance and control strategies of DC and AC motors in industrial scenarios.

**CO4.** Demonstrate hands-on skills in controlling special-purpose motors such as stepper, servo, and BLDC motors for robotics and automation applications.

**CO5.** Design, build, and present an automated system by integrating sensors, actuators, and Arduino controllers through a mini-project.

**Lab Assignments/Activities: (Any 6)**

1. Interfacing of LED to blink after every 1 sec.
2. Sensor interfacing with Arduino (LM35, Ultrasonic).
3. DC motor SROAd control using PWM.
4. AC motor starters practical demonstration.
5. Stepper motor positioning control.
6. Servo motor positional accuracy experiments.
7. BLDC motor SROAd control demonstration.
8. Mini-project: Arduino-based automation system integrating sensors, actuators (Mandatory).

**Text Books**

| |
|---|
| 1. Muhammad Ali Mazidi, “The AVR Microcontroller and Embedded Systems using Arduino”, Pearson Education.<br>2. V.K. Mehta & Rohit Mehta, “Principles of Electrical Machines”, S. Chand Publication |
| **Reference Books** |
| 1. Simon Monk, “Programming Arduino: Getting Started with Sketches”, McGraw-Hill.<br>2. P.S. Bimbhra, “Electrical Machinery”, Khanna Publishers. |
| **Online References** |
| 1. NPTEL: Introduction To Internet Of Things, By Prof. Sudip Misra, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs53<br>2. NPTEL: Electrical Machines – II, By Prof. Tapas Kumar Bhattacharya, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ee06 |

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (PCC(L)):**<br>**Robot Operating System** | | | | | | | | | **Course Code:**<br>**25RAPCC203L** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Basic Linux OS
2. Basic Python/C++ Programming
3. Fundamentals of Robotics.

**Course Objectives:**

1. Introduce Robot Operating System (ROS).
2. Provide hands-on experience with ROS tools.
3. Develop ROS nodes and packages.
4. Understand robot sensing and communication.
5. Implement robotic applications using ROS.

**Course Outcomes:**

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

**CO1.** **Explain** the architecture of the Robot Operating System including nodes, topics, message

**CO2.** **Install and configure** Ubuntu and ROS environment for robot software development.

**CO3.** **Develop** ROS workspace, packages, and basic communication programs using publisher and subscriber.

**CO4.** **Implement** ROS services and create custom messages for inter-node communication.

**CO5.** **Analyze and visualize** ROS system communication using tools such as rqt graph, rosnode & rostopic

**List of Experiments:**

1. Installation and configuration of Ubuntu operating system and ROS environment.
2. Study and execution of basic Linux commands for file and system management.
3. Study of ROS architecture including nodes, topics, messages, and ROS master.
4. Simulation and control of TurtleBot using keyboard teleoperation in ROS.
5. Creation of ROS workspace and development of ROS packages.
6. Implementation of a publisher node in Python for message publishing in ROS.
7. Implementation of a subscriber node for receiving messages in ROS.
8. Implementation of ROS services for request–response communication.
9. Creation and implementation of custom messages in ROS.
10. Study and usage of ROS command-line tools such as rqt_graph, rosnode, and rostopic.

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (Vocational and Skill Enhancement Course-I): Programming Lab** | | | | | | | | | | **Course Code: 25RAVSE201** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Engineering Mathematics
2. Programming Fundamentals

**Course Objectives:**

1. To develop programming skills using Python and MATLAB for solving engineering problems.
2. To understand and apply programming constructs, data structures, and numerical computation techniques.
3. To utilize Python libraries and MATLAB tools for data processing, analysis, and visualization.
4. To develop computational solutions for robotics and automation applications.
5. To enhance problem-solving, analytical thinking, and project development skills through practical implementation.

**Course Outcomes:**

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

**CO1.** Develop Python programs using basic programming constructs, functions, and data structures.

**CO2.** Apply Python libraries such as NumPy and Matplotlib for numerical computation and data visualization.

**CO3.** Use MATLAB for matrix operations, engineering computations, and graphical representation of data.

**CO4.** Design and implement simple computational solutions for robotics and automation-related problems using Python or MATLAB.

**CO5.** Develop and demonstrate a mini-project integrating programming concepts for robotics and automation applications.

**List of Experiments:** Students shall complete any four experiments from Experiments 1 to 5 and any two experiments from Experiments 6 to 8. Experiment 9 is mandatory for all students.

1. Write Python programs for basic input/output operations and arithmetic calculations.
2. Develop Python programs using decision-making and looping constructs.
3. Implement Python programs using functions and data structures such as lists and dictionaries.
4. Perform numerical computations using Python libraries such as NumPy.
5. Visualize data using Python Matplotlib for plotting engineering and sensor data.
6. Use MATLAB for basic operations and matrix computations.
7. Develop MATLAB programs for plotting and visualization of engineering data.
8. Create a simple application using Python or MATLAB for robotics-related data processing or simulation
9. Students have to complete one mini project based on Python or MATLAB related to robotics and automation applications.

The following are some suggested mini-project titles suitable for SE Robotics and Automation Engineering students. Students may also propose and undertake a mini-project of their own choice, provided it is relevant to the Programming Lab and involves the application of Python and/or MATLAB in robotics and automation domains.

**Mini Project Titles**

1. **Sensor Data Monitoring and Visualization System**
   *Develop a program to simulate and visualize sensor data such as temperature or distance.*
2. **Line Following Robot Logic Simulation**
   *Implement logic for a line-following robot using Python or MATLAB.*
3. **Obstacle Detection and Decision-Making System**
   *Create a program to simulate obstacle detection using conditional logic.*
4. **Robot Path Planning Simulation**
   *Develop a simple path planning algorithm (straight line/grid-based movement).*
5. **Robot Trajectory Plotting using MATLAB**
   *Plot and analyze robot motion trajectories using MATLAB.*
6. **Automated Data Logging and Analysis System**
   *Create a program to store, analyze, and visualize robotic system data.*

**Text Books**

1. Reema Thareja – Python Programming Using Problem Solving Approach, Oxford
2. Stormy Attaway – MATLAB: A Practical Introduction to Programming and Problem Solving

**Reference Books**

1. Mark Lutz – Learning Python, O'Reilly
2. Sumitabha Das – UNIX Concepts and Applications

**MOOC / NPTEL Courses/Online Resources:**

**NPTEL Courses**

1. Programming in Python – NPTEL
2. MATLAB Programming for Numerical Computation – NPTEL

**MOOC / Online Resources**

1. **Coursera** – Python and MATLAB courses

**Useful Web Links**

1. **Python Software Foundation** – https://www.python.org
2. **MathWorks** – https://www.mathworks.com

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (HSSM)-I: Engineering Economics** | | | | | | | | | | **Course Code: 25HSM201A** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

1. Basic Mathematics
2. Basic Economics
3. General Engineering Knowledge

**Course Objectives:**

1. To develop a comprehensive understanding of the principles of engineering economics among students.
2. To equip students with analytical skills and knowledge required for evaluating engineering projects.
3. To build a fundamental understanding of accounting principles, financial analysis, and various funding strategies.
4. To enable students to understand market structures, pricing strategies, and the impact of government policies and economic factors.
5. To examine the role of engineers in industrialization and economic development.

**Course Outcomes:**

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

**CO1.** Apply engineering economic concepts such as cost analysis, time value of money, break-even analysis, and investment evaluation.

**CO2.** Use cost estimation techniques, evaluate asset depreciation, perform capital budgeting, and carry out replacement analysis.

**CO3.** Interpret financial statements, analyze financial ratios, evaluate different sources of finance, manage working capital, and perform project appraisal.

**CO4.** Analyze various market structures and pricing strategies, and assess the impact of government policies, taxation, and inflation on engineering projects.

**CO5.** Analyze emerging trends such as circular economy concepts and Industry 4.0 from an economic perspective.

**Course Contents**

| **Unit I** | **Introduction to Engineering Economics** | **06 Hours** |
|---|---|---|

Basic Concepts: Definition and importance of engineering economics, principles and applications in decision making, cost estimation, investment analysis, profitability assessment, resource optimization, risk management, comparison with traditional economics, and overview of microeconomics and macroeconomics.

Cost Concepts: Fixed, variable, marginal, sunk, and opportunity costs.

Time Value of Money: Present worth, future worth, annuities, and compounding techniques.

Break-even Analysis: Cost–volume–profit (CVP) analysis and contribution margin.

| Unit II | Cost Estimation and Capital Budgeting | 06 Hours |
|---|---|---|
| Cost Estimation Techniques: Direct and Indirect Costs, Overheads<br>Depreciation Methods: Straight Line, Declining Balance, and Sum of Years' Digits<br>Capital Budgeting: Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index Replacement Analysis: Economic Life and Useful Life of Equipment | | |
| **Unit III** | **Financial Management and Accounting** | **06 Hours** |
| Basic Accounting Principles: Balance Sheet, Profit and Loss Statement, Cash Flow<br>Financial Ratios: Liquidity, Profitability, and Solvency Ratios<br>Sources of Finance: Equity, Debt, Venture Capital, Working Capital Management<br>Project Appraisal: Feasibility Studies, Risk Analysis in Investment Decisions | | |
| **Unit IV** | **Market Structures and Economic Decision Making** | **06 Hours** |
| Market Structures: Perfect competition, monopoly, oligopoly, and monopolistic competition.<br>Pricing Strategies: Cost-based pricing, market-based pricing, penetration pricing, and skimming pricing.<br>Government Policies and Taxation: GST, income tax, corporate tax, and industrial incentives.<br>Inflation: Concept of inflation and its impact on engineering projects | | |
| **Unit V** | **Industrial Economics and Engineering Ethics** | **06 Hours** |
| Industrialization and Economic Development: Role of engineers in economic growth.<br>Public and Private Sector Enterprises: Comparison of public sector and private sector enterprises.<br>Engineering Ethics and Professionalism: Corporate social responsibility (CSR) and sustainable development.<br>Emerging Trends: Green economics, circular economy, Industry 4.0, and their economic impacts. | | |
| | **Total Hours** | **30** |

**Course Activities for Term Work evaluation:**

1. **Cost Estimation and Budgeting Exercise**
   Students prepare detailed cost estimates for a simple engineering product or project including material, labour, overhead, and profit calculations using practical data.
2. **Case Study on Engineering Economic Decisions**
   Students analyze real-life engineering projects related to investment decisions, cost control, depreciation, or resource allocation and present economic solutions.
3. **Capital Budgeting and Financial Analysis Activity**
   Students perform Payback Period, NPV, and IRR calculations for different investment alternatives using spreadsheets and interpret the results.
4. **Market Survey and Pricing Strategy Analysis**
   Students conduct a survey on pricing methods, market competition, and consumer demand for engineering products and prepare an analytical report.
5. **Mini Project on Industrial Economics and Sustainability**
   Students study an industry or startup and prepare a report on production systems, financial planning, CSR activities, green economics, or Industry 4.0 practices.

**Text Books**


1. Engineering Economics by R. Panneerselvam Publisher- PHI learning private limited
2. "Engineering Economy (16th Edition)" by William G. Sullivan & Elin M. Wicks
3. "Fundamentals of Engineering Economics (2nd Edition)" by Chan S. Park
4. "Principles of Engineering Economic Analysis" by John A. White, Kenneth E. Case, David B. Pratt

**Reference Books**

1. Principles of Engineering Economy by Eugene L. Grant
2. Engineering Economy: Analysis of Capital Expenditures by Gerald W. Smith
3. Applied Economic Analysis for Technologists, Engineers, and Managers by Michael S. Bowman
4. Engineering Economics for Capital Investment Analysis by Tung Au and Thomas P. Au
5. Schaum's Outline of Engineering Economics by Jose A. Sepulveda and William E. Souder

**MOOC / NPTEL Courses/Online Resources:**

1. Engineering Economic Analysis – NPTEL (IIT Roorkee) by Prof. Pradeep K. Jha: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me98
2. Project Management for Managers by By Prof. Mukesh Kumar Barua, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg71
3. Financial Accounting By Prof. Puran Singh, IIT Mandi: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg65
4. Introduction to Market Structures By Prof. Amarjyoti Mahanta, IIT Guwahati: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs84
5. Ethics in Engineering Practice By Prof. Susmita Mukhopadhyay, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg42

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (HSSM)-I: Entrepreneurship Development and IPR** | | | | | | | | | | **Course Code: 25HSM201B** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

1. Market study
2. Break even analysis
3. Profit loss
4. Accounting

**Course Objectives:**

1. To understand the concepts, role, and importance of entrepreneurship and innovation in economic and social development.
2. To identify and evaluate business opportunities, especially technology-based and sustainable ventures.
3. To develop entrepreneurial mindset, creativity, and problem-solving ability.
4. To understand startup ecosystem, government policies, IPR, funding, and incubation support.
5. To prepare a basic business plan incorporating ethical, financial, and sustainability considerations.

**Course Outcomes:**

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

**CO1.** Explain concepts of entrepreneurship, innovation, and their role in economic and societal development.

**CO2.** Identify entrepreneurial opportunities using creativity, design thinking, and market analysis tools.

**CO3.** Analyze feasibility of a business idea considering technical, financial, legal, and social aspects.

**CO4.** Apply knowledge of startup ecosystem, IPR, funding, and government initiatives to venture creation.

**CO5.** Develop and present a basic business plan demonstrating teamwork, communication, ethics, and lifelong learning attitude.

**Course Contents**

| **Unit I** | **Introduction to Entrepreneurship** | **06 Hours** |
|---|---|---|

Entrepreneurship: Definition, types, and characteristics, Entrepreneur vs Manager, Role of entrepreneurship in economic development, Innovation: Types and sources, Case studies of successful entrepreneurs (Indian & global).

| **Unit II** | **Creativity, Innovation & Opportunity Identification** | **06 Hours** |
|---|---|---|

Entrepreneurial mindset and creativity, Design Thinking for innovation, Idea generation techniques, Opportunity identification and screening, Market research and customer validation, Technology-based entrepreneurship.

| Unit III | Feasibility Analysis & Business Models | 06 Hours |
|---|---|---|
| Technical, market, and financial feasibility, Business Model Canvas (BMC), Costing, pricing, and break-even analysis, Risk analysis and mitigation, Ethics and sustainability in entrepreneurship. | | |
| **Unit IV** | **Startup Ecosystem, IPR & Funding** | **06 Hours** |
| Startup India initiative and government schemes (MSME, SIDBI, DPIIT), Incubation centers, accelerators, and angel networks, Basics of Intellectual Property Rights (Patents, Copyrights, Trademarks), Sources of funding: Bootstrapping, venture capital, crowdfunding, Legal aspects of starting a venture. | | |
| **Unit V** | **Business Plan Development & Entrepreneurial Skills** | **06 Hours** |
| Business plan preparation and structure, Team building and leadership, Communication and pitching skills.<br>Social entrepreneurship and sustainable startups, Future trends and lifelong learning for entrepreneurs. | | |
| | **Total Hours** | **30** |

**Course Activities for Term Work evaluation:**

1. **Business Idea Identification and Opportunity Analysis**
   Students identify innovative business ideas, analyze market opportunities, customer needs, and prepare a brief opportunity assessment report.
2. **Case Study on Successful Entrepreneurs and Startups**
   Students study successful entrepreneurs or startups and analyze their business models, innovation strategies, challenges, and growth factors.
3. **Business Model Canvas (BMC) Activity**
   Students prepare a Business Model Canvas for a startup idea covering value proposition, customer segments, revenue streams, and key resources.
4. **Mini Project on Startup Ecosystem and IPR**
   Students explore startup support systems such as MSME, Startup India, incubation centers, patents, trademarks, and funding schemes and prepare a report.
5. **Business Plan Presentation and Pitching Activity**
   Students develop and present a basic business plan including marketing, financial planning, costing, break-even analysis, and sustainability considerations.

**Text Books**

1. Vasant Desai – Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
2. S. S. Khanka – Entrepreneurial Development, S. Chand & Company.
3. Donald F. Kuratko – Entrepreneurship: Theory, Process and Practice, Cengage Learning.
4. Peter F. Drucker – Innovation and Entrepreneurship, Harper Business.

**Reference Books**

1. Osterwalder & Pigneur – Business Model Generation, Wiley.
2. Barringer & Ireland – Entrepreneurship: Successfully Launching New Ventures, Pearson.
3. Robert Hisrich et al. – Entrepreneurship, McGraw-Hill.

**MOOC / NPTEL Courses/Online Resources:**

1. NPTEL1, Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL2, Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ge08

3. NPTEL3, Innovation, Business Models and Entrepreneurship, By Prof. Rajat Agrawal, Prof. Vinay Sharma, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg63
4. NPTEL4, Patent Drafting for Beginners, By Prof. Feroz Ali IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_hs04
5. NPTEL5, Intellectual Property Rights and Competition Law, By Prof. KD Raju, Prof. Niharika Sahoo Bhattacharya, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg96

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (HSSM)-I: Project Management & Business Planning** | | | | | | | | | **Course Code: 25HSM201C** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

Basic understanding of management principles, Fundamental knowledge of engineering project work, Basic knowledge of economics and finance, Familiarity with planning and organizational concepts

**Course Objectives:**

1. To introduce the concepts and methodologies of project management in engineering and business sectors.
2. To develop skills for project planning, scheduling, monitoring, and control.
3. To understand financial and risk aspects associated with project management.
4. To provide knowledge about entrepreneurship and business planning.
5. To enable students to prepare and evaluate comprehensive business plans.

**Course Outcomes:**

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

**CO1.** Explain the fundamentals, life cycle, and organizational aspects of project management.

**CO2.** Apply project planning and scheduling techniques such as WBS, CPM, and PERT.

**CO3.** Analyze project costs, budgeting methods, and risk management strategies.

**CO4.** Identify business opportunities and develop feasible business models.

**CO5.** Prepare and evaluate a complete business plan for new ventures or engineering projects.

**Course Contents**

| **Unit I** | **Introduction to Project Management** | **06 Hours** |
|---|---|---|

Definition and characteristics of a project, Concept and importance of project management, Types of projects (engineering, infrastructure, IT, industrial), Project life cycle: initiation, planning, execution, monitoring, and closure, Project stakeholders and their roles, Project management knowledge areas, Role and responsibilities of a project manager, Organizational structures for project management (functional, matrix, projectized), Overview of project management tools and techniques.

| **Unit II** | **Project Planning and Scheduling** | **06 Hours** |
|---|---|---|

Project planning process, Work Breakdown Structure (WBS) and task identification, Activity sequencing and dependency relationships, Project scheduling techniques, Gantt charts and milestone charts, Network diagrams and project network analysis, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Resource allocation and resource levelling, Project scheduling software tools overview.

| **Unit III** | **Project Cost & Risk Management** | **06 Hours** |
|---|---|---|

Project cost estimation techniques, Budget preparation and financial planning, Project financing and funding sources, Cost control and cost performance monitoring, Earned Value Management (EVM) concept, Risk identification and classification, Risk assessment and analysis methods, Risk

mitigation and contingency planning, Quality management in projects, Project monitoring, evaluation, and control techniques.

| Unit IV | Business Planning and Entrepreneurship | 06 Hours |
|---|---|---|

Introduction to entrepreneurship and innovation, Characteristics of successful entrepreneurs, Identification of business opportunities, Business idea generation and screening, Feasibility analysis (technical, economic, market feasibility), Market research and demand analysis, Product and service planning, Business model development, Legal requirements and regulatory framework for starting a business.

| Unit V | Business Plan Preparation and Evaluation | 06 Hours |
|---|---|---|

Structure and components of a business plan, Executive summary preparation, Marketing plan and competitive analysis, Operations and production planning, financial planning (cost, revenue, profit projections), Break-even analysis and financial feasibility, Funding sources and venture capital, Business plan presentation and pitching, Evaluation of business proposals, Case studies of successful startups and business ventures.

| | Total Hours | 30 |
|---|---|---|

**Course Activities for Term Work evaluation:**

1. **Project Planning and Scheduling Activity**
   Students prepare a Work Breakdown Structure (WBS), Gantt chart, network diagram, and project schedule for a small engineering or business project using practical examples.
2. **Case Study on Project Management and Risk Analysis**
   Students analyze real-life engineering or business projects focusing on project planning, cost estimation, risk management, delays, and corrective actions.
3. **Hands-on Activity using Project Management Tools**
   Students use project planning tools/software to perform CPM, PERT, resource allocation, scheduling, and project tracking activities.
4. **Business Plan Development and Presentation**
   Students prepare and present a business plan including market analysis, feasibility study, budgeting, marketing strategy, and financial projections.
5. **Mini Project on Entrepreneurship and Business Feasibility**
   Students identify a startup/business idea and conduct feasibility analysis covering technical, economic, operational, and financial aspects.

**Text Books**

1. Project Management: A Managerial Approach – Jack R. Meredith, Samuel J. Mantel Jr., Scott M. Shafer, John Wiley & Sons, 9th / 10th / 11th Edition,
2. Project Management in Practice –Jack R. Meredith, Samuel J. Mantel Jr., Scott M. Shafer, Margaret M. Sutton, John Wiley & Sons,6th / 7th Edition, Year: 2020

**Reference Books**

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling –: Harold Kerzner. Publisher: John Wiley & Sons,12th Edition, 2017.
2. Operations Management – William J. Stevenson, Publisher: McGraw Hill Education, Edition: 13th Edition.
3. Business Plan Preparation: Entrepreneurship Development –, S. S. Khanka Publisher: S. Chand Publishing.
4. Entrepreneurship Development and Small Business Enterprises –: Poornima M. Charantimath Publisher: Pearson Education

| **MOOC / NPTEL Courses/Online Resources:** |
| --- |
| 1. Introduction to Project Management: Principles & Practices By Dr. Nimisha Singh, Quality Council of India: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg80<br>2. Business Planning and Project Management by Dr. Ravi Ahuja, SPPU, Pune: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec23_mg06<br>3. Project Management By Prof. Ramesh Anbanandam, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg01<br>4. Project Management: Planning, Execution, Evaluation and Control by By Prof. Sanjib Chowdhury, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_mg78<br>5. Project Planning & Control, By Prof. Koshy Varghese, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ce91 |

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (HSSM)-I: Financial Management for Engineers** | | | | | | | | | | **Course Code: 25HSM201D** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

1. Basic knowledge of Engineering Mathematics
2. Fundamentals of Economics and Accounting
3. Analytical and quantitative reasoning skills

**Course Objectives:**

1. To introduce the principles and scope of financial management for engineering professionals.
2. To enable students to interpret and analyze financial statements.
3. To develop ability to evaluate engineering investments using capital budgeting techniques.
4. To understand cost of capital and financing decisions in organizations.
5. To apply financial tools for techno economic evaluation of engineering projects.

**Course Outcomes:**

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

**CO1.** Understand fundamental concepts of financial management and its role in engineering organizations.

**CO2.** Analyze financial statements and evaluate financial performance.

**CO3.** Apply capital budgeting methods for evaluating engineering investment decisions.

**CO4.** Evaluate cost of capital and capital structure decisions.

**CO5.** Apply working capital and financial planning concepts for engineering projects.

**Course Contents**

| **Unit I** | **Introduction to Financial Management** | **06 Hours** |
|---|---|---|

Role and scope of financial management in engineering organizations
Financial environment, financial markets and institutions
Time value of money: present value, future value, annuity concepts
Financial statements: balance sheet, income statement and cash flow statement
Ratio analysis and financial performance indicators

| **Unit II** | **Cost of Capital and Capital Structure** | **06 Hours** |
|---|---|---|

Concept and importance of cost of capital
Cost of debt, equity and preference capital
Weighted average cost of capital (WACC)
Capital structure theories: Net income approach, Net operating income approach, Modigliani–Miller theory
Leverage analysis: operating leverage, financial leverage and combined leverage

| **Unit III** | **Capital Budgeting** | **06 Hours** |
|---|---|---|

Nature and significance of capital budgeting
Cash flow estimation for engineering projects
Investment evaluation methods: Payback period, accounting rate of return

Discounted cash flow methods: Net present value (NPV), Internal rate of return (IRR), Profitability index. Risk and uncertainty in capital budgeting

| **Unit IV** | **Working Capital Management** | **06 Hours** |
|---|---|---|

Concept and importance of working capital
Operating cycle and cash conversion cycle
Management of cash, receivables and inventory
Short term financing sources
Working capital policies and risk–return trade off

| **Unit V** | **Financial Decision Making in Engineering Projects** | **06 Hours** |
|---|---|---|

Techno economic feasibility analysis
Project financing and financial planning
Budgeting and cost control techniques
Break even analysis and sensitivity analysis
Introduction to financial modelling using spreadsheets

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

**Course Activities for Term Work evaluation:**

1. **Financial Statement Analysis Activity**
   Students analyze balance sheets, income statements, and cash flow statements of companies and interpret financial performance using ratio analysis.
2. **Case Study on Capital Budgeting Decisions**
   Students evaluate engineering investment projects using Payback Period, NPV, IRR, and Profitability Index methods and recommend suitable decisions.
3. **Hands-on Activity using Financial Spreadsheet Tools**
   Students perform budgeting, break-even analysis, sensitivity analysis, and financial modelling using spreadsheet software.
4. **Mini Project on Working Capital Management**
   Students study working capital practices of an industry or business and prepare a report on inventory, receivables, cash management, and short-term financing.
5. **Presentation on Financial Decision Making in Engineering Projects**
   Students prepare and present techno-economic feasibility analysis, project financing methods, cost control strategies, and risk-return evaluation for engineering projects.

**Text Books**


1. Prasanna Chandra – Financial Management: Theory and Practice, McGraw Hill.
2. I. M. Pandey – Financial Management, Vikas Publishing.
3. Eugene F. Brigham and Michael C. Ehrhardt – Financial Management: Theory & Practice, Cengage Learning.


**Reference Books**


1. Brealey, Myers and Allen – Principles of Corporate Finance, McGraw Hill.
2. Van Horne & Wachowicz – Fundamentals of Financial Management, Pearson.
3. Jonathan Berk and Peter DeMarzo – Corporate Finance, Pearson.
4. Ross, Westerfield and Jordan – Fundamentals of Corporate Finance, McGraw Hill.


**MOOC / NPTEL Courses/Online Resources:**

1. Financial Management for Managers by Prof. Anil K. Sharma, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg31
2. Corporate Finance by Prof. Abhijeet Chandra, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg93
3. Foundations of Accounting & Finance By Prof. Arun Kumar Gopalaswamy, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_ec01
4. Working Capital Management By Prof. Anil K. Sharma, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_mg40
5. Engineering Economic Analysis By Prof. Pradeep Kumar Jha, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_me98

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| **Semester- III** | | | | | | | | | | | | | |
| **Course Name (VEC):**<br>**Universal Human Values** | | | | | | | | | | **Course Code:**<br>**25VEC201** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

The course requires openness to self-reflection and willingness to understand ethical and value-based perspectives in personal and professional life.

**Course Objectives:**

1. To help students understand the importance of human values in personal & professional life.
2. To develop ethical awareness and responsible decision-making.
3. To create harmony between individual, society, and nature.
4. To encourage engineers to contribute towards sustainable and value-based development.

**Course Outcomes:**

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

**CO1.** Explain the concept of human values and self-exploration, and recognize their importance in personal life, professional life, and the role of engineers in society.

**CO2.** Understand the importance of sustainable development, environmental responsibility, and ecological balance, and evaluate the impact of technology on society and nature.

**CO3.** Apply values such as trust, respect, empathy, and responsibility to maintain harmony in family and society and practice ethical behavior in social interactions.

**CO4.** Demonstrate professional ethics, value-based decision making, leadership, and teamwork in engineering practice for the welfare of society.

**CO5.** Understand the relationship between self and body, differentiate their needs, and develop self-awareness and balanced lifestyle practices for personal well-being.

**Course Contents**

| **Unit I** | **Introduction to Human Values** | **06 Hours** |
|---|---|---|

Meaning and importance of human values, Basic needs of values, need for value based education in Engineering, Types of Human Values, Importance of human values to full fill happy and successful life, Values in personal life and professional life,, Factors affecting human values- Cultural, societal factors, personal factors , experiences, Concept of self-exploration, How to cultivate both values and skill in person's life that navigate him to face life's challenges and opportunities, Role of Engineer in society. Technology and values.

| **Unit II** | **Harmony in Nature** | **06 Hours** |
|---|---|---|

Understanding of harmony in Nature, Four orders of nature, Physical, Bio, Animal, Human order, interconnectedness and mutual fulfilment among four orders. Basic characteristic of nature, perseverance, bravery, Generosity, recyclability and self-regulation in nature, Holistic perception of harmony at all levels of existence, human being as a cause of imbalance in nature-pollution, depletion of resources, and role of technology in nature. Understanding existence of human being as a co-existence of mutually interacting units -in all pervasive space. Sustainable development,

Environmental responsibility, Resource conservation, Ecological balance, Technology and its impact on society.

| **Unit III** | **Harmony in Family and Society** | **06 Hours** |
|---|---|---|

Family as the basic unit of society: role of family in developing values, mutual understanding, and responsibility. Values in relationships: trust, respect, affection, care, guidance, and gratitude in maintaining harmony in family and society. Ethical behavior in society: honesty, responsibility, empathy, cooperation, and respect for diversity in social interactions. Social harmony and responsible citizenship: duties and responsibilities of individuals towards society and community. Professional ethics and social responsibility: role of engineers and professionals in promoting ethical practices and sustainable development. Role of values in building a harmonious society: importance of value-based decision making in personal, social, and professional life.

| **Unit IV** | **Holistic Development and Professional Ethics** | **06 Hours** |
|---|---|---|

Holistic approach to life and education: integration of intellectual, emotional, ethical, and social development for balanced personal and professional growth. Human values and ethical principles: understanding honesty, integrity, empathy, responsibility, and respect in personal and social life. Professional ethics: ethical conduct in professional practice, integrity in work, accountability, and commitment to societal welfare. Ethical decision making: identifying ethical dilemmas and applying value-based reasoning in professional situations. Social and environmental responsibility of professionals: contribution of engineers and professionals towards sustainable development and societal well-being. Role of values in leadership and teamwork: importance of trust, cooperation, and ethical behaviour in professional environments.

| **Unit V** | **Harmony Between Self and Body** | **06 Hours** |
|---|---|---|

Understanding the Self and the Body: distinction between the conscious self (I) and the physical body. Self–body coexistence: relationship between the self as the experiencer and the body as the instrument of action. Needs of the self and the body: physical needs (food, rest, health) and psychological needs (happiness, values, purpose). Harmony in the individual: maintaining balance between mental well-being and physical health through responsible living. Role of self-awareness and self-regulation: understanding thoughts, emotions, and behavior for a balanced life. Importance of healthy lifestyle: discipline, proper habits, and value-based living for overall well-being.

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

**Activities for term work Evaluation:**

1. Group Discussion on Human Values and Ethics
2. Case Study Analysis on Ethical Issues in Society and Profession
3. Reflective Journal Writing on Self-Development and Values
4. Role Play / Skit on Social Responsibility and Moral Values
5. Poster Presentation on Environmental Awareness and Sustainability
6. Debate on Contemporary Ethical and Social Issues
7. Community Service / Social Outreach Activity Report
8. Seminar / Presentation on Professional Ethics and Leadership
9. Essay Writing on Family Values, Harmony, and Responsibility
10. Participation in Workshops, Expert Talks, and Value-Based Activities

**Text Books**


1. R. R. Gaur, R. Sangal, and G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi.
2. R. R. Gaur, R. Sangal, and G. P. Bagaria, Universal Human Values – Understanding Harmony AICTE / Excel Books.


**Reference Books**


1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering McGraw Hill.

2. Charles B. Fleddermann, Engineering Ethics Pearson.

**Online References**

1. Exploring Human Values – Visions of Happiness & Perfect Society- A. K. Sharma, IIT Kanpur
2. Moral Thinking – An Introduction to Values and Ethics: Prof. Vineet Sahu, IIT Kanpur

**MOOC / NPTEL Courses**

1. Human values and Professional Ethics, By Dr. Kounsar Jan, Deptt of education University of Kashmir
   https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg125
2. Moral Thinking – An Introduction to Values and Ethics by Prof. Vineet Sahu, IIT Kanpur
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs169

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- III** | | | | | | | | | | | | | |
| **Course Name:**<br>**Community Engagement Project** | | | | | | | | | | **Course Code:**<br>**25RAELC201** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. It is an experiential learning approach that combines community service, community development, education and learning.
2. Project involves students in community development and service activities and applies the experience to personal and academic development.
3. The targeted contribution of college students to the village/local development will benefit the community.

**Course Objectives:**

1. Establish a mutually beneficial relationship between the college and the community.
2. Opportunities to engage with their local community, fostering empathy, teamwork, and problem- solving skills while contributing positively to their surroundings.
3. An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
4. The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
5. The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact.

**Course Outcomes:**

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

**CO1.** Identify and analyze local community needs and challenges by engaging with stake- holders and evaluating real-world problems.

**CO2.** Design and implement practical, creative, and context-specific solutions using engineering principles to address community issues.

**CO3.** Reflect and evaluate the effectiveness of their interventions and articulate lessons learned through reports and presentations.

**Guidelines:**

1. A group of 3 to 4 students or a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
2. Each group is allotted to a faculty member of the department as a mentor.
3. The group of students will be associated with a government official / village authorities /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
4. The Community Engagement Project should be different from the regular programmes of NSS/NC- C/Green Club/Hobby Clubs, Special Interests Groups etc.
5. An activity book has to be maintained by each of the students to record the activities undertak-en/involved and will be countersigned by the concerned mentor/HoD.
6. Project report shall be submitted by each student/group of students.

7. An internal evaluation shall also be conducted by a committee constituted by the HoD.
8. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
9. Students' groups can conduct an awareness programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e-waste management or any other activity in an area of their studies and as per his/her aptitude.

**List of Topics**

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall.

- Use and/or miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programmes
- Horticulture Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection
- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Organic farming, IoT implementations
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels
- Chemicals in daily life
- Music and dance
- Women education and empowerment

**Project Scope**

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustainability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community

**Text Books**


1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.


**Online References**

**MOOC / NPTEL/YouTube Links:**

NPTEL course: Ecology and Society
https://onlinecourses.nptel.ac.in/noc20_hs77/preview

**Web Links:**

1. UNESCO: Education for Sustainable Development https://www.unesco.org
2. EPICS (Engineering Projects in Community Service) https://engineering.purdue.edu/EPICS
3. Ashoka: Innovators for the Public https://www.ashoka.org
4. Design for Change https://www.dfcworld.com

# S.Y.B. Tech. Robotics and Automation Engineering

# (2025 Pattern)

## Curriculum Structure: Semester IV

(With effect from Academic Year 2026-27)

## S.Y.B. Tech. Robotics and Automation Engineering (2025 Pattern)

### Curriculum Structure: Semester IV

| Course Category | Course Code | Course Name | Hrs/Week | | | Examination Scheme and Marks | | | | | | | Credits | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | P | T | CCA | ISE | ESE | PR | OR | TW | Total | L | P | T | Total |
| PCC | 25RAPCC204 | Design of Machine Elements | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC205 | Control Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| | 25RAPCC206 | Hydraulic and Pneumatic Systems | 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 03 |
| *MDM* | *25AIMDM202E* | *Multidisciplinary Minor-II* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| *OEC* | *25OEC202* | *Open Elective Course-II* | 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 02 |
| PCC(L) | 25RATPCC204L | Design of Machine Elements Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCCC205L | Control Systems Lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| PCC(L) | 25RAPCC206L | Hydraulic and Pneumatic Systems Lab | - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 01 |
| VSEC | 25RAVSE202 | Computer Aided Design Lab | - | 2 | - | - | - | - | 25 | - | - | 25 | - | 1 | - | 01 |
| *ACE* | *25AEC201* | *Modern Indian Language (MIL)* | 2 | - | - | - | - | - | - | 25 | 25 | 50 | 2 | - | - | 02 |
| *HSSM* | *25HSM202* | *Entrepreneurship/Economics/ Management Course-II* | - | - | 2 | - | - | - | - | - | 50 | 50 | - | - | 2 | 02 |
| VEC | 25VEC202 | Indian Constitution and Governance | - | - | 1 | - | - | - | - | - | 25 | 25 | - | - | 1 | 01 |
| | **Total** | | **15** | **08** | **03** | **100** | **150** | **250** | **50** | **75** | **100** | **725** | **15** | **04** | **03** | **22** |

**Multidisciplinary Minor-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AIMDM202E | Fundamentals of Data Structure |

**Open Elective-II:**

| Basket No. | Sr. No. | Course Code | Course Name |
|---|---|---|---|
| 1 | 1 | 25OEC202A | Leadership and Team Dynamics |
| 2 | 2 | 25OEC202B | Green Practices and ESG Frameworks |
| 3 | 3 | 25OEC202C | Innovation and Business Strategy |
| 4 | 4 | 25OEC202D | Stress Management and Mental Well-Being |
| 5 (A) | 5 | 25OEC202E | French Language Module-II |
| 5 (B) | 6 | 25OEC202F | German Language Module-II |
| 5 (C) | 7 | 25OEC202G | Japanese Language Module-II |

**Vocational and Skill Enhancement Course-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25RAVSE202 | Computer Aided Design Lab |

**Entrepreneurship/Economics/Management Courses (HSSM)-II:**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25HSM202A | Business Fundamentals for Entrepreneurs |
| 2 | 25HSM202B | Entrepreneurship and Start-ups |
| 3 | 25HSM202C | Fundamentals of Accounting and Finance |
| 4 | 25HSM202D | Business Intelligence and Analytics |

**Modern Indian Language (MIL)**

| Sr. No. | Course Code | Course Name |
|---|---|---|
| 1 | 25AEC201A | Marathi |
| 2 | 25AEC201B | Sanskrit |

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC):**<br>**Design of Machine Elements** | | | | | | | | | | **Course Code:**<br>**25RAPCC204** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

1. Engineering Mathematics
2. Strength of Materials
3. Engineering Mechanics
4. Engineering Graphics
5. Engineering Workshop

**Course Objectives:**

1. To understand the basic principles, design procedure, standards, factor of safety, and failure theories used in the design of simple machine elements.
2. To study the design principles of shafts, keys, and couplings used in mechanical power transmission systems.
3. To understand the working principles, terminology, and design considerations of power screw mechanisms used in lifting and positioning devices.
4. To study different types of springs, their materials, terminology, and the design procedure of helical springs.
5. To understand the fundamentals of gear design, force analysis on gear teeth, and the classification and selection of bearings.

**Course Outcomes:**

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

**CO1.** Students will be able to apply machine design principles and failure theories to design simple machine components such as cotter joints and knuckle joints. (CO1 – K2/K3)

**CO2.** Students will be able to design shafts, keys, and rigid couplings based on strength, torsional rigidity, and standard design practices. (CO2 – K3)

**CO3.** Students will be able to analyze torque, efficiency, and stresses in power screws and design mechanisms such as screw jacks and ball screw systems. CO3 – K3/K4

**CO4.** Students will be able to analyze stresses, deflection, and design helical springs for specified load and deflection requirements. (CO4 – K3/K4)

**CO5.** Students will be able to analyze spur gear tooth strength using Lewis equation and select appropriate bearings based on load and operating conditions. (CO5 – K3/K4).

**Course Contents**

| **Unit I** | **Introduction to Machine Design** | **08 Hours** |
|---|---|---|

Machine Design, Basic procedure of Machine Design, Requisites of design engineer, Use of standards in design, Factor of safety, Selection of Preferred Sizes, Theories of Failures, Design of simple machine parts, Socket and Spigot cotter joint, knuckle joint.

| **Unit II** | **Design of Shafts, Keys and Couplings** | **08 Hours** |
|---|---|---|

Introduction to Shafts, Design of shaft based on strength and torsional rigidity basis, Design of Shaft as per ASME Code, Introduction to Keys and its types, Design of rectangular/square key, Introduction to Couplings and its classification, Design of Rigid Couplings (Muff and Flange).

| **Unit III** | **Design of Power Screw** | **08 Hours** |
|---|---|---|

Introduction to Power Screw, Forms of Threads, Single start and Multiple start threads, Terminology of Power Screw, Torque Equations, Self-locking and Overhauling concept, Efficiency of Square Threaded Screw, Stresses in power screws, Design of Screw Jack, Recirculating Ball Screw Mechanism.

| **Unit IV** | **Design of Springs** | **08 Hours** |
|---|---|---|

Introduction to Springs, Types of Spring, Terminology of Helical Springs, Styles of End, Stress and Deflection equations, Series and Parallel connections, Spring Materials, Design of Helical Springs.

| **Unit V** | **Design of Gears and Bearings** | **08 Hours** |
|---|---|---|

Introduction to Gear Design: Basic terminology: pitch circle, module, pressure angle, addendum, addendum, Detailed Analysis of Spur Gears, Force analysis on gear teeth (tangential and radial forces), Lewis equation for gear tooth strength, Types of Gears.
Introduction to Bearings: Classification: sliding/contact bearings and rolling element bearings, Bearing selection criteria: load, speed, temperature, alignment, Static and dynamic load carrying capacities, Lubrication and maintenance for enhanced life.

| | **Total Hours** | **40** |
|---|---|---|

**Course Activities for Continuous Comprehensive Assessment (CCA):**
*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Case Study Analysis**
   Student has to select real life example to design the components like, joints, shaft, keys and coupling. Using the concept of factor of safety and preferred sizes.
2. **Industrial Problem-Solving Activity**
   Design industrial conveyors drive shaft and flange coupling to safely transmit torque using ASME code guidelines, and size its pneumatic belt- tensioner frame using a standardized knuckle joint under a load.

| **CCA2** | **10 Marks** |
|---|---|

3. **Poster Presentation**
   Create a technical poster analyzing lift mechanism driven by a self-locking square-threaded power screw, supported by a spring-damper suspension, bearing and driven by a compact spur gear motor.
4. **Technical Presentation**
   Present a technical design system using lifting screws, the springs, bearings and the reliability of its gear-driven motor drive.
5. **Design & Simulation Project**
   Model and simulate a machine using Recirculating Ball Screw, supported by a heavy-duty helical spring connection, and driven by a robust spur gear transmission.

**Text Books**

1. Budynas, R. G. and Nisbett, J. K., Shigley's Mechanical Engineering Design, 11th Edition, McGraw-Hill Education, 2020.

2. Bhandari, V. B., Design of Machine Elements, 4th Edition, McGraw-Hill Education India.
3. Spotts, M. F., Shoup, T. E., and Hornberger, L. E., Design of Machine Elements, 8th Edition, Pearson Education

**Reference Books**

1. Orthewein, W. C., Machine Component Design, Jaico Publishing House.
2. Juvinall, R. C. and Marshek, K. M., Fundamentals of Machine Component Design, 6th Edition, Wiley India.
3. PSG College of Technology, PSG Design Data Book, Latest Edition, Coimbatore.
4. Black, P. H. and Adams, O. E., Machine Design, 3rd Edition, McGraw-Hill.

**Online References**

MOOC / NPTEL Courses:

1. Design of Machine Elements I, IIT Kharagpur, Prof. G. Chakraborty, Prof. S.K. Roychowdhury, Prof. B. Maiti
   https://nptel.ac.in/courses/112105124
2. Gear And Gear Unit Design: Theory And Practice, By Prof. Rathindranath Maiti|IIT Kharagpur
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me37

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC): Control Systems** | | | | | | | | | **Course Code: 25RAPCC205** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

1. Engineering Mathematics
2. Basic Electronics.

**Course Objectives:**

1. To understand fundamental concepts and develop mathematical models of control systems.
2. To analyze time response characteristics of control systems.
3. To study stability of control systems using analytical methods.
4. To understand frequency domain analysis of control systems.
5. To introduce basic control system design techniques for robotics applications.

**Course Outcomes:**

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

**CO1.** Model physical systems and obtain their transfer functions.
**CO2.** Evaluate system performance using time response specifications and steady-state errors.
**CO3.** Determine system stability using Routh criterion and root locus techniques.
**CO4.** Analyze system stability using Bode plots and Nyquist criterion.
**CO5.** Apply control design concepts to improve system performance in robotics applications.

**Course Contents**

| **Unit I** | **Basics of Control Systems and Mathematical Modeling** | **08 Hours** |
|---|---|---|

Introduction to Control Systems, Open-loop and Closed-loop Control Systems, Effect of Feedback on System Performance, Mathematical Modelling of Physical Systems: Mechanical Systems (Translational & Rotational), Electrical Systems, Analogous Systems (Force-Voltage & Force-Current analogy), Transfer Function Concept.

| **Unit II** | **Time Response Analysis** | **08 Hours** |
|---|---|---|

Standard Test Signals (Step, Ramp, Impulse),Time Response of First Order Systems, Time Response of Second Order Systems, Time Domain Specifications: Rise Time, Peak Time, Settling Time, Overshoot, Steady State Errors and Error Constants, Introduction to Controllers, PI, PD, PID Controllers (Concept only).

| **Unit III** | **Stability Analysis** | **08 Hours** |
|---|---|---|

Concept of Stability (Absolute & Relative Stability), Necessary Conditions for Stability, Routh-Hurwitz Stability Criterion, Relative Stability using Routh Table, Introduction to Root Locus Technique, Construction of Root Locus, Effect of Pole-Zero Locations on System Behaviour

| **Unit IV** | **Frequency Response and Stability** | **08 Hours** |
|---|---|---|

Frequency Response Concept, Correlation between Time and Frequency Response, Bode Plot (Magnitude and Phase), Gain Margin and Phase Margin, Introduction to Nyquist Stability Criterion, Concept of Lead, Lag, and Lead-Lag Compensation.

| **Unit V** | **Control System Design Concepts for Robotics** | **08 Hours** |
|---|---|---|

Introduction to System Design Approaches, Performance Criteria for Control Systems (Stability, Accuracy, Speed), Basic Design using Root Locus (Conceptual), Basic Design using Bode Plot (Conceptual), Introduction to Compensation Techniques: Phase Lead Compensation, Phase Lag Compensation, Applications in Robotics: Position Control Systems, Speed Control Systems, Servo Systems.

| | |
|---|---|
| **Total Hours** | **40** |

**Course Activities for Continuous Comprehensive Assessment (CCA):**
*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Modeling and Time Response Analysis:**
   Students develop the mathematical model and transfer function of a given control system and analyze its step response to determine time-domain specifications such as rise time, settling time, peak time, and overshoot.
2. **Control System Case Study:**
   Students study a real-life control system (e.g., cruise control, robotic arm, temperature control), identify its feedback mechanism, develop a block diagram, and evaluate its response characteristics

| **CCA2** | **10 Marks** |
|---|---|

3. **Stability and Control System Design:**
   Students analyze the stability of a given control system using Routh-Hurwitz criterion, study frequency response characteristics, and suggest suitable compensation techniques for improved performance.
4. **Root Locus and Bode Plot Analysis:**
   Students construct and interpret root locus and Bode plots of a given system and assess its stability and performance for control system design.
5. **Frequency Response and Compensation Study:**
   Students compare Lead, Lag, and Lead-Lag compensators using frequency response analysis and recommend the most suitable compensation technique for a given application.

**Text Books**


1. Katsuhiko Ogata, Modern Control Engineering, 5th Edition, PHI Learning Private Limited, New Delhi.
2. I.J. Nagrath, M. Gopal, Control Systems Engineering, 7th Edition, New Age International Publishers, New Delhi, 2020.


**Reference Books**


1. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, PHI Private Limited, New Delhi, 2011.
2. Richard C. Dorf, Robert N. Bishop, Modern Control Systems, 13th Edition, Pearson / Addison Wesley
3. B.C. Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, New York.


**Online References**

NPTEL: Control Systems, IIT Madras
https://nptel.ac.in/courses/107106081

| S.Y.B. Tech. Robotics and Automation Engineering | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC):**<br>**Hydraulic and Pneumatic Systems** | | | | | | | | | **Course Code:**<br>**25RAPCC206** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 3 | - | - | 20 | 30 | 50 | - | - | - | 100 | 3 | - | - | 3 |

**Prerequisite:**

Engineering Physics, Engineering Mechanics, Basic Electrical Engineering

**Course Objectives:**

1. To introduce fundamental concepts, governing laws, and working mediums in hydraulic and pneumatic systems.
2. To explain construction and working of pumps, actuators, and motors used in fluid power systems.
3. To describe the function and operation of different types of valves used for control and regulation.
4. To develop an understanding of designing, analyzing, and simulating hydraulic circuits for various applications.
5. To familiarize students with practical applications, maintenance practices, and safety protocols in fluid power systems.

**Course Outcomes:**

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

**CO1.** Explain the principles, structure, and benefits of hydraulic and pneumatic systems.

**CO2.** Compare and classify pumps, actuators, and motors used in hydraulic systems.

**CO3.** Select and explain various control valves based on system requirements.

**CO4.** Design and analyze basic fluid power circuits used in automation and robotics.

**CO5.** Evaluate and troubleshoot fluid power systems for safe and efficient operations.

**Course Contents**

| **Unit I** | **Introduction to Fluid Power** | **08 Hours** |
|---|---|---|

Introduction of hydraulic and pneumatic systems: structure, applications, advantages, limitations Governing laws: Pascal's law, Bernoulli's principle, continuity equation (overview only) Hydraulic fluids and their properties, fluid conditioning, filters, coolers Pneumatics: working medium, FRL unit, characteristics of compressed air.

| **Unit II** | **Hydraulic Pumps** | **08 Hours** |
|---|---|---|

Introduction to Hydraulic Pumps, Principle of Operation, Types of Hydraulic Pumps, Gear, Vane pump, Pumping theory of positive displacement pumps.

| **Unit III** | **Hydraulic Valves and Control Components** | **08 Hours** |
|---|---|---|

Introduction and Classification of valves: symbols and standards Directional control valves (DCVs): poppet, sliding spool, Solenoid and pilot-operated DCVs, check valves, shuttle valves Pressure control valves: relief, sequence, unloading, reducing Flow control valves: needle, throttle, compensated and non-compensated types.

| **Unit IV** | **Actuators and Motors** | **08 Hours** |
|---|---|---|

Introduction and Classification of actuators, Hydraulic cylinders: single-acting and double-acting, construction, mounting Hydraulic motors: types (gear, vane, radial piston), characteristics, selection criteria Pneumatic actuators: single-acting, double-acting, diaphragm and rotary actuators.

| **Unit V** | **Hydraulic & Pneumatic Automation System** | **08 Hours** |
|---|---|---|

Introduction to electro hydraulic & electro pneumatic system, Basic circuits: control of single and double-acting cylinders, Regenerative circuits Sequencing, counterbalance, and speed control circuits. Accumulators: types, working, applications with circuits Intensifier: function and application.

| | **Total Hours** | **40** |
|---|---|---|

**Course Activities for Continuous Comprehensive Assessment (CCA):**
*Students are required to complete any one activity from CCA 1 and CCA 2 respectively.*

| **CCA1** | **10 Marks** |
|---|---|

1. **Problem-Based Learning (PBL)**
   Selection of hydraulic system for an industrial application with pump selection and justification
2. **Mini Project**
   Develop a working/CAD model demonstrating hydraulic or pneumatic principles.
3. **Technical Poster & Presentation**
   Comparative analysis of hydraulic and pneumatic systems.

| **CCA2** | **10 Marks** |
|---|---|

4. **Technical Seminar**
   Topics on electro-hydraulic systems, smart pneumatics system
5. **Integrated Case Study Analysis**
   Analyze an industrial hydraulic/pneumatic automation system covering valves, actuators, motors and automation circuits.
6. **Literature Review**
   Students review research paper related to hydraulic and pneumatics and make a report

**Text Books**


1. S.R. Mujumdar, Pneumatic Systems, Tata McGraw Hill, 2002 Edition, ISBN: 9780074602317
2. Anthony Esposito, Fluid Power with Applications, Pearson Education, ISBN: 9788177585803
3. Peter Rohner, Industrial Hydraulic Control, Hydraulic Supermarket, 2005, ISBN: 9780958149310


**Reference Books**


1. Fluid Power: Generation, Transmission and Control, Wiley, 2018, ISBN: 9788126539543
2. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education (Singapore) Pvt. Ltd., ISBN: 8178083396
3. Andrew Parr, Hydraulics and Pneumatics: A Technician's and Engineer's Guide, Elsevier
4. M. Galal Rabie, Fluid Power Engineering, McGraw Hill


**Online References**

1. Oil Hydraulics and Pneumatics – NPTEL, Instructor: Prof. S. Somashekhar, IIT Madras, https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me28
2. Fundamentals of Industrial Oil Hydraulics and Pneumatics by Prof. R. N. Maiti, IIT Kharagpur https://nptel.ac.in/courses/112105047
3. Principles of Hydraulic Machines and System Design by Prof. Pranab K. Mondal, IIT Guwahati. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me98

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (MDM-II): Fundamentals of Data Structure** | | | | | | | | | **Course Code: 25AIMDM202E** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

1. Programming and Problem Solving
2. Object Oriented Programming

**Course Objectives:**

1. To understand the standard and abstract data representation methods.
2. To understand various data searching and sorting methods.
3. To understand various algorithmic strategies to approach the problem solution.
4. To build problem-solving skills by applying appropriate algorithm.

**Course Outcomes:**

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

**CO1.** Design the algorithms to solve the programming problems, identify appropriate algorithmic strategy for specific application, and analyze the time and space complexity.

**CO2.** Understand use of sequential data structures- Array to store and process data.

**CO3.** Understand the fundamental concepts of searching techniques

**CO4.** Understand the computational efficiency of the principal algorithms for sorting and choose the most efficient one for the application.

**CO5.** Compare and contrast different implementations of data structures (dynamic and static).

**Course Contents**

| **Unit I** | **Introduction to Algorithm Data Structures** | **06 Hours** |
|---|---|---|

Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart. Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method.

Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types, Data Structures Types (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures)

| **Unit II** | **Linear Data Structures Using Sequential Organization** | **06 Hours** |
|---|---|---|

Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Two-dimensional arrays.

| **Unit III** | **Searching** | **06 Hours** |
|---|---|---|

Searching: Search Techniques-Sequential Search/Linear Search, Binary Search (recursive and non-recursive) Fibonacci Search, Space complexity, Time complexity of each technique.

| **Unit IV** | **Sorting** | **06 Hours** |
|---|---|---|

Sorting: Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort.

| **Unit V** | **Linear Data Structure Using Link List** | **06 Hours** |
|---|---|---|

Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management operations, Linked List as ADT, Types of Linked List: Singly linked, linear and Circular Linked Lists, Doubly Linked List.

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

**Course Activities for Continuous Comprehensive Assessment (CCA):**
*Students are required to complete any one activity from Categories 1 and 2, and any one activity from Categories 3, 4, and 5.*

| **CCA1 (Compulsory)** | **10 Marks** |
|---|---|

Algorithm Analysis Assignment (any one)

1. Compare any two searching algorithms and any two sorting algorithms
   Students should include: Algorithm, Flowchart/Pseudocode, Time Complexity, Space Complexity, Comparison Table
2. Compare any two sorting algorithms and any two sorting algorithms
   Students should include: Algorithm, Flowchart/Pseudocode, Time Complexity, Space Complexity, Comparison Table

| **CCA2 (Any one)** | **10 Marks** |
|---|---|

1. **Practical Coding Activity**
   Students implement any one of the following:
   - Merge two arrays.
   - Binary Search (Recursive and Non-Recursive).
   - Quick Sort or Merge Sort.
   - Singly Linked List Operations (Insertion, Deletion, Traversal).
2. **Poster and Presentation Activity**
   Topic: Role of Data Structures and Algorithms in Robotics
   Students can explain:
   - Sensor data storage using Arrays
   - Path planning algorithms
   - Task scheduling using Linked Lists
   - Importance of Searching and Sorting in Robotics

**Text Books**


1. Horowitz and Sahani, “Fundamentals of Data Structures in C++”, University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926
2. Horowitz, Sahani, Dinesh Mehata, “Fundamentals of Data Structures in C++”ǁ, Galgotia Publisher, ISBN: 8175152788, 9788175152786


**Reference Books**


1. Yashwant Kanetkar & A. Kanetkar, “Let us Python”, BPB Publisher, ISBN: 9789389845006
2. Brassard and Bratley, “Fundamentals of Algorithmic”, Prentice Hall India/Pearson Education, ISBN 13-9788120311312.


**Online References**

**MOOC / NPTEL Courses:**

1. Data Structures And Algorithms by Prof. Naveen Garg, IIT Delhi

https://nptel.ac.in/courses/106102064?utm_source=chatgpt.com

2. Programming, Data Structures and Algorithms using C, by Prof. Hema A Murthy, Prof. Shankar Balachandran, Prof. N. S. Narayanaswamy, Prof. Sudarshan Iyengar, IIT Madras https://nptel.ac.in/courses/106106127

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 1): Leadership and Team Dynamics** | | | | | | | | | **Course Code: 25OEC202A** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Basic communication and interpersonal skills

**Course Objectives:**

1. Introduce concepts of leadership, organizational behaviour, and group dynamics.
2. Develop communication, interpersonal, and collaborative leadership skills.
3. Explain leadership styles, motivation theories, and team processes.
4. Enhance conflict resolution, negotiation, and decision-making abilities.
5. Prepare students for leadership roles in multicultural and multidisciplinary organizations.

**Course Outcomes:**

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

**CO1.** Explain leadership theories, organizational behavior, and group dynamics concepts.

**CO2.** Apply communication and interpersonal skills in team environments.

**CO3.** Analyze leadership styles, group processes, and motivational approaches.

**CO4.** Evaluate team effectiveness, conflict management, ethics, and leadership challenges.

**CO5.** Develop leadership strategies for professional and global organizational environments.

**Course Contents**

| **Unit I** | **Foundations of Leadership and Organizational Behaviour** | **06 Hours** |
|---|---|---|

Introduction to leadership and team management
Leadership versus management
Leadership myths and leadership development
Organizational behavior fundamentals
Groups and types of groups
Stages of group development
Emotional intelligence and self-awareness.

| **Unit II** | **Leadership Theories and Leadership Development** | **06 Hours** |
|---|---|---|

Trait and behavioural leadership theories
Situational and contingency leadership models
Path-goal theory and Leader-Member Exchange (LMX) theory
Transformational and transactional leadership
Power, influence, and persuasion
Leadership ethics, values, and credibility.

| **Unit III** | **Communication, Motivation, and Interpersonal Behaviour** | **06 Hours** |
|---|---|---|

Communication process and barriers
Verbal and non-verbal communication
Social networks, rumors, and grapevine
Motivation theories and leadership
Transactional analysis and JOHARI Window
Coaching, mentoring, and feedback mechanisms.

| Unit IV | Team Dynamics and Conflict Management | 06 Hours |
|---|---|---|

Group dynamics and team processes
Team formation and team effectiveness
Cooperation, competition, and cohesiveness
Delegation and empowerment
Conflict management and negotiation
Virtual and multicultural teams.

| Unit V | Organizational Ethics and High-Performance Leadership | 06 Hours |
|---|---|---|

Organizational justice and ethical behavior
Corporate Social Responsibility (CSR)
Positive organizational scholarship
Building trust and credibility in teams
High-performance team development
Global leadership and leadership challenges in modern organizations

| | Total Hours | 30 |
|---|---|---|

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Leadership Style Role Play**
   Students perform role plays demonstrating different leadership styles, communication approaches, and conflict management situations.
2. **Team Building & Group Dynamics Activity**
   Practical activities/games to study teamwork, cooperation, delegation, trust-building, and group decision-making.
3. **Case Study Analysis on Organizational Behaviour**
   Analyze real-life organizational situations related to motivation, leadership challenges, ethics, or team conflicts and present solutions.
4. **Communication & Negotiation Workshop**
   Hands-on practice sessions on verbal/non-verbal communication, negotiation skills, feedback mechanisms, and interpersonal behaviour.
5. **Self-Assessment & Leadership Development Report**
   Students prepare a report based on personality tests, emotional intelligence assessment, JOHARI window, or leadership skill evaluation with improvement plans.

**Text Books**


1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the Lessons of Experience, 9th Edition, McGraw Hill Education, 2019.


**Reference Books**


1. Robbins, S.P., Judge, T.A. & Vohra, N., Organizational Behavior, 18th Edition, Pearson Education, 2019.
2. Parek, U. & Khanna, S., Understanding Organizational Behavior, 4th Edition, Oxford University Press, 2018.
3. Greenberg, J. & Baron, R., Behavior in Organizations, 10th Edition, Pearson-Prentice Hall, 2009.
4. Luthans, F., Organizational Behavior, 10th Edition, McGraw-Hill, 2004.
5. Cameron, K.S. & Spreitzer, G.M., The Oxford Handbook of Positive Organizational Scholarship, Oxford University Press, 2012.
6. Baron, R.A. & Byrne, D., Social Psychology, 10th Edition, Pearson Education, 2004.

| Online Resources |
| --- |
| 1. Organizational Behaviour: Individual Dynamics in Organization by Prof. Abraham Cyril Issac: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg20<br>2. Leadership and Team Effectiveness by Prof. Santosh Rangnekar: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg39<br>3. Leadership & Management: https://swayam-plus.swayam2.ac.in/courses/course-details?id=F_WADHW_26<br>4. Harvard Business Review Leadership Resources: https://hbr.org/topic/subject/leadership-and-managing-people<br>5. https://www.edx.org/learn/leadership |

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 2): Green Practices & ESG Frameworks** | | | | | | | | | | **Course Code: 25OEC202B** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Basic knowledge of environmental science and sustainability, Understanding of industrial processes and resource utilization, Basic awareness of corporate management and ethics

**Course Objectives:**

1. To introduce the principles of sustainability and green practices in engineering and industry.
2. To understand Environmental, Social, and Governance (ESG) frameworks used in modern organizations.
3. To analyse environmental impacts and promote sustainable resource management.
4. To study social responsibility and governance practices for sustainable development.
5. To apply ESG reporting standards and sustainability assessment tools in organizations.

**Course Outcomes:**

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

**CO1.** Explain the concepts of sustainability, green practices, and ESG frameworks.

**CO2.** Analyse environmental impacts and adopt green technologies for sustainable development.

**CO3.** Evaluate social responsibility and stakeholder engagement practices in organizations.

**CO4.** Understand governance principles, ethical leadership, and regulatory frameworks.

**CO5.** Apply ESG reporting standards and sustainability assessment methods in industries.

**Course Contents**

| **Unit I** | **Fundamentals of Sustainability and Green Practices** | **06 Hours** |
|---|---|---|

Concept of sustainability and sustainable development, Environmental challenges: climate change, global warming, biodiversity loss, resource depletion, Principles of green practices and environmental responsibility, Green economy and circular economy concepts, Sustainable Development Goals (SDGs) and global sustainability initiatives, Sustainable consumption and production patterns, Role of engineering and technology in sustainable development, Importance of green practices in industrial and organizational activities.

| **Unit II** | **Environmental Sustainability and Green Technologies** | **06 Hours** |
|---|---|---|

Environmental sustainability and environmental protection strategies, Environmental Impact Assessment (EIA) and its importance, Carbon footprint analysis and greenhouse gas emissions, Carbon management strategies and carbon neutrality initiatives, Renewable energy technologies: solar, wind, hydro, biomass, Energy efficiency and energy conservation methods, Waste management techniques: reduce, reuse, recycle (3R concept), Water resource management and pollution control, Green manufacturing, eco-friendly materials, and cleaner production technologies.

| **Unit III** | **Social Responsibility and Sustainable Development** | **06 Hours** |
|---|---|---|

Concept and importance of Corporate Social Responsibility (CSR), Employee welfare, workplace health, and safety standards, Labour rights and fair working conditions, Diversity, equity, and

inclusion in organizations, Stakeholder engagement and community development initiatives, social impact assessment and community sustainability programs, Ethical business conduct and responsible supply chain management, Role of organizations in social and economic development.

| **Unit IV** | **Governance and Ethical Business Practices** | **06 Hours** |
|---|---|---|

Concept and principles of corporate governance, Governance structures and roles of board of directors, Transparency, accountability, and ethical leadership, Risk management and compliance mechanisms, Business ethics and anti-corruption policies, Legal and regulatory frameworks related to corporate governance, Sustainability governance and corporate responsibility policies, Governance practices for long-term organizational sustainability.

| **Unit V** | **ESG Reporting, Assessment, and Implementation** | **06 Hours** |
|---|---|---|

Introduction to ESG metrics and sustainability performance indicators, ESG reporting frameworks and standards, Global Reporting Initiative (GRI) guidelines, Integrated reporting and sustainability disclosure practices, ESG ratings, benchmarking, and performance evaluation, Green finance, sustainable investments, and climate finance, Implementation of ESG strategies in organizations, Challenges in ESG adoption and reporting, Case studies of ESG implementation in industries and multinational companies.

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Campus Green Audit & Waste Segregation Study**
   Students conduct a sustainability audit of the campus/department by analyzing waste generation, segregation practices, energy usage, and water consumption. Submit findings with improvement recommendations.
2. **Carbon Footprint Calculation Project**
   Students calculate the carbon footprint of a household, classroom, or small organization using standard carbon calculators and prepare a report suggesting carbon reduction strategies.
3. **ESG Reporting Case Analysis**
   Students select a company and study its ESG or sustainability report (based on GRI/SDG framework). Prepare a presentation evaluating environmental, social, and governance practices.
4. **Sustainable Product / Process Design Activity**
   Teams design an eco-friendly product, packaging solution, or green operational process applying principles of reduce–reuse–recycle and resource efficiency.
5. **Community Awareness & Social Responsibility Campaign**
   Organize and document an awareness activity such as tree plantation, plastic-free drive, energy conservation campaign, or social impact survey, followed by submission of outcomes and reflections.

**Text Books**


1. Understanding Sustainability Principles and ESG Policies: Colin Read, Springer Nature, Year: 2023
2. The ESG and Sustainability Deskbook for Business, Kristyn Noeth, Springer, 2024


**Reference Books**


1. Values at Work: Sustainable Investing and ESG Reporting, Daniel C. Esty, Todd Cort, Palgrave Macmillan, Year: 2020
2. Business Responsibility and Sustainability in India, Bimal Arora, Pawan Budhwar, Divya Jyoti Publisher: Palgrave Macmillan, Year: 2019
3. Looking at and Beyond Corporate Governance in India, Authors: Seema Joshi, Ruchi Kansil Publisher: Springer / Palgrave Macmillan Year: 2023

4. Dharmanomics: An Indigenous and Sustainable Economic Model, Author: Sriram Balasubramanian Publisher: Bloomsbury India, Year: 2024

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 3): Innovation and Business Strategy** | | | | | | | | | | **Course Code: 25OEC202C** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Basic understanding of technology, creativity, and problem-solving concepts.

**Course Objectives:**

1. Introduce concepts of innovation, creativity, and business strategy.
2. Develop strategic thinking and innovation management skills.
3. Explain business models, entrepreneurship, and technology innovation processes.
4. Familiarize students with sustainability, intellectual property rights, and innovation ecosystems.
5. Prepare students for innovation-driven business and entrepreneurial environments.

**Course Outcomes:**

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

**CO1.** Explain concepts of innovation, creativity, and business strategy.

**CO2.** Apply innovation management and strategic thinking tools for business problem-solving.

**CO3.** Analyze business models, technology innovation, and entrepreneurial strategies.

**CO4.** Evaluate sustainability, intellectual property, and innovation management practices.

**CO5.** Develop innovative business solutions and strategic growth approaches.

**Course Contents**

| **Unit I** | **Foundations of Innovation and Creativity** | **06 Hours** |
|---|---|---|

Innovation and creativity: concepts and importance
Innovation in the current business environment
Types of innovation
Schools of innovation
Challenges of innovation
Divergent and convergent thinking

| **Unit II** | **Innovation Management and Design Thinking** | **06 Hours** |
|---|---|---|

Innovation management process
Idea management systems
Design thinking and entrepreneurship
Experimentation and prototyping
Co-creation and idea championship
Incubation and entrepreneurship ecosystems.

| **Unit III** | **Business Models and Strategic Innovation** | **06 Hours** |
|---|---|---|

Business models and value proposition
Entrepreneurship and social entrepreneurship
Blue Ocean Strategy
Strategic positioning and competitive advantage
Business model failure: reasons and remedies

Innovation-driven business growth

| Unit IV | Technology Innovation and Intellectual Property Rights | 06 Hours |
|---|---|---|

Technology innovation process
Technology forecasting and planning
Technological innovation management strategies
Management of innovation
Intellectual Property Rights (IPR)
Patents, copyrights, and patents in India.

| Unit V | Sustainable Innovation and Future Business Trends | 06 Hours |
|---|---|---|

Sustainability innovation and entrepreneurship
Innovation for sustainable development
SME involvement in sustainability
Material efficiency and sustainable business models
Managing investors for innovation
Future markets and innovation opportunities for India

| | Total Hours | 30 |
|---|---|---|

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Innovation Idea Pitch Presentation**
   Students identify a real-world problem and present an innovative product, service, or business solution using creativity and design thinking tools.
2. **Business Model Canvas Workshop**
   Teams prepare a Business Model Canvas for a startup or sustainable business idea, explaining value proposition, customer segments, revenue streams, and competitive advantage.
3. **Prototype Development & Demonstration**
   Students create a basic prototype/mock-up of an innovative product or digital solution and demonstrate its functionality and market relevance.
4. **Case Study Analysis on Successful Innovations**
   Analyze companies known for innovation and strategy (e.g., startups or technology firms) and present factors behind their success, business strategy, and innovation practices.
5. **IPR & Patent Search Activity**
   Students perform a patent/trademark search related to a chosen innovation area and prepare a short report on intellectual property protection and commercialization opportunities.

**Text Books**


1. Krishnan, R.T. & Dabholkar, V., 8 Steps to Innovation: Going from Jugaad to Excellence, HarperCollins India.


**Reference Books**


1. Drucker, Peter F., Innovation and Entrepreneurship, Routledge.
2. Harvard Business Review Series, Innovation and Entrepreneurship, Harvard Business School Publishing.
3. Osterwalder, A. & Pigneur, Y., Business Model Generation, Wiley.
4. Kim, W. Chan & Mauborgne, Renée, Blue Ocean Strategy, Harvard Business Review Press.
5. Tidd, J. & Bessant, J., Managing Innovation, Wiley Publications.


**Online Resources**

1. Innovation Business Models and Entrepreneurship by Prof. Vinay Sharma, Prof. Rajat Agrawal https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95

2. Entrepreneurship & IP strategy by Prof. Gouri Gargate: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_hs213
3. Managing Innovation by Rishikesha T Krishnan and Vinay Dabholkar: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb19_mg05
4. Business Strategy Specialization by University of Virginia: https://www.coursera.org/specializations/business-strategy
5. Design Thinking for Beginners: Develop Innovative Ideas (Udemy): https://www.udemy.com/course/design-thinking-for-beginners/?couponCode=PMNVD2025
6. Strategic Management Resources: https://www.hbsp.harvard.edu/catalog/collections/strategic-management-resources
7. https://www.edx.org/learn/innovation

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 4):**<br>**Stress Management and Mental Well Being** | | | | | | | | | | **Course Code:**<br>**25OEC202D** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Basic awareness about personal health, emotions, and daily life challenges.

**Course Objectives:**

1. To introduce the concept of stress, mental health, and wellbeing.
2. To help students identify stressors in academic and professional life.
3. To develop effective coping strategies and stress management skills.
4. To promote emotional intelligence and resilience.
5. To encourage healthy lifestyle habits for long-term wellbeing.

**Course Outcomes:**

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

**CO1.** Explain the concepts of stress, mental health, and wellbeing

**CO2.** Identify sources of stress and analyze their impact

**CO3.** Apply stress management techniques

**CO4.** Demonstrate emotional intelligence and coping strategies

**CO5.** Design a personal wellbeing and stress management plan.

**Course Contents**

| **Unit I** | **Fundamentals of Stress and Mental Health** | **06 Hours** |
|---|---|---|

Concept and definition of stress and mental wellbeing, Types of stress: Eustress and Distress, Stress response and General Adaptation Syndrome (GAS), Causes and symptoms of stress, Mind–body relationship, Impact of stress on academic performance and productivity. Difference between stress, anxiety, and depression.

| **Unit II** | **Sources of Stress and Emotional Awareness** | **06 Hours** |
|---|---|---|

Academic, professional, social, and personal stressors; Personality types and stress (Type A and Type B personality);
Emotional intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills; Identifying negative thinking patterns.

| **Unit III** | **Stress Management Techniques** | **06 Hours** |
|---|---|---|

Relaxation techniques: Deep breathing, Progressive muscle relaxation; Meditation and mindfulness, Yoga and physical exercises for stress reduction, Time management and goal setting, Positive thinking and cognitive restructuring.

| **Unit IV** | **Mental Wellbeing and Healthy Lifestyle** | **06 Hours** |
|---|---|---|

Importance of sleep, nutrition, and physical activity, managing emotions: anxiety, anger, frustration, Building resilience and self-confidence, Work–life balance, Digital wellbeing and social media stress.

| Unit V | Personal Development and Coping Strategies | 06 Hours |
|---|---|---|
| Interpersonal communication and relationship management, Coping strategies for change and uncertainty, Conflict management and emotional regulation, Developing a personal wellbeing plan, Case studies on stress management in student and workplace environments. | | |
| | **Total Hours** | **30** |

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Stress Diary & Self-Assessment Activity**
   Students maintain a weekly stress journal to identify stress triggers, emotional responses, and coping methods, followed by a reflective analysis report.
2. **Mindfulness and Relaxation Practice Session**
   Conduct guided activities such as meditation, deep breathing, yoga, or progressive muscle relaxation and submit observations on stress reduction outcomes.
3. **Case Study Analysis on Mental Wellbeing**
   Analyze real-life or workplace/student stress management cases and suggest coping strategies, emotional intelligence techniques, and wellbeing solutions.
4. **Work–Life Balance & Digital Wellness Survey**
   Students design and conduct a survey on stress, screen time, sleep, or work–life balance among peers, then present findings with recommendations.
5. **Personal Wellbeing and Stress Management Plan**
   Prepare an individual wellness plan including fitness, sleep, nutrition, time management, and emotional wellbeing strategies for long-term mental health improvement.

**Text Books**


1. Leahy, Robert L. The Worry Cure. Three Rivers Press, 2006.
2. Carnegie, Dale. How to Stop Worrying and Start Living. Simon & Schuster, 1948.
3. Johnstone, Matthew. I Had a Black Dog. Robinson Publishing, 2005.


**Reference Books**


1. Goleman, Daniel. Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books, 1995.
2. Kabat-Zinn, Jon. Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life. Hyperion, 1994.
3. Covey, Stephen R. The 7 Habits of Highly Effective People. Free Press, 1989.


**Online Resources**

1. NPTEL course on Stress Management by Prof. Rajlakshmi Guha, IIT Kharagpur: https://nptel.ac.in/courses/121105009
2. NPTEL course on Psychology of Stress, Health and Well-being by Prof. Dilwar Hussain, IIT Guwahati: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs29

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 5(A)): French Language Module-II** | | | | | | | | | | **Course Code: 25OEC202E** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

French Language Module-I.

**Course Objectives:**

1. To strengthen beginner-level communication skills in French.
2. To improve listening, reading and writing abilities.
3. To develop confidence in practical conversations.
4. To introduce travel and public communication vocabulary.
5. To prepare students for DELF A1 level competency.

**Course Outcomes:**

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

**CO1.** Use basic French expressions confidently.
**CO2.** Understand simple dialogues and instructions.
**CO3.** Read and write short paragraphs.
**CO4.** Participate in guided conversations.
**CO5.** Apply French in practical situations.

**Course Contents**

| **Unit I** | **Voyages (Travel)** | **06 Hours** |
|---|---|---|

Talking about one's dream travel destination
The near future tense
Prepositions
Giving a reason (parce que / car).

| **Unit II** | **Au magasin... au restaurant (At the store... at the restaurant)** | **06 Hours** |
|---|---|---|

Clothes and accessories
Shopping dialogues
French cuisine and some famous dishes
Restaurant communication

| **Unit III** | **La vie quotidienne (Daily life)** | **06 Hours** |
|---|---|---|

Pronominal verbs
Talk about one's routine
Talk about one's favourite outings
Conversation to plan outings.

| **Unit IV** | **Quand j'était petie ...( When I was little...)** | **06 Hours** |
|---|---|---|

Past tense (Le passé compose)
Talk about some activities in the past
Past continuous (L'imparfait)
Talk about one's childhood

| Unit V | La francophonie (The French-speaking world) | 06 Hours |
|---|---|---|
| Francophone countries<br>Talking about seasons and climate<br>Expressing emotions<br>Conversations. | | |
| | **Total Hours** | **30** |

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Shopping Role Play:** Students perform shopping conversations using French vocabulary and expressions.
2. **Restaurant Communication Activity:** Students practice ordering food and interacting in French.
3. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions.
4. **Paragraph Writing in French:** Students write short paragraphs on daily routines or hobbies.
5. **French Culture Presentation:** Students present information on French-speaking countries or traditions.

**Text Books**


1. Véronique M Kizirian, Emmanuelle Daill, Annie Berthet, Catherine Hugot, “Alter Ego+ (A1)”, Hachette, ISBN: 9782011558107, (Goyal Publishers)
2. Nathalie Hirschsprung, Tony Tricot, “Cosmopolite 1-A1”, Textbook +Workbook (2 Book Set) (Goyal Publishers), ISBN: 9788194434108.


**Reference Books**


1. Annie Heminway, “Practice Makes Perfect: Complete French Grammar”, McGraw-Hill Education, ISBN-13 : 978-1259642371
2. Claire Miquel, “Vocabulaire progressif du francais - Niveau debutant (A1)”, Cle International, ISBN-13 : 978-2090380170, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
3. Evelyne Siréjols, “Communication En Dialogues”, CLE international, ISBN: 9782090380637 (Goyal Publishers)
4. Myrna Bell Rochester, “Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast”, McGraw Hill, ISBN-13 : 978-0071453875
5. Claire Miquel, “Communication Progressive du Français A1”, CLE International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
6. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 2, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
7. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) Part 2., Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007.


**Online Resources**

1. The Complete French Course : Learn French – Beginners: https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
2. Francés Introductorio: https://www.coursera.org/learn/frances-introductorio
3. Français Débutant A1: https://www.coursera.org/learn/french-beginner
4. The Complete French Course : Learn French - Low Intermediate: https://www.udemy.com/course/the-complete-french-course-learn-french-low-intermediate/?couponCode=PMNVD2025
5. Complete French Course: Learn French for Beginners: https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 5(B)): German Language Module-II** | | | | | | | | | **Course Code: 25OEC202F** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

German Language Module-I.

**Course Objectives:**

1. To strengthen beginner-level communication skills in German.
2. To improve reading, writing and listening abilities.
3. To develop confidence in practical conversations.
4. To introduce travel and public communication vocabulary.
5. To prepare students for Goethe A1 level competency.

**Course Outcomes:**

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

**CO1.** Use beginner-level German expressions confidently.
**CO2.** Understand simple dialogues and instructions.
**CO3.** Read and write short passages.
**CO4.** Participate in practical conversations.
**CO5.** Apply German in everyday situations.

**Course Contents**

| **Unit I** | **Wohnen und Leben (Housing and life)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- House (different types of houses and things inside a house)
- Furniture
- Renting

**Grammar**

- Accusative case
- Definite, Indefinite articles in accusative case
- Accusative case – Personal Pronouns
- Accusative case – Possessive Pronouns

**Skills**

- Speaking: describe room/home
- Reading: advertisements

**Writing:** a message to friends to invite for celebration

| **Unit II** | **Stadt und Orientierung (City and Orientation)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- Places in city
- Means of transport
- Directions
- Travel
- Planning and hotel booking

**Grammar**

- Types of sentences and formation- statement, interrogative sentence, imperative sentence

- Past tense formation- haben, sein

**Skills**

- Speaking: asking/giving directions
- Listening: friends planning a trip
- Writing: My last trip
- Reading: trip blogs and experiences

**Activity**

- Navigation task

| **Unit III** | **Essen und Trinken (Food and Drink)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- Food
- Beverages
- Restaurant expressions
- Shopping and cooking

**Grammar**

- Perfekt tense introduction - haben/sein
- Adjectives

**Skills**

- Reading and writing: food blogs
- Speaking: ordering food, expressing likes/dislikes

**Activity**

- café roleplay

| **Unit IV** | **Gesundheit und Körper (Health and body)** | **06 Hours** |
|---|---|---|

**Topics and Vocabulary**

- Body parts
- Symptoms
- Medicine

**Grammar**

- Conjunctions
- Modal auxiliary- function, usage, structure

**Skills**

- Email writing/ message writing- unable to attend an event because of illness
- Reading- health related small text

**Activity**

- Doctor-patient conversations

| **Unit V** | **Intercultural Communication (Intercultural Communication)** | **06 Hours** |
|---|---|---|

**Topics**

- German etiquette
- Punctuality
- University culture
- Workplace culture

**Skills**

- Intercultural awareness

Formal communication

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Shopping Role Play:** Students perform shopping conversations using German vocabulary and expressions.
2. **Restaurant Communication Activity:** Students practice food ordering conversations in German.

3. **Travel Conversation Simulation:** Students perform dialogues related to travel situations and directions.
4. **Paragraph Writing in German:** Students write short paragraphs on familiar topics in German.
5. **German Culture Presentation:** Students present information about German-speaking countries and traditions.

**Text Books**

1. Stefanie Dengler, “Netzwerk A1 (Textbook + Workbook + Glossar)”, Hachette , ISBN: 9788183077033, (Goyal Publishers)
2. Kurs Und Ubungsbuch, “Studio-D A1 - Combo of 3 (German)”, Goyal Publishers & Distributers.

**Reference Books**

1. Martin Durrell, “Hammer's German Grammar and Usage”, Fifth Edition: Volume 1, Hodder Education
2. Harriette Lanzer, Anne Lise Gordon, “German Vocabulary Builder”, OUP Oxford
3. Funk and Kuhn, “Studio D A1Deutsch Buch “, Cornelsen Verlag (Goyal Publishers India).

**Online Resources**

1. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
2. Practise German for free (Goethe-Institut Resources): https://www.goethe.de/en/spr/ueb.html
3. Learn German Easily: https://learn-german-easily.com/
4. BBC Languages German: https://www.bbc.co.uk/languages/german/
5. Gothe Exam A1 practice material: https://www.goethe.de/ins/mm/en/spr/prf/gzsd1/ueb.html
6. Best Way to Learn German Language: Full Beginner (A1.1): https://www.udemy.com/course/best-way-to-learn-german-full-beginner-starter-kit/?couponCode=PMNVD2025
7. Best Way to Learn German Language: Beginner Level 2 (A1.2) : https://www.udemy.com/course/learn-german-for-the-advancing-beginner-a1-a2/?couponCode=PMNVD2025

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (OE-2) (Basket No 5(C)): Japanese Language Module-II** | | | | | | | | | | **Course Code: 25OEC202G** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | 20 | 30 | 50 | - | - | - | 100 | 2 | - | - | 2 |

**Prerequisite:**

Japanese Language Module-I.

**Course Objectives:**

1. To strengthen beginner-level Japanese communication skills.
2. To improve reading and writing abilities in Japanese.
3. To develop confidence in practical conversations.
4. To introduce travel and public communication vocabulary.
5. To prepare students for JLPT N5 level competency.

**Course Outcomes:**

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

**CO1.** Communicate using beginner-level Japanese expressions.
**CO2.** Understand short dialogues and passages.
**CO3.** Read and write basic Japanese sentences.
**CO4.** Participate in practical conversations.
**CO5.** Apply Japanese in everyday situations.

**Course Contents**

| **Unit I** | **Kihon bunpō (tsudzuki) (Basic Grammar Continuation)** | **06 Hours** |
|---|---|---|

Verb forms
Adjectives
Particle usage
Question and negative forms

| **Unit II** | **Jissen-tekina komyunikēshon (Practical Communication)** | **06 Hours** |
|---|---|---|

Shopping conversations
Travel communication
Restaurant communication
Asking directions
Communication with Doctor
Kanji –Lesson 4 (Textbook 1 &2)

| **Unit III** | **Risuningu to supīkingu no sukiru (Listening and Speaking Skills)** | **06 Hours** |
|---|---|---|

Pronunciation improvement
Listening comprehension
Dialogue practice
Group conversation
Kanji –Lesson 5 (Textbook 1 &2)

| **Unit IV** | **Yomikaki (Reading and Writing)** | **06 Hours** |
|---|---|---|

Reading short passages
Writing paragraphs
Vocabulary enhancement
Translation practice
Kanji –Lesson 6 (Textbook 1 & 2)

| **Unit V** | **Bunka-teki oyobi shakai-teki komyunikēshon (Cultural and Social Communication)** | **06 Hours** |
|---|---|---|

Japanese culture and etiquette
Social conversations
Telephone communication
Presentation activities
Kanji –Lesson 7 (Textbook 1 & 2)

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

**List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Shopping Role Play:** Students perform shopping conversations using Japanese vocabulary and expressions.
2. **Restaurant Communication Activity:** Students practice ordering food and basic interaction in Japanese.
3. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions in Japanese.
4. **Paragraph Writing in Japanese:** Students write short paragraphs on daily routines or hobbies.
5. **Japanese Culture Presentation:** Students present information about Japanese traditions or festivals.

**Text Books**


1. 3A Corporation, “Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary”, ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India
2. Banno Eri, “Genki: An Integrated Course in Elementary Japanese II Textbook [third Edition]”, ISBN-13 : 978-4789017329, Japan Times.


**Reference Books**


1. The Japan Foundation, “Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities”, Goyal Publishers
2. The Japan Foundation, “Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences”, Goyal Publishers, ISBN-13: 9788183078047
3. The Japan Foundation, “Marugoto Starter (A1) Katsudoo”, Goyal Publishers
4. “Japanese for Busy People,3rd edition”, Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
5. Tae Kim, “A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar”, Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
6. Timothy G. Stout , Kaori Hakone, “Japanese Kanji for Beginners: (JLPT Levels N5 & N4) First Steps to Learn the Basic Japanese Characters”, Tuttle Publishing UK, Verseas Press India Pvt Ltd.


**Online Resources**

1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
2. JF-Japanese e-learning:

https://minato-jf.jp/

3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL): https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83
4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online
5. Marugoto OOnline: https://www.marugoto-online.jp/info/
6. JLPT N5 Practice Material: https://www.jlpt.jp/e/samples/sampleindex.html

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC-L):**<br>**Design of Machine Elements Lab** | | | | | | | | | | **Course Code:**<br>**25RAPCC204L** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Engineering Mathematics
2. Engineering Mechanics
3. Engineering Graphics, Engineering Workshop

**Course Objectives:**

1. To develop understanding of mechanical properties of materials through experimental testing.
2. To interpret engineering drawings using GD&T standards.
3. To apply design principles for machine elements such as power screws, springs, and gears.
4. To develop skills in assembly and detailed drawing of mechanical components.
5. To analyze and select machine elements like bearings using standard data and catalogue.

**Course Outcomes:**

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

**CO1.** Conduct tensile tests and determine mechanical properties such as stress, strain, and modulus of elasticity.

**CO2.** Interpret and apply Geometric Dimensioning and Tolerancing (GD&T) in engineering drawings.

**CO3.** Design and analyze machine elements such as power screws and helical springs under given loading conditions.

**CO4.** Prepare assembly and detailed drawings of mechanical systems such as screw jack using standard conventions.

**CO5.** Analyze spur gear design and select suitable bearings from manufacturer catalogues based on operating conditions.

**List of Experiments:**

1. Conduct tensile testing to determine the mechanical properties of materials.
2. Study and interpretation of Geometric Dimensioning and Tolerancing (GD&T).
3. Design and analysis of a power screw.
4. Preparation of assembly and detailed drawings of a screw jack.
5. Study and Design of Helical Spring.
6. Study and Design Analysis of Spur Gears and Selection of Bearings from manufacturers catalogue.

**Virtual Laboratories:**

1. https://eerc01-iiith.vlabs.ac.in/exp/tensile-test-experiment/
2. https://mr-iitkgp.vlabs.ac.in/exp/oldham-coupling-mechanism/

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC-L):**<br>**Control Systems Lab** | | | | | | | | | | **Course Code:**<br>**25RAPCC205L** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Engineering Mathematics

**Course Objectives:**

1. To understand modeling and analysis of control systems using simulation tools.
2. To analyze time and frequency response of control systems.
3. To study stability of systems using various techniques.
4. To design and analyze controllers for improving system performance in robotics applications.

**Course Outcomes:**

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

**CO1.** Model and simulate control systems.
**CO2.** Analyze system performance in time and frequency domains.
**CO3.** Determine stability using analytical and graphical methods.
**CO4.** Design controllers to improve performance of robotic and automation systems.

**Lab Assignments/Activities: (Any 8)**

1. Find the overall transfer function of the system using block diagram algebra and verify the result.
2. Determine the stability of a given system using Routh-Hurwitz Criterion. Also find the marginal value of gain KKK and frequency of sustained oscillations.
3. Construct the root locus of the given system and comment on system stability for different values of gain.
4. Determine the time domain specifications (rise time, peak time, settling time, overshoot) of the given system for step input.
5. Calculate the steady state error and error coefficients for Type 0 and Type 1 systems for step and ramp inputs.
6. Determine the frequency domain specifications of the system such as bandwidth and resonant peak.
7. Draw the Bode plot of the given system, determine Gain Margin (GM) and Phase Margin (PM), and comment on system stability.
8. Determine the stability of the system using Nyquist Criterion.
9. Obtain the state space model of a given system and determine its response.
10. Design and analyze a PID controller for a given system and study its effect on response time, steady state error, and overall performance.

**Virtual Laboratories:**

1. Study the effect of addition of zeros to the forward path transfer function of a closed loop system
   https://ce-dei.vlabs.ac.in/exp/study-the-effect-of-addition-of-zeros-to-the-forward-path-transfer-function-of-a-closed-loop-system/
2. To obtain root locus for a given transfer function of the system.
   https://ce-dei.vlabs.ac.in/exp/to-obtain-root-locus-for-a-given-transfer-function-of-the-system/

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (PCC-L):**<br>**Hydraulic and Pneumatic Systems Lab** | | | | | | | | | | **Course Code:**<br>**25RAPCC206L** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | 25 | - | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Engineering Physics
2. Engineering Mechanics
3. Basic Electrical Engineering

**Course Objectives:**

1. To understand the working principles of hydraulic components.
2. To understand the working principles of pneumatic components.
3. To develop skills in designing hydraulic circuits.
4. To develop skills in designing pneumatic circuits.
5. To analyze the performance of hydraulic and pneumatic systems.

**Course Outcomes:**

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

**CO1.** Understand hydraulic components used for basic applications.

**CO2.** Understand pneumatic components used for basic applications.

**CO3.** Demonstrate the operation of pneumatic actuators using basic pneumatic circuits.

**CO4.** Implement speed control of pneumatic cylinders using flow control valves in fluid power systems

**CO5.** Implement speed control of hydraulic cylinders using flow control valves in fluid power systems

**List of Experiments:**

1. Study of Hydraulic Power Pack and Components.
   (Identification and working of pump, reservoir, pressure gauge, filters and valves.)
2. Study of Pneumatic Components.
   (Identification of compressor, FRL unit, actuators and fittings)
3. Study Double Acting Cylinder using Hydraulic Circuit.
4. Study of Single/Double Acting Cylinder Using Pneumatic Circuit.
5. Electro pneumatic Automation of Linear Actuator & Electro Hydraulic Automation of Linear Actuator.
6. Speed Control of Pneumatic Cylinder using Flow Control Valve.
7. Design and Implementation of Basic Hydraulic Circuit.
8. Study of Sequential Control in Hydraulic System
9. Speed control of Hydraulic cylinder using Flow control Valve.

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (VSEC):**<br>**Computer Aided Design Lab** | | | | | | | | | | **Course Code:**<br>**25RAVSE202** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | 2 | - | - | - | - | - | - | 25 | 25 | - | 1 | - | 1 |

**Prerequisite:**

1. Engineering Drawing
2. Computer Graphics

**Course Objectives:**

1. Introduce students to modern CAD/CAM/CAE tools used in mechanical and robotic system design.
2. Develop proficiency in 2D drafting and 3D part modeling using industry-standard CAD software.
3. Enable students to perform assembly modeling and generate detailed engineering drawings.
4. Provide exposure to toolpath generation, CAM code generation, and manufacturing simulation.
5. Develop analytical skills using CAD/FEA tools for structural, thermal, and CFD analysis.
6. Familiarize students with modelling and simulation of robotic arms using 3D modelling software.

**Course Outcomes:**

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

**CO1.** Create accurate 2D engineering drawings using CAD software following standard drafting practices

**CO2.** Develop 3D part models and generate detailed drawings with proper dimensions and tolerances.

**CO3.** Construct assembly models and verify motion and fitment of components in robotic systems.

**CO4.** Generate toolpaths and CAM codes for manufacturing applications using suitable CAM software.

**CO5.** Perform structural, thermal, and CFD analysis using CAD/FEA tools and interpret simulation results.

**CO6.** Model and simulate basic robotic arm mechanisms using 3D modeling software for visualization and functional understanding.

**List of Experiments: Perform any 8 of 10 and Mini project is compulsory**

1. Introduction to Computer Aided Design and Drafting
2. Study of 2D drafting software and drawing of any 2 examples with 2D drafting software
3. Drawing of 2D and 3D objects with any CAD software along with Part Modelling and Drafting for any 2 examples
4. Drawing of 2D and 3D objects with any CAD software along with Assembly Modelling and Drafting for any 2 examples
5. Simulation of Toolpath generation and CAM code generation with suitable CAM software for any 2 examples

6. Engineering Analysis with CAD/FEA software for Structural load
7. Engineering Analysis with CAD/FEA software for Thermal load
8. Engineering Analysis with CAD/FEA software for Computational Fluid Dynamics
9. Study of Modeling and simulation of Robotic Arm with 3D Modeling Software
10. Robot Kinematics and dynamics using software such as Robo Analyser, Gazebo, Robologix etc

**Virtual Laboratories:**

1. Engineering Graphics Lab NITK SURATHKAL
   https://eg-nitk.vlabs.ac.in/
2. Engineering Graphics Lab
   https://eg-dei.vlabs.ac.in/List%20of%20experiments.html

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (AEC):**<br>**Modern Indian Language (Marathi)** | | | | | | | | | | **Course Code:**<br>**25AEC201A** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | - | - | - | 25 | 25 | - | 50 | 2 | - | - | 2 |

**Course Objectives (अभ्यासक्रमाची उद्दिष्ट्ये):**

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.
२. प्रसारमाध्यमातील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.
३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे
४. लोकशाहीतील **जीवनव्यवहार** आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.
५. प्रसारमाध्यमांची लेखनक्षमता विकसित करणे.

**Course Outcomes (अभ्यासक्रम परिणाम):**

हा अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थी पुढील बाबी साध्य करू शकतील :

CO१. मराठी भाषेतील प्रगत भाषिक कौशल्यांचा प्रभावीपणे वापर करून संवाद साधू शकतील.

CO२. प्रसारमाध्यमांतील संज्ञापनाचे विविध प्रकार, स्वरूप व समाजातील त्यांचे स्थान स्पष्ट करू शकतील.

CO३. व्यक्तिमत्त्व विकासामध्ये भाषेचे महत्त्व ओळखून प्रभावी संवादकौशल्य विकसित करू शकतील.

CO४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांतील परस्परसंबंधांचे विश्लेषण करू शकतील.

CO५. प्रसारमाध्यमांसाठी विविध प्रकारचे लेखन कौशल्य आत्मसात करून प्रभावी लेखन करू शकतील.

**Course Contents (अभ्यासक्रम विषयवस्तू)**

| **Unit I** | **घटक १** | **06 Hours** |
|---|---|---|

मराठी भाषेची आविष्कार रूपे
भाषा आणि व्यक्तिमत्त्व विकास: सहसंबंध
लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे.

| **Unit II** | **घटक २** | **06 Hours** |
|---|---|---|

वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन

आकाशवाणीसाठी भाषणाची संहितालेखन

दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन

समीक्षणात्मक लेखन: पुस्तक समीक्षण, चित्रपट समीक्षण

| Unit III | घटक ३ | 06 Hours |
|---|---|---|
| भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे<br>नवमाध्यमे आणि समाजमाध्यमांचे प्रकार: ब्लॉग, फेसबुक, ट्विटर<br>नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर, परिणाम | | |
| **Unit IV** | **घटक ४** | **06 Hours** |
| वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन, ई-मेल<br>व्यावहारिक लेखन कौशल्य : अर्जलेखन व पत्रलेखन | | |
| **Unit IV** | **घटक ५** | **06 Hours** |
| अनुवाद कौशल्य (Translation): इंग्रजी किंवा इतर भाषांमधून मराठीत अनुवाद करणे.<br>कथा/कादंबरी/संवाद लेखन: सर्जनशील साहित्याची निर्मिती, पटकथा आणि संवाद लेखन. | | |
| | **Total Hours** | **30** |

**Term Work Evaluation**
*Subject teacher should frame minimum 10 assignments-based covering on all five units*

1. **सारांश लेखन (Summary Writing)**

विद्यार्थ्यांनी उतारा वाचून स्वतःच्या शब्दात एक संक्षिप्त सारांश लिहावा.
Students read a passage and write a **short summary** in their own words.

2. **भाषांतर (Translation Assignment)**

विद्यार्थ्यांनी इंग्रजी भाषेतील मजकूर मराठीमध्ये भाषांतरित करावा.
Students translate text from **English to Marathi**.
**Example**

- Short technical paragraph translation
- Daily communication sentences

3. **पत्र लेखन (Letter Writing)**

विद्यार्थ्यांनी वेगवेगळ्या प्रकारची औपचारिक व अनौपचारिक पत्रे लिहावी
**Types**

- औपचारिक पत्र (Formal Letter)
- अनौपचारिक पत्र (Informal Letter)
- अर्ज लेखन

4. **गट्क्रिया (Group Activity)**

विद्यार्थ्यांनी खालीलपैकी एक गट क्रियाकलाप करावा.
**Example**

- रोड शो
- स्किट प्ले
- एकांकिका

**5. सादरीकरण (Presentation Assignment)**

विद्यार्थ्यांनी तंत्रज्ञान, पर्यावरण, सामाजिक इ . कोणत्याही एका विषयावर सादरीकरण करावे.

Students present a topic in Marathi.

**Examples**

- तंत्रज्ञानातील नवीन शोध
- पर्यावरण विषयक सादरीकरण

**6. गटचर्चा (Group Discussion)**

विद्यार्थ्यांनी गटांमध्ये एखाद्या विषयावर चर्चा करावी.

Students discuss a topic in groups.

**Example Topics**

- सोशल मीडियाचा प्रभाव
- ऑनलाइन शिक्षणाचे फायदे व तोटे

**7. मराठी ब्लॉग लिहणे**

विद्यार्थ्यांनी त्यांच्या अभ्यासाच्या क्षेत्रातील विकासावर २०० शब्दांपर्यंत ब्लॉग लिहून पोस्ट लिहून सोशल मीडियावर पोस्ट कराव्या.

Write blogs and posts on social media up to 200 words on recent development in their field of study.

**8. पुस्तक परीक्षण (Book Review)**

विद्यार्थ्यांना मराठी पुस्तक किंवा लेख वाचावे आणि त्यावर समीक्षा लिहावी.

Students read a Marathi book or article and write a **review**.

**9. चित्रपट परीक्षण (Marathi film Review)**

विद्यार्थ्यांनी उपलब्ध असलेला सामाजिक मराठी चित्रपट पाहावा आणि त्यावर समीक्षा लिहून, ती त्यांच्या आवडीच्या सोशल मीडियावर पोस्ट करावी.

Social Marathi movie available and write a review on post it on social media of their choice.

**10. स्पर्धांमध्ये सहभाग** (Participation in Competition)

पुरुषोत्तम, फिरोदिया, दाजीकाका गाडगीळ करंडक, आणि श्रीटेज करंडक या स्पर्धांमध्ये सहभाग नोंदवावा.

Participation in Purushottam karandam, Firodia karandak, Dajikaka Gadgil Karandak and Shreetej Karandak.

**Text Books**


१. सायबर संस्कृती : डॉ. रमेश वरखडे
२. व्यावहारिक मराठी: डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर
३. उपयोजित मराठी : संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई
४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात , दीपक शिक्रापूरकर, उज्ज्वल मराठे, उत्कर्ष प्रकाशन, पुणे
५. व्यावहारिक मराठी, पुणे विद्यापीठ प्रकाशन, पुणे
६. प्रसारमाध्यमांसाठी लेखन कौशल्य, यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (AEC):**<br>**Modern Indian Language (Sanskrit)** | | | | | | | | | | **Course Code:**<br>**25AEC201B** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| 2 | - | - | - | - | - | 25 | 25 | - | 50 | 2 | - | - | 2 |

**Prerequisite:**

Basic ability to read Devanagari script is helpful but not mandatory

**Course Objectives:**

1. To introduce engineering students to the basic structure of the Sanskrit language.
2. To highlight the relevance of Sanskrit in modern fields such as Computational Linguistics and Artificial Intelligence.
3. To encourage appreciation of Indian Knowledge Systems and their applications in modern engineering and research.

**Course Outcomes:**

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

**CO1.** Understand the basic structure, phonetics, and grammar of the Sanskrit language.
**CO2.** Construct simple Sanskrit sentences using basic grammatical rules.
**CO3.** Interpret selected Sanskrit verses related to science, mathematics, and philosophy.
**CO4.** Recognize the contributions of ancient Indian scholars to science and engineering.
**CO5.** Appreciate the relevance of Sanskrit in modern fields such as computational linguistics, knowledge.

**Course Contents**

| **Unit I** | **Introduction to Sanskrit Language** | **06 Hours** |
|---|---|---|

Importance and historical development of Sanskrit, Characteristics of Sanskrit as a scientific language, Sanskrit alphabet (Varnamala): vowels and consonants, Pronunciation rules and phonetics, Basic introduction to Sanskrit grammar

- पठित अवबोधनम् | गद्यान्श् अपेक्षित कार्य : प्रश्नोत्तरामी तथा निर्देशानुसार कृतयः
- पठित अवबोधनम् | पद्यान्श

| **Unit II** | **Basic Sanskrit Grammar** | **06 Hours** |
|---|---|---|

Introduction to nouns (Subanta), Gender and number (Vachana), Case system (Vibhakti), Introduction to verbs (Dhatu), Present tense forms, Formation of simple sentences

सन्धिकार्यम् समास प्रत्ययाः त्यकार अव्ययाः समय लेखनम् - अनुप्रयुक्त-व्याकरणम्

| **Unit III** | **Reading and Interpretation of Sanskrit Texts** | **06 Hours** |
|---|---|---|

Reading simple Sanskrit shlokas, Vocabulary building for scientific and technical terms, Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature, Practice exercises in sentence construction and translation

| **Unit IV** | **Reading and Interpretation of Sanskrit Texts** | **06 Hours** |
|---|---|---|

Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature Practice exercises in sentence construction and translation

लेखनकौशलम् वृत्तान्तलेखनम्, चित्रपटवर्णनम्, निबन्धलेखनम्

| **Unit V** | **Sanskrit and Modern Science & Technology** | **06 Hours** |
|---|---|---|

Sanskrit and computational linguistics
Logic and knowledge representation in Sanskrit texts
References to engineering concepts in ancient texts
Sanskrit terminology used in mathematics, astronomy, and architecture. Mathematical problems from Lilavati by **Bhaskara II**
Structure of Sanskrit grammar and its relevance to computer science
Applications of Sanskrit in modern research
Overview of Sanskrit influence on Artificial Intelligence and language processing

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

**Term Work Evaluation**

*Subject teacher should frame minimum 10 assignments-based covering on all five units*

1. Summary Writing: Students read a passage and write a short summary in their own words.
2. Translation Assignment: Students translate text from English to Sanskrit.
3. Short technical paragraph translation
4. Daily communication sentences
5. Letter Writing
6. Group Discussion
7. Book Review
8. Film review
9. Blog writing
10. Participation in a Competition

**Text Books**

1. सरस्वती - मणिका संस्कृत व्याकरणम
2. नवम तथा दशम कक्षा 'मणिका' पुस्तकम
3. संस्कृत आल्हादः - दादशी कक्षा तथा निभन्धसोपन:

**Reference Books**

1. Panini Ashtadhyayi – Panini
2. Selected Sanskrit texts related to science and mathematics.

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (HSSM) -II: Business Fundamentals for Entrepreneurs** | | | | | | | | | | **Course Code: 25HSM202A** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

- Basic understanding of economics and management principles
- Analytical thinking and problem-solving skills
- Awareness of technological innovations and industry trends

**Course Objectives:**

1. To introduce engineering students to fundamental concepts of entrepreneurship and business management.
2. To develop the ability to identify and evaluate entrepreneurial opportunities in technology-driven markets.
3. To provide knowledge of basic marketing, financial, and operational aspects required to start and manage a business.
4. To enable students to understand business models, startup ecosystems, and funding mechanisms.
5. To develop the capability to prepare a structured business plan for a technology-based venture.

**Course Outcomes:**

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

**CO1.** Explain the role of entrepreneurship in economic and technological development.

**CO2.** Identify and analyze business opportunities using systematic tools and techniques.

**CO3.** Apply marketing and financial fundamentals for planning entrepreneurial ventures.

**CO4.** Design sustainable business models and evaluate startup feasibility.

**CO5.** Develop and present a comprehensive business plan for a technology-based enterprise.

**Course Contents**

| **Unit I** | **Introduction to Entrepreneurship** | **06 Hours** |
|---|---|---|

Concept and evolution of entrepreneurship, Entrepreneur vs manager.
Types of entrepreneurs: techno-entrepreneurs, social entrepreneurs, women entrepreneurs, intrapreneurs.
Characteristics of successful entrepreneurs. Role of entrepreneurship in economic development.
Entrepreneurial ecosystem in India – Startup India, Make in India, Atmanirbhar Bharat initiatives.

| **Unit II** | **Opportunity Identification and Business Environment** | **06 Hours** |
|---|---|---|

Creativity and innovation in entrepreneurship.
Idea generation techniques – brainstorming, design thinking, TRIZ basics.
Opportunity recognition and feasibility analysis.
Environmental scanning – PESTLE analysis.
Industry and market analysis.

Legal forms of business organizations: sole proprietorship, partnership, LLP, private limited company.

| Unit III | Marketing Fundamentals for Entrepreneurs | 06 Hours |
|---|---|---|

Introduction to marketing management.
Market research and customer discovery.
Market segmentation, targeting and positioning (STP).
Product development and product life cycle.
Pricing strategies for startups.
Digital marketing tools and social media marketing for new ventures

| Unit IV | Financial Fundamentals for Startups | 06 Hours |
|---|---|---|

Introduction to accounting and financial statements.
Cost concepts and break-even analysis.
Financial planning and budgeting.
Sources of startup funding – angel investors, venture capital, bank loans, incubators, crowdfunding.
Government schemes supporting startups in India.
Basics of financial risk management.

| Unit V | Business Planning and Startup Management | 06 Hours |
|---|---|---|

Business models and Business Model Canvas.
Preparation of a business plan – structure and components.
Operations management for startups.
Intellectual Property Rights (IPR) and regulatory compliance.
Startup growth strategies and scaling.
Sustainability and ethical practices in entrepreneurship.

| | Total Hours | 30 |
|---|---|---|

**Course activities for term work evaluation**

1. **Business Opportunity Identification Activity**
   Students identify innovative startup ideas, analyze market needs, customer problems, and prepare an opportunity assessment report.
2. **Case Study on Successful Startups and Entrepreneurs**
   Students study successful startups or entrepreneurs and analyze their business models, innovation strategies, marketing approaches, and growth factors.
3. **Hands-on Activity using Business Planning Tools**
   Students prepare SWOT analysis, Business Model Canvas (BMC), customer segmentation, and basic market analysis using practical examples.
4. **Mini Project on Startup Ecosystem and Funding**
   Students explore startup support systems such as Startup India, incubators, venture capital, crowdfunding, and government schemes and prepare a report.
5. **Business Plan Development and Pitch Presentation**
   Students develop and present a business plan including product idea, marketing strategy, financial planning, pricing, budgeting, and startup feasibility analysis.

**Text Books**


1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A., Entrepreneurship, McGraw Hill Education.
2. Barringer, B. R., & Ireland, R. D., Entrepreneurship: Successfully Launching New Ventures, Pearson Education.
3. Kuratko, D. F., Entrepreneurship: Theory, Process and Practice, Cengage Learning.


**Reference Books**


1. Drucker, P., Innovation and Entrepreneurship, Harper Business.

2. Ries, E., The Lean Startup, Crown Publishing.
3. Desai, V., Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
4. Blank, S., & Dorf, B., The Startup Owner's Manual, K & S Ranch Press.
5. Timmons, J. A., & Spinelli, S., New Venture Creation, McGraw Hill.

**Online References**

**MOOC / NPTEL Courses:**

1. NPTEL Course on Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL course on Business Fundamentals for Entrepreneurs by Prof. Devdip Purkayastha, IIT Bombay: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg11
3. NPTEL Course on Entrepreneruship and Start-ups, By Dr. P. Jakulin Divya Mary, National Institute of Technical Teachers' Training and Research, Chennai: https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed60
4. NPTEL Course on Business Development: From Start to Scale Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg61

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (HSSM) -II: Entrepreneur and Start-ups** | | | | | | | | | | **Course Code: 25HSM202B** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

1. Market study
2. Break even analysis
3. Profit loss
4. Accounting

**Course Objectives:**

1. Understand the concepts, role, and importance of entrepreneurship and innovation in economic and social development
2. Identify and evaluate business opportunities, especially technology-based and sustainable ventures.
3. Develop entrepreneurial mindset, creativity, and problem-solving ability
4. Understand startup ecosystem, government policies, IPR, funding, and incubation support.
5. Prepare a basic business plan incorporating ethical, financial, and sustainability considerations.

**Course Outcomes:**

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

**CO1.** Explain concepts of entrepreneurship, innovation, and their role in economic and societal development.

**CO2.** Identify entrepreneurial opportunities using creativity, design thinking, and market analysis tools.

**CO3.** Analyze feasibility of a business idea considering technical, financial, legal, and social aspects.

**CO4.** Apply knowledge of startup ecosystem, IPR, funding, and government initiatives to venture creation.

**CO5.** Develop and present a basic business plan demonstrating teamwork, communication, ethics, and lifelong learning attitude.

**Course Contents**

| **Unit I** | **Introduction to Entrepreneurship** | **06 Hours** |
|---|---|---|

Entrepreneurship: Definition, types, and characteristics, Entrepreneur vs Manager, Role of entrepreneurship in economic development, Innovation: Types and sources, Case studies of successful entrepreneurs (Indian & global)

| **Unit II** | **Creativity, Innovation & Opportunity Identification** | **06 Hours** |
|---|---|---|

Entrepreneurial mindset and creativity
Design Thinking for innovation
Idea generation techniques
Opportunity identification and screening

Market research and customer validation
Technology-based entrepreneurship

| Unit III | Feasibility Analysis & Business Models | 06 Hours |
|---|---|---|

Technical, market, and financial feasibility
Business Model Canvas (BMC)
Costing, pricing, and break-even analysis
Risk analysis and mitigation
Ethics and sustainability in entrepreneurship

| Unit IV | Startup Ecosystem, IPR & Funding | 06 Hours |
|---|---|---|

Startup India initiative and government schemes (MSME, SIDBI, DPIIT)
Incubation centers, accelerators, and angel networks
Basics of Intellectual Property Rights (Patents, Copyrights, Trademarks)
Sources of funding: Bootstrapping, venture capital, crowdfunding
Legal aspects of starting a venture

| Unit V | Business Plan Development & Entrepreneurial Skills | 06 Hours |
|---|---|---|

Business plan preparation and structure
Team building and leadership
Communication and pitching skills
Social entrepreneurship and sustainable startups
Future trends and lifelong learning for entrepreneurs

| | Total Hours | 30 |
|---|---|---|

**Course activities for term work evaluation:**

1. **Business Opportunity Identification Activity**
   Students identify innovative startup ideas, analyze market needs, customer problems, and prepare an opportunity assessment report.
2. **Case Study on Successful Startups and Entrepreneurs**
   Students study successful startups or entrepreneurs and analyze their business models, innovation strategies, marketing approaches, and growth factors.
3. **Hands-on Activity using Business Planning Tools**
   Students prepare SWOT analysis, Business Model Canvas (BMC), customer segmentation, and basic market analysis using practical examples.
4. **Mini Project on Startup Ecosystem and Funding**
   Students explore startup support systems such as Startup India, incubators, venture capital, crowdfunding, and government schemes and prepare a report.
5. **Business Plan Development and Pitch Presentation**
   Students develop and present a business plan including product idea, marketing strategy, financial planning, pricing, budgeting, and startup feasibility analysis.

**Text Books**


1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A., Entrepreneurship, McGraw Hill Education.
2. Barringer, B. R., & Ireland, R. D., Entrepreneurship: Successfully Launching New Ventures, Pearson Education.
3. Kuratko, D. F., Entrepreneurship: Theory, Process and Practice, Cengage Learning.


**Reference Books**


1. Drucker, P., Innovation and Entrepreneurship, Harper Business.
2. Ries, E., The Lean Startup, Crown Publishing.

3. Desai, V., Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.
4. Blank, S., & Dorf, B., The Startup Owner's Manual, K & S Ranch Press.
5. Timmons, J. A., & Spinelli, S., New Venture Creation, McGraw Hill.

**Online References**

1. NPTEL course on Entrepreneurship and Start-ups by Dr. P. Jakulin Divya Mary, National Institute of Technical Teachers' Training: https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr25_ed60
2. NPTEL Course on Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
3. NPTEL Course on Business Development: From Start to Scale Prof. C Bhaktavatsala Rao, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_mg61
4. Government Schemes for Start-ups: https://www.startupindia.gov.in/content/sih/en/government-schemes.html

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (HSSM) -II: Fundamentals of Accounting and Finance** | | | | | | | | | **Course Code: 25HSM202C** | | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Prerequisite:**

Basic knowledge of arithmetic and percentages, along with the ability to interpret simple numerical data and tables. No prior background in accounting or finance is required.

**Course Objectives:**

1. This course introduces basic concepts of financial accounting and corporate finance to engineering students.
2. It helps students understand financial statements,
3. Apply accounting principles, and use financial tools for decision-making.

**Course Outcomes:**

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

**CO1.** Apply key accounting principles in business contexts.

**CO2.** Interpret financial statements and reports.

**CO3.** Understand working capital and its components.

**CO4.** Evaluate capital budgeting decisions.

**CO5.** Gain awareness of financial markets and financing options.

**Course Contents**

| **Unit I** | **Introduction to Accounting** | **06 Hours** |
|---|---|---|

Meaning and purpose of accounting, Users of accounting information, Accounting principles, concepts and conventions, Types of accounts and rules of debit and credit Journal, Ledger and Trial Balance, Preparation of Final Accounts (simple adjustments)

| **Unit II** | **Financial Statements and Analysis** | **06 Hours** |
|---|---|---|

Introduction to Financial Statements, Balance Sheet: Classification of assets and liabilities, Profit and Loss Statement, Cash Flow Statement – Format and Components, Financial Ratio Analysis – Concept and Uses, Computation of Liquidity and Profitability Ratios

| **Unit III** | **Cost Concepts and Working Capital** | **06 Hours** |
|---|---|---|

Meaning and classification of costs, Fixed vs Variable costs, Break-even analysis – concept and formula, Importance of working capital, Working capital cycle, Techniques for managing working capital

| **Unit IV** | **Introduction to Finance and Time Value of Money** | **06 Hours** |
|---|---|---|

Meaning and scope of finance, Financial goals and functions, Time Value of Money – Concept, Present value and future value, Simple and compound interest, Annuities and perpetuities

| **Unit V** | **Capital Budgeting and Financial Markets** | **06 Hours** |
|---|---|---|

Introduction to capital budgeting, Payback period, Net Present Value (NPV), Internal Rate of Return (IRR), Overview of financial markets, Financing options – Equity and Debt.

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

**Course activities for term work evaluation:**

1. **Accounting Principles and Journal Preparation Activity**
   Students prepare journal entries, ledgers, and trial balances for simple business transactions to understand the fundamentals of accounting practices.
2. **Financial Statement Analysis Case Study**
   Students analyze balance sheets, profit and loss statements, and cash flow statements of companies to evaluate financial performance and decision-making.
3. **Cost Analysis and Break-even Calculation Exercise**
   Students perform cost classification, break-even analysis, and working capital calculations using numerical examples and practical business scenarios.
4. **Time Value of Money and Investment Analysis Activity**
   Students solve problems related to simple and compound interest, annuities, present value, future value, NPV, and IRR for financial decision-making.
5. **Mini Project on Capital Budgeting and Financial Markets**
   Students study capital budgeting techniques, financing options, equity and debt markets, and prepare a report on investment and financing decisions.

**Text Books**


1. S. A. Siddiqui & A. S. Siddiqui – Fundamentals of Financial Accounting – PHI Learning
2. Paul D. Kimmel, Jerry J. Weygandt, Donald E. Kieso – Financial Accounting: Tools for Business Decision Making – Wiley
3. Mike Piper – Accounting Made Simple – CreateSpace


**Reference Books**


1. Prasanna Chandra – Financial Management: Theory & Practice – McGraw-Hill
2. Stephen A. Ross, Randolph W. Westerfield & Jeffrey Jaffe – Corporate Finance – McGraw-Hill
3. Ray H. Garrison, Eric W. Noreen & Peter C. Brewer – Managerial Accounting – McGraw-Hill
4. Jerry J. Weygandt, Paul D. Kimmel, Donald E. Kieso – Accounting Principles – Wiley


**Online References**

1. NPTEL course on Foundations of Accounting Finance by Prof. Arun Kumar Gopalaswamy, IIT Madras:
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10
2. NPTEL Course on Financial Markets, Institutions and Financial Services By Prof. Divya Verma, Guru Gobind Singh Indraprastha University, Delhi:
   https://onlinecourses.swayam2.ac.in/e-learning/preview/cec26_mg12
3. NPTEL Course on Working Capital Management by Prof. Anil K. Sharma, IIT Roorkee:
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg61
4. Time value of money- Concepts and Calculations
   http://digimat.in/nptel/courses/video/109107115/109107115.html

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (HSSM) -II: Business Intelligence and Analytics** | | | | | | | | | | **Course Code: 25HSM202D** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 2 | - | - | - | 50 | - | - | 50 | - | - | 2 | 2 |

**Course Objectives:**

1. To introduce the concepts of Business Intelligence (BI) and Business Analytics (BA) in modern organizations.
2. To understand the role of Decision Support Systems and Data Warehousing in business decision-making.
3. To learn techniques of data analysis, reporting, and visualization used in BI tools.
4. To develop knowledge of data preparation, predictive analytics, and machine learning applications in business.

**Course Outcomes:**

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

**CO1.** Understand the concepts of Decision Support Systems, Business Intelligence, and Business Analytics.

**CO2.** Understand the architecture of Data Warehouses and OLAP systems used in business intelligence.

**CO3.** Apply data preparation, reporting, and visualization techniques to analyze business data.

**CO4.** Analyze the impact of predictive analytics, machine learning, and analytics applications

**CO5.** Apply Machine Learning in BI.

**Course Contents**

| **Unit I** | **Introduction to Data-Driven Business Intelligence and Analytics** | **06 Hours** |
|---|---|---|

**Decision Support Systems (DSS):** Definition of system, representation of decision-making process, evolution of information systems, Decision Support System, development of DSS, Simon's four stages of decision-making process, strategies and approaches of decision makers.

**Business Intelligence (BI):** Definition of BI, components of BI, BI architecture, data–information–knowledge concepts, setting up data for BI, role of mathematical models, business intelligence architectures, ethics in business intelligence.

**Business Analytics (BA):** Definition of business analytics, types of analytics – descriptive, diagnostic, predictive and prescriptive analytics, concept of insights, business analytics in practice, importance of data in business analytics, types of data, data quality, 5Vs of big data, data sources and collection methods, data privacy, security and ethical considerations.

| **Unit II** | **Analytical Decision-Making and Architecture of DW & BI** | **06 Hours** |
|---|---|---|

Analytical decision-making process, characteristics, framing business problems into analytical questions, skills of a business analyst. Data exploration and visualization (Excel, Tableau, Power BI), concept of statistical analysis and hypothesis testing. Data visualization, exploratory data analysis (EDA), data cleaning and inspection. BI and DW architecture, relation between BI and DW, role of DSS, EIS, MIS, digital dashboards, need for BI. OLAP concepts, OLAP vs OLTP, cubes, drill-down, roll-up, slice-and-dice, ROLAP vs MOLAP, schemas: star, snowflake, fact constellation.

| Unit III | Predictive, Prescriptive Analytics and Reporting Authoring | 06 Hours |
|---|---|---|
| Text analytics and web analytics, report authoring (relational & multidimensional models), types of reports (list, crosstab, statistics, charts, maps, financial), report features (grouping, sorting, filtering, calculations, conditional formatting, summary lines, drill-up, drill-down, drill-through), report scheduling and output formats (PDF, Excel, CSV, XML). | | |
| **Unit IV** | **Business Analytics in Marketing and Finance** | **06 Hours** |
| Marketing Analytics, Customer segmentation, targeting, and positioning, Campaign management and ROI measurement, Data-driven marketing strategies. Financial Analytics - Risk management and credit scoring, financial forecasting and planning, Case studies: Financial performance improvement through analytics (Non-Statistical - Conceptual Treatment only). | | |
| **Unit V** | **Business Analytics Applications and Machine Learning in BI** | **06 Hours** |
| Impact of machine learning in BI: classification problems, evaluation of classification models, Bayesian methods, logistic regression. Clustering methods: partition and hierarchical methods, evaluation of clustering models. Association rule mining: structure of association rules and Apriori algorithm. | | |
| | **Total Hours** | **30** |

**Course activities for term work evaluation:**

1. **Business Intelligence Case Study Analysis:**
   Students analyze real-world business cases to understand the role of Business Intelligence (BI), Decision Support Systems (DSS), and data-driven decision-making in organizations.
2. **Data Visualization and Dashboard Development Activity**
   Students create charts, dashboards, and analytical reports using tools such as Excel, Tableau, or Power BI to present business insights effectively.
3. **Hands-on Activity on Data Analysis and Reporting**
   Students perform data cleaning, exploratory analysis, report generation, and visualization using business datasets to identify trends and patterns.
4. **Marketing and Financial Analytics Mini Project**
   Students analyze customer segmentation, campaign performance, sales trends, and financial data using analytical techniques and prepare a business analytics report.
5. **Machine Learning Applications in Business Activity**
   Students explore classification, clustering, association rule mining, and predictive analytics techniques using sample datasets and present their findings and business implications.

**Text Books**


1. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams - Essentials of Business Analytics, Cengage Learning.
2. James Evans, Business Analytics, Pearson.
3. Albright Winston, Business Analytics - Data Analysis - Data Analysis and Decision Making, Cengage Learning, Reprint
4. Sahil Raj, Business Analytics, Cengage Learning.
5. Knaflic, C. N. (2015). Storytelling with data: A data visualization guide for business professionals. Wiley.
6. Siegel, E. (2016). Predictive analytics: The power to predict who will click, buy, lie, or die. Wiley.


**Reference Books**


1. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber


**Online References**

**e-Books:**

1. https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf

2. www.cs.ccsu.edu/~markov/weka-tutorial.pdf
3. http://www.biomedicahelp.altervista.org/Magistrale/Clinics/BIC_PrimoAnno/IdentificazioneModelliDataMining/Bus iness%20Intelligence%20-%20Carlo%20Vercellis.pdf
4. https://download.e-bookshelf.de/download/0000/5791/06/L-G-0000579106-0002359656.pdf

**MOOC / NPTEL Courses:**

1. Business Analytics for management decision By Prof. Rudra P Pradhan, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg11
2. Business analytics and data mining modeling using R By Prof. Gaurav Dixit, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg24
3. Business Analysis for Engineers: http://www.digimat.in/nptel/courses/video/110106050/110106050.html
4. Business Intelligence & Analytics By Prof. Saji K Mathew, IIT Madras: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs65

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| **Semester- IV** | | | | | | | | | | | | | |
| **Course Name (VEC):**<br>**Indian Constitution and Governance** | | | | | | | | | | **Course Code:**<br>**25VEC202** | | | |
| **Teaching Scheme (Hours/Week)** | | | **Examination Scheme** | | | | | | | **Credits** | | | |
| **L** | **P** | **T** | **CCA** | **ISE** | **ESE** | **TW** | **OR** | **PR** | **TOTAL** | **L** | **P** | **T** | **TOTAL** |
| - | - | 1 | - | - | - | 25 | - | - | 25 | - | - | 1 | 1 |

**Prerequisite:**

Basic awareness of Indian history, civic studies at school level, and general understanding of social and political systems.

**Course Objectives:**

1. To introduce students to the philosophy, features, and framework of the Indian Constitution.
2. To understand the structure, powers, and functions of the Union and State governments.
3. To explain Fundamental Rights, Duties, and Directive Principles and their role in democracy.
4. To familiarize students with constitutional bodies and governance mechanisms in India.
5. To develop awareness of contemporary issues related to constitutional values, governance, and citizenship.

**Course Outcomes:**

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

**CO1.** Explain the historical background, features, and structure of the Indian Constitution.
**CO2.** Describe Fundamental Rights, Directive Principles, and Fundamental Duties and their significance.
**CO3.** Apply constitutional provisions to analyze the functioning of Union and State governments.
**CO4.** Analyze the role of constitutional and statutory bodies in Indian governance.
**CO5.** Evaluate contemporary governance issues with reference to constitutional values and ethics.

**Course Contents**

| **Unit I** | **Introduction to Indian Constitution** | **03 Hours** |
|---|---|---|

Meaning and importance of Constitution Historical background and making of the Indian Constitution Salient features of the Indian Constitution Preamble: objectives and significance Citizenship – provisions and amendments

| **Unit II** | **Fundamental Rights, Duties, and Directive Principles Fundamental Rights** | **03 Hours** |
|---|---|---|

Types, scope and limitations Right to Equality, Freedom, Religion, Constitutional Remedies Directive Principles of State Policy – objectives and classification Fundamental Duties and their relevance Relationship between Fundamental Rights and DPSPs

| **Unit III** | **Union and State Government Structure Union Government** | **03 Hours** |
|---|---|---|

President, Vice-President, Prime Minister, Council of Ministers Powers and functions of Parliament State Government: Governor, Chief Minister, State Legislature Center–State relations: legislative, administrative, and financial

| **Unit IV** | **Constitutional and Statutory Bodies Election Commission of India** | **03 Hours** |
|---|---|---|

Composition, powers, and functions Union Public Service Commission (UPSC) and State Public Service Commissions (SPSC): roles and responsibilities Comptroller and Auditor General (CAG) of India: duties and significance in financial accountability Finance Commission: composition,

functions, and role in centre–state financial relations Judiciary in India: structure, jurisdiction, and role of the Supreme Court and High Courts

| **Unit V** | **Governance, Democracy and Contemporary Issues Concept of democracy and good governance Local self-government** | **03 Hours** |
|---|---|---|

Panchayati Raj and Urban Local Bodies Constitutional amendments and landmark judgments Ethical governance and citizen participation Current issues related to Indian Constitution and governance.

| | **Total Hours** | **15** |
|---|---|---|

**Course activities for term work evaluation:**

1. Group Discussion on Fundamental Rights and Duties
2. Debate on Constitutional and Contemporary Governance Issues
3. Case Study Analysis on Indian Judiciary and Landmark Judgments
4. Seminar / Presentation on Indian Constitution and Democratic Values
5. Poster Making on Fundamental Rights, Duties, and Good Governance
6. Essay Writing on Role of Citizens in Democracy and Nation Building
7. Mock Parliament / Mock Election Activity
8. Assignment on Constitutional Bodies and Their Functions
9. Field Visit / Report on Local Self-Government Institutions
10. Quiz / Awareness Activity on Indian Constitution and Governance Systems

**Text Books**

1. M. V. Pylee, An Introduction to the Constitution of India, Vikas Publishing
2. D. D. Basu, Introduction to the Constitution of India, LexisNexis

**Reference Books**

1. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press
2. Subhash Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust

**Online References**

- **MOOC / NPTEL Courses**

1. https://onlinecourses.nptel.ac.in/noc22_hs79/preview
   (NPTEL1, Introduction to Indian Constitution, Prof. Sudhir Krishnaswamy, National Law School of India University)
2. https://onlinecourses.nptel.ac.in/noc23_hs118/preview
   (NPTEL2, Indian Constitution: Rights and Governance, Prof. Sudhir Krishnaswamy, National Law School of India University)
3. https://onlinecourses.nptel.ac.in/noc22_hs67/preview
   NPTEL3, Constitutional Studies, Prof. Alok Prasanna Kumar, National Law School of India University)
4. https://onlinecourses.nptel.ac.in/noc23_hs89/preview
   (NPTEL4, Public Policy and Governance, Prof. Anamika Barua, IIT Guwahati)
5. https://onlinecourses.nptel.ac.in/noc24_hs90/preview
   (NPTEL5, Governance and Public Administration in India, Prof. Anamika Barua, IIT Guwahati)