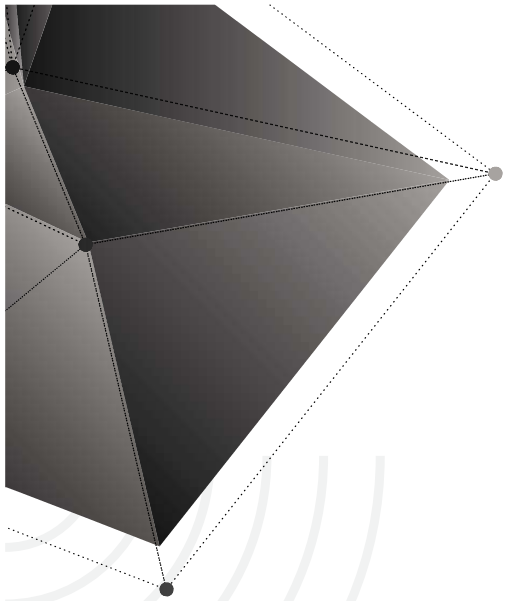
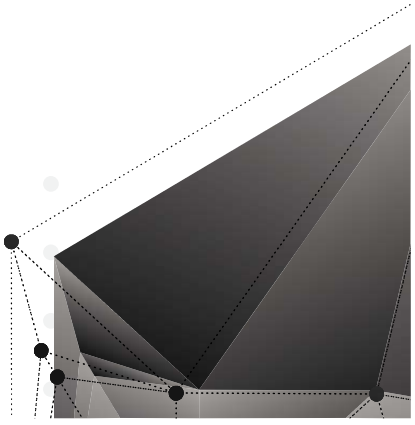


FIFTH SEMESTER

'MECHATRONICS'



DESIGN OF MACHINE ELEMENTS

Course Code:	455001
Course Title	Design of Machine Elements
No. of Credits	10 (TH:6,T:0,P:8)

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

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Develop drawings on CAD software.

COURSE CONTENTS

Unit - 1 : Introduction to Design

1. Machine Design philosophy and Procedures;
2. General Considerations in Machine Design;
3. Types of loads;
4. Concepts of stress, Strain;
5. Stress– Strain Diagram for Ductile and Brittle Materials;
6. Types of Stresses
7. Simple Numericals;
8. Fatigue;
9. Endurance Limit;
10. Factor of Safety.
11. Stress Concentration, Causes & Remedies;
12. Properties of Engineering materials;
13. Theories of Elastic Failures;

Unit - 2 : Design of Simple Machine Parts:

- Cotter Joint;
- Knuckle Joint;
- Turnbuckle;
- Design of Levers

Unit: 3- Design of Shafts, Keys, Couplings & Spur Gears

- Types of Shafts;
- Shaft materials;
- Standard Sizes;

- Design of Shafts (Hollow and Solid) using strength and rigidity criteria;
- ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley;
- Design of Sunk Keys;
- Design of Couplings ;
- Muff Coupling;
- Protected type Flange Coupling.

Unit : 4 - Design of Power Screws

- Thread Profiles used for power Screws;
- Relative merits and demerits of each;
- Efficiency of power screws;
- Design of Screw Jack;
- Design of springs
- Classification and Applications of springs;
- Spring terminology;
- Materials and Specifications;
- Stresses in springs;
- Deflection of springs;
- Energy stored in springs;
- Leaf springs: Construction and Application.

UNIT 5 - DESIGN OF FASTENERS

- Stresses in Screwed fasteners;
- Bolts of Uniform Strength;

Practical Outcomes:

1. Understand the significance of design considerations from different aspects in practical product development.
2. Apply engineering principles to select appropriate materials and assemble bolted joints effectively.
3. Analyze and design riveted joints considering various loading conditions and joint configurations.
4. Demonstrate the ability to design shafts to withstand different types of loading scenarios.
5. Develop practical skills in designing couplings for torque transmission and motion transfer applications.

Practical Exercises:

1. Analyze a common household product's design considerations based on economics, manufacturing, aesthetics, and ergonomics.
2. Design and assemble a bolted joint for a given application, considering load and safety factors.
3. Construct and analyze a riveted joint using specified materials and dimensions.
4. Calculate the dimensions and material specifications for a shaft based on torque and rotational speed requirements.
5. Construct a Bell-Crank lever mechanism to achieve a specific mechanical advantage.
6. Design and fabricate a cone clutch, determining clutch plate dimensions and spring force.
7. Modify a simple product design to enhance manufacturability and ease of assembly.

Reference Books:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575).
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co.,Delhi (ISBN: 978-9382609-513).
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.
8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

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EMBEDDED SYSTEM

Course Code:	455002
Course Title	Embedded System
No. of Credits	10 (TH:6,T:0,P:8)

COURSE OUTCOMES:- At the end of the course, the student will be able to:

1. Explain Arduino/Arduino mega specification such as GPIO pins, serial communication, baud rate calculation.
2. Write basic C codes for Arduino / AT Mega .
3. Interface different analog and digital peripheral with Arduino /Mega.

COURSE CONTENTS

UNIT 1 –

- Embedded C basics operators for Arduino;
- Familiarizing with the Arduino IDE;
- Sketch designing for Arduino Communication interfaces using serial port;
- Basic understanding of the code with Boolean operations, pointer access operations, bitwise operations, compounded operations.

UNIT 2 –

- Embedded C control structure blocks;
- looping mechanism – for, do and while;
- The branching operations based on conditions expression.

UNIT 3 -

- Introduction to Arduino ATMega;
- Arduino ATMega specifications including power ratings, digital and analog peripherals;
- Difference between the C language and Embedded C language;
- Arduino ATMega Ports, Pins, Digital and Analog Peripherals.

UNIT 4 -

- Communication with Arduino;
- Different communication modules available with their real-life application Communication interface.

PRACTICAL OUTCOMES: At the end of the course, the student will be able to:

1. Install Arduino/Arduino mega IDE.
2. Write basic C codes for Arduino /ATMega (for LED Blinking With Button).
3. Interface different analog and digital peripheral with Arduino /ATMega.

List of Practicals:

1. Built-in LED state control by push button sketch implementation
2. Built-in LED blinking sketch implementation
3. Built-in LED blinking by toggling states based on binary operation
4. Built-in LED state control by user interface through serial port
5. User interface for Boolean operation and bit wise operation through serial port
6. User interface for compounded operation through serial port
7. Looping mechanism to check the state of pin and if change print its status on serial port
8. Controlling multiple LEDs with a loop and an array
9. Use a potentiometer to control the blinking of an LED.
10. Uses an analog output (PWM pin) to fade an LED.
11. Servo Motor Control using PWM
12. Temperature sensor interfacing and sending its reading over serial port
13. I2C light sensor interfacing and sending its reading over serial port

References /Suggested Learning Resources:

1. Arduino Projects For Dummies (For Dummies Series) Kennedy George; Davis Bernard; Prasanna SRM Wiley (5 July 2013), ISBN: 978-1118551479.
2. Make: Getting Started With Arduino - The Open Source Electronics Prototyping Platform Massimo Banzi and Michael Shiloh Shroff/Maker Media; Third edition (27 December 2014), ISBN : 978-9351109075.

Suggested Software/Learning Websites:

1. https://www.arduino.cc/reference/en/
2. https://learn.adafruit.com/category/learn-arduino

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'Elective 1-1'
THERMAL ENGINEERING

Course Code:	455003
Course Title	Thermal Engineering
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES:- At the end of the course, the student will be able to:

1. Understand the basics of thermodynamics and components of a thermal power plant
2. Classify I.C. engines and understand their working and constructional features.
3. Understand different systems of I.C. engines
4. Know the working and applications of gas turbines
5. Know the applications of refrigeration and classify air-conditioning systems.

COURSE CONTENTS

Unit - 1 : Introduction To Thermodynamics

- Role of Thermodynamics in Engineering and Science;
- Types of Systems;
- Thermodynamic Equilibrium;
- Properties, State, Process and Cycle;
- Elementary introduction to Zeroth Law;
- First Law, Heat & Work Interactions for various non-flow and flow processes (No numericals);
- Second laws of thermodynamics Kelvin-Planck and Clausius Statements (No numericals).

Unit - 2 : Internal Combustion Engines:

- Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams;
- Internal and external combustion engines;
- Advantages of I.C. engines over external combustion engines;
- Classification of I.C. engines;
- Working of four-stroke and two-stroke petrol and diesel engines;
- Comparison of two stroke and four stroke IC engines;
- Comparison of C.I. and S.I. engines.

Unit - 3 : I.C. Engine Systems:

- Fuel system of Petrol engines;
- Fuel system of Diesel engines;
- Cooling system - Air cooling and Water cooling system;

- Types of lubricating systems used in I.C. engines with line diagram.

UNIT 4 - Gas Turbines

- Air-standard Brayton cycle, description with P-V and T-S diagrams;
- Gas turbines Classification, open cycle gas turbines and closed cycle gas turbines;
- Applications and limitations of gas turbines;

UNIT 5 - Refrigeration & Air-conditioning:

- Refrigeration; COP of refrigeration systems;
- Vapour Compression system: components, working & applications;
- Air conditioning; Classification of Air-conditioning systems;
- Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system.

References:

1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House, Delhi
2. Elements of Mechanical Engineering – M. L. Mathur, F. S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai.
4. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, NewDelhi.
5. Thermal Engineering – R. K. Rajput,8th Edition, Laxmi publications Pvt Ltd, New Delhi.

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'Elective 1-2'
MATERIAL SCIENCE & ENGINEERING

Course Code:	455004
Course Title	Material Science & Engineering
No. of Credits	5 (TH:5,T:0,P:0)

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

1. Explain about crystal structures and atomic bonds.
2. Describe about classification of ferrous metals and their properties.
3. Explain about non-ferrous metals, cutting tool materials and composites along with their properties.
4. Describe about the various metallic failures and knowledge in testing of materials.
5. Explain the principle of corrosion, their types and its prevention methods along with the various surface engineering processes.

COURSE CONTENTS

Unit - 1 Crystal Structures and Bonds

- Unit cell and space lattice;
- Crystal system
- The seven basic crystal systems;
- Atomic radius and atomic radius for Simple Cubic, BCC and FCC;
- Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP;
- Bonds in solids: Primary and secondary bond (Introduction);

Unit : 2 - Phase Diagrams, Ferrous Metals and Its Alloys

- Isomorphs, eutectic and eutectoid systems;
- Iron-Carbon binary diagram;
- Iron and Carbon Steels;
- Flow sheet for production of iron and steel
- Iron ores
- Pig iron:
- Classification
- Composition and Effects of Impurities on Iron;
- Cast Iron: Classification, Composition. properties & uses
- Wrought Iron: Properties, uses / applications
- Comparison of cast iron, wrought iron and mild steel and high carbon steel;
- Standard commercial grades of steel as per BIS and AISI;
- Alloy Steels – Types and uses.
- Stainless steel - Types and uses.

Unit : 3 - Non - Ferrous Metals and Its Alloys

- Properties of Non-Ferrous metals;
- Copper alloys: Brasses, bronzes – composition, properties and uses;
- Aluminium alloys: properties and uses;
- Nickel alloys: properties and uses;
- Types of Anti-friction/Bearing alloys;
- Standard commercial grades as per BIS/ASME.

Unit 4 - Failure Analysis & Testing of Materials

- Introduction to failure analysis;
- Fatigue, Endurance Limit;
- Characteristics of Fatigue Fracture;
- Variables Affecting Fatigue Life;
- Creep, Creep Curve, Creep Fracture;
- Destructive Testing, Non-destructive testing;

Unit : 5 - Surface Engineering

- Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces;
- Organic coatings, Electroplating and Special metallic plating;
- Electro polishing and photo-etching.

References:

1. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
2. Material Science & Engineering – R.K. Rajput, S.K. Kataria & Sons, New Delhi, 2004.
3. Material Science – R.S. Khurmi, S. Chand & Co. Ltd., New Delhi, 2005

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‘Elective 2-1’
TOTAL QUALITY MANAGEMENT

Course Code:	455005
Course Title	Total Quality Management
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES : After completion of this course the students are able to:

1. Develop an understanding on quality management philosophies and frameworks
2. Develop in-depth knowledge on various tools and techniques of quality management
3. Learn the applications of quality tools and techniques in both manufacturing and service industry
4. Develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those.
5. Emerging concepts for quality and Taguchi optimization technique for off-line

COURSE CONTENTS

Unit - I : Introduction :

Definition of quality, dimensions of quality, quality planning, quality costs, basic concepts of total quality management, historical review, principles of TQM, Role of senior management, quality statements.

Unit - II : Total Quality Management Principles

Customer satisfaction – customer perception of quality, customer complaints, service quality, customer retention, employee involvement – motivation, empowerment, teams, recognition and reward, performance appraisal, benefits, continuous process improvement – Juran trilogy, PDSA cycle, 5s, kaizen.

Unit - III : Total Quality Management Tools

Bench marking – reasons to benchmark, bench marking process, Basic idea of Quality Function Deployment (QFD).

Unit - IV : Quality Systems

Quality Auditing - Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Requirements and Benefits.

Unit - V : Statistical Process Control (SPC)

The seven tools of quality, overview of central tendency and dispersion, population and sample, process capability, concept of six sigma.

Text & Reference Books:

1. Total Quality Management, M.P. Poonia & S.C. Sharma, Khanna Publishing House, 2018.
2. Total Quality Management – An Introductory Text by Paul James, Prentice Hall
3. Quality Control and Applications by Housen & Ghose
4. Industrial Engineering Management by O.P. Khanna.

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‘Elective 2-2’
COMPUTER INTEGRATED MANUFACTURING (CIM)

Course Code:	455006
Course Title	Computer Integrated Manufacturing (CIM)
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES :- At the end of the course, the student will be able to:

1. Understand the Concept of Computer Integrated Manufacturing
2. Understand the principle of Computer Aided Design
3. To know about Computer Aided Manufacturing
4. To learn about Computer aided production scheduling; computer aided inspection planning
5. Understand the Integrating NC machines, robots, AGVs, and other NC equipment.

COURSE CONTENTS

Unit-1:Introduction to Computer Intigrated Manufacturing

- Concept of Computer Integrated Manufacturing (CIM);
- Basic components of CIM;
- Future automated factory; social and economic factors.

Unit : 2 - Computer Aided Design (Theoretical Aspects)

- Computer Aided Design (CAD): Hardware and Software requirement;
- Product modelling, automatic drafting; engineering analysis;
- FEM design review and evaluation;
- Group Technology Centre.

Unit : 3- Computer Aided Manufacturing

- Computer Aided Manufacturing (CAM);
- Overview of Computer assisted NC part programming;
- Overview of Computer assisted robot programming; computer aided process planning (CAPP);
- Overview of Computer aided material requirements planning (MRP).
- Overview of Automated Guided Vehicle (AGV) and its applications in manufacturing.

Reference Books:

1. CAD, CAM, CIM - P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing - Paul G. Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation – S. R. Deb, Tata McGraw Hill.

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‘Open Elective 1-1’
INDUSTRIAL AUTOMATION CONCEPTS

Course Code:	455007
Course Title	Industrial Automation Concepts
No. of Credits	4 (TH:4,T:0,P:0)

COURSE OUTCOMES :- At the end of the course, the student will be able to:

1. Identify different types of automation systems.
2. Interface I/O devices with the PLC modules.
3. Develop PLC ladder programs for various applications.
4. Select the suitable motor drives for different applications
5. Prepare simple SCADA applications.

COURSE CONTENTS

Unit - 1 : Introduction of Industrial Automation

1. Industrial automation overview;
2. Architecture of Industrial Automation Systems;
3. Data Acquisition Systems;

Unit : 2 - PLC Fundamentals

1. Building blocks of PLC: CPU, Memory organization, Input-output modules (digital & analog), Power supply.
2. Fixed and Modular PLC and their types, Redundancy in PLC module.
3. I/O module selection criteria
4. Interfacing different I/O devices with appropriate I/O modules

Unit - 3 : PLC Programming and Applications

1. PLC I/O addressing
2. PLC programming Instructions.
3. PLC programming language.
4. PLC Based Applications: Motor sequence control, Traffic light control, Tank Level control, Stepper motor control.

Unit- 4: Supervisory Control & Data Acquisition System (SCADA)

1. Introduction to SCADA: General SCADA architecture/ block diagram, Benefits of SCADA.
2. Various editors of SCADA.

3. Interfacing SCADA system with PLC:
    - Typical connection diagram,
    - Object Linking & embedding for Process Control (OPC) architecture,
    - Steps in Creating SCADA Screen for simple object,
    - Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC.
4. Applications of SCADA: Traffic light control, water distribution, pipeline control.

References:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
4. Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN : 9780130607188
5. Stenerson Jon, Industrial automation and Process control, PHI Learning, New Delhi, 2003, ISBN: 9780130618900
6. Mitra, Madhuchandra; Sengupta, Samarjit, Programmable Logic Controllers and Industrial Automation - An introduction, Penram International Publication, 2015, ISBN: 788187972174
7. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097179 Electrical Engineering Curriculum Structure
8. Bailey David ; Wright Edwin, Practical SCADA for industry, Newnes (an imprint of Elsevier), UK 2003, ISBN:0750658053

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‘Open Elective 1-2’
INTERNET OF THINGS

Course Code:	435002
Course Title	Internet of Things
No. of Credits	4 (TH:4,T:0,P:0)

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

1. Understand the fundamental concepts and principles of the Internet of Things (IoT) and its applications.
2. Design and develop IoT architectures, considering scalability, security, and interoperability.
3. Implement IoT solutions using relevant hardware platforms, software frameworks, and programming languages.
4. Apply data collection and analytics techniques to extract insights from IoT systems.
5. Analyze and evaluate the challenges and ethical considerations related to privacy, security, and data governance in IoT deployments.
6. Explore emerging trends and applications of IoT, such as smart cities, industrial IoT, healthcare, and agriculture.

COURSE CONTENTS

Unit 1:

1.1 Introduction to IoT

1.2 Sensing elements

1.3 Actuation methods

Unit - 2 :

2.1 Basics of IoT Networking

2.2 Communication Protocols

2.3 Sensor networks

Unit - 3 :

3.1 Introduction to Basic Arduino programming

3.2 Integration of Sensors/Actuators to Arduino

Unit - 4 :

4.1 Implementation of IoT with Raspberry Pi (Overview Only)

4.2 Data Handling Analytics

Unit - 5 :

5.1 Case Studies of IoT applications (any one example) in the filed of :

5.1.1 Agriculture

5.1.2 Healthcare

5.1.3 Activity Monitoring

References:

1. "Internet of Things (A Hands-on Approach)" by Arshdeep Bahga and Vijay Madisetti.
2. "IoT Solutions in Microsoft's Azure IoT Suite" by Scott Klein and Paolo Patierno.
3. "Raspberry Pi IoT Projects: Prototyping Experiments for Makers" by John C. Shovic and Jeff Chang.
4. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro.
5. "Practical Internet of Things with MQTT and RabbitMQ" by Anand Vemuri.
6. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22
7. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
8. Internet of Things by Dr. Jeeva Jose, Khanna Publishing House (Edition 2017)
9. Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill

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SUMMER INTERNSHIP-II

Course Code:	AS501
Course Title	Summer Internship - II
No. of Credits	3 (TH:0,T:0,P:0)

Summer Internship provides an invaluable opportunity for students pursuing their Diploma in Engineering to gain real-world experience and exposure to various industrial production units and commercial activities related to their field of study. This program aims to bridge the gap between theoretical knowledge and practical application, equipping students with the necessary skills and expertise to thrive in the branch related industry.

At the end of the **Fourth semester,** students will undertake a minimum **6-week** Summer Internship, scheduled during the semester break following the Fourth Semester examinations. The respective Heads of Departments (HoDs) and experienced faculty members will guide and assist students in securing suitable training opportunities that align with their specialization. Each student will have a personalized training schedule developed in collaboration with the training providers, ensuring a comprehensive and enriching learning experience.

Before starting their training, students will receive a comprehensive briefing about the organizational setup, product range, manufacturing processes, and significant machinery and materials used in the training organization. This preliminary understanding will enhance their engagement and productivity during the internship.

To ensure a fruitful learning experience, faculty members will supervise students during their training in the industry or field organization. Each teacher will mentor a small group of 4-5 students, providing personalized attention and guidance. Students will be encouraged to maintain daily reports in their diaries, which will assist them in composing their final training report and presentation.

The evaluation process for the Summer Internship will include both internal and external assessments, as per the study and evaluation scheme of the **Fifth Semester.** During the viva-voce/presentation examination, students' understanding of materials, industrial processes, practices in the industry, and problem-solving abilities will be assessed. The evaluation will also focus on their application of knowledge and skills in real-life situations.

The components of evaluation will comprise:

(a) Punctuality and regularity: 15%

(b) Initiative in learning new things: 15%

(c) Relationship with peers and colleagues: 10%

(d) Summer Internship report: 25%

(e) Viva-Voce: 35%

We believe that this Summer Internship program will be a transformative experience for our students, empowering them to excel in their future careers and make meaningful contributions to the Engineering industry. The collaborative efforts of our experienced faculty members and industry partners will ensure that students gain valuable insights and practical skills during this immersive learning journey.

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MAJOR PROJECT-I

Course Code:	AS502
Course Title	Major Project - I
No. of Credits	1 (TH:0,T:0,P:2)

The evaluation of Major Project-I will be conducted to assess students' understanding, application, and presentation of their chosen project topic. The following evaluation criteria will be used to measure their performance:

1. **Project Identification (10%):**
   - Clarity and relevance of the chosen project topic.
   - Demonstration of understanding of the industry or community needs addressed by the project.
   - Adequate justification for selecting the particular project topic.

2. **Project Proposal (10%):**
   - Comprehensive description of project objectives and scope.
   - Logical and well-structured methodology for project execution.
   - Feasibility of the proposed project, considering available resources.

3. **Literature Review (10%):**
   - Thoroughness of the research conducted in relevant academic and professional sources.
   - Critical analysis of existing literature, identifying gaps and potential contributions of the project.

4. **Feasibility Study (10%):**
    - Evaluation of the project's practicality and viability.
    - Assessment of potential risks and proposed mitigation strategies.

5. **Project Planning (20%):**
    - Detailed project plan, including timeline, milestones, and resource allocation.
    - Realistic budgeting and cost management strategies.

6. **Proposal Presentation (30%):**
    - Clarity and effectiveness of communication during the presentation.
    - Ability to address questions and defend the project proposal confidently.
    - Professionalism and engagement with the panel and audience.

7. **Overall Impression (10%):**
    - Demonstrated commitment and effort throughout the project.
    - Creativity and innovation in problem-solving.
    - Adherence to project management principles and best practices.

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