B. Sc. in Materials Science and Engineering

University of Rajshahi

Faculty of Engineering

Department of Materials Science and Engineering

Curriculum for B. Sc. Engineering

Session: 2025-2026

Examination	
B. Sc. Engg. First Year	**2026**
B. Sc. Engg. Second Year	**2027**
B. Sc. Engg. Third Year	**2028**
B. Sc. Engg. Fourth Year	**2029**

1. Title of the Academic Program:

B. Sc. in Materials Science and Engineering

2. Name of the University:

University of Rajshahi

3. Vision of the University:

To pursue enlightenment and creativity in producing world-class human resources to cater for the needs of the changing times.

4. Mission of the University (MU):

MU1	To ensure a world-class curriculum with talented academicians and a conducive academic and research environment for the generation and dissemination of knowledge.
MU2	To maintain international standards in education with a focus on both knowledge and skills, and humanitarian and ethical values to meet the needs of society and the state.
MU3	To develop strategic partnerships with leading national and international universities, and organizations for academic as well as research collaborations.

5. Name of the Program Offering Entity (POE):

Department of Materials Science and Engineering (MSE)

6. Vision of the Program Offering Entity:

It aims to be a centre of education and research, producing innovative engineers who can address the global challenges of tomorrow’s Materials Science and Engineering arena.

7. Mission of the Program Offering Entity (POE):

To achieve the vision of MSE, we want to

POE1	Cultivate students with a vibrant engineering education and prepare them for a future outlook.
POE2	Promote cutting-edge materials-based interdisciplinary research to figure out sustainable solutions for national and global problems.
POE3	Develop new material, design, or technology with a focus on 'Make in Bangladesh' and `Future Today` concept.
POE4	Nurture the leadership role of the students to be compatible with the multi-disciplinary materials community.

8. Objectives of the Program Offering Entity (POE)

Materials Science and Engineering is one of the most important, lucrative, and practical subjects in modern science. Nowadays, the subject is considered a barometer of a country's development. The objectives of MSE are to create skilled engineers who can deal with the processing, designing, and characterizing of materials, develop new materials, produce cost-effective materials, and apply the materials in structures, machines, and devices of technological importance.

9. Name of the Degree:

B. Sc. Engineering

10. Description of the Program:

The B.Sc. Engineering in Materials Science and Engineering program will be offered over a period of four academic years, each of a normal duration of one calendar year. The four academic years shall be designated as First Year, Second Year, Third Year, and Fourth Year in succeeding higher levels of study. The academic year will be divided into two semesters (First and Second). Under no circumstances, any student shall be allowed to continue his/her study for B. Sc. Engineering degree for more than six academic years. A student will be required to have 70% attendance of the total number of periods of lectures/tutorials/laboratory classes held during the semester to appear as a regular candidate at that semester final examinations. The courses offered by the Materials Science and Engineering department will consist of theoretical, practical, viva voce, quizzes/class tests, attendance, and a research project, totaling 4000 marks (160 credits).

11. Graduate Attributes:

- Sound knowledge and demonstration capabilities
- Creative thinking and analytical abilities
- Team work, communication skills and social responsibilities
- Professionalism and leadership potential
- Technological capabilities
- Insightfulness and emotional intelligence

12. Program Educational Objectives (PEOs):

The graduates of the Materials Science and Engineering Program at the University of Rajshahi will

PEO1	be compatible for employment and research in industry, laboratories, academia, and allied professions.
PEO2	be engaged in materials discovery and/or processing to meet national or global challenges.
PEO3	demonstrate ethical responsibility for their profession and community.
PEO4	serve the society through science and technology.

13. Program Learning Outcomes (PLOs)

After completion of the B.Sc. Engineering in Materials Science and Engineering program graduates will be able to

PLO-1	**Engineering knowledge:** Demonstrate appropriate breadth and depth of knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialization to solve complex materials science and engineering related problems.
PLO-2	**Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems to establish conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PLO-3	**Design/development of solutions:** Design systems, components, processes, or a new material to solve a complex engineering problem that meets specified needs with

appropriate consideration for public health, safety, cultural, societal, and environmental considerations.

PLO-4 **Investigation:** Conduct investigations of complex problems using research-based knowledge of materials science and engineering to search for new methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PLO-5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex materials engineering problems.

PLO-6 **The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex engineering problems.

PLO-7 **Environment and sustainability:** Understand and evaluate the sustainability and impact of a new material or technology while solving complex engineering problems in societal and environmental contexts.

PLO-8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-9 **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.

PLO-10 **Communication:** Communicate effectively unanswered questions about materials in writing and oral presentations; express the scientific and societal impact of their work; and disseminate new knowledge through archived publications, such as articles, theses, effective reports, and design documentation on complex engineering activities with the engineering community and society.

PLO-11 **Project management and finance:** Demonstrate 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, to manage projects and in multi-disciplinary environments.

PLO-12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in, independent and life-long learning in the broadest context of technological change.

14. Mapping the mission of the University with PEOs

PEOs	MU1	MU2	MU3
PEO 1	√		√
PEO 2			√
PEO 3		√	
PEO 4		√	

15. Mapping PLOs with the PEOs

PLOs	PEO 1	PEO 2	PEO 3	PEO 4
PLO 1	√	√		
PLO 2	√	√		
PLO 3	√	√		
PLO 4	√	√		
PLO 5	√	√		
PLO 6			√	√
PLO 7			√	√
PLO 8			√	
PLO 9			√	
PLO 10	√	√		
PLO 11	√	√		
PLO 12	√	√		

16. Mapping courses with PLOs

Y/S	Course Code and Title	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12
First Year First Semester	MSE1111 Introduction to Materials Science and Engineering	√		√									√
	MSE1121 Crystallography-I	√	√	√									
	MATH1111 Matrices, Vector Analysis, and Coordinate Geometry	√	√	√									
	PHY1111 Electricity and Magnetism	√	√	√	√								
	PHY1112 Electricity and Magnetism Sessional	√	√		√								
	CHEM1111 Organic Chemistry	√	√		√								
	CHEM1112 Organic Chemistry Sessional	√	√		√								
	ENG1111 Technical and Communicative English	√								√	√		
	MSE 1112	√	√	√									

	Engineering Drawing												
First Year Second Semester	MSE1211 Crystallography-II	√	√	√	√								
	MSE1212 Crystallography-II Sessional	√			√								
	MSE1221 Solid and Fluid Mechanics	√	√	√	√								
	MSE1222 Solid and Fluid Mechanics Sessional	√	√	√	√								
	MATH1211 Calculus and Differential Equations	√	√	√	√								
	CHEM1211 Physical and Inorganic Chemistry	√	√	√	√								
	CHEM1212 Physical and Inorganic Chemistry Sessional	√	√	√									
	ECON1211 Industrial Economics						√					√	√
	ME1212 Mechanical Engineering Workshop	√		√									
	MSE1210 Board Viva voce									√	√		
Second Year First Semester	MSE2111 Materials Thermodynamics	√	√		√								
	MSE2112 Materials Thermodynamics Sessional	√	√		√								
	MSE2121 Quantum and Semiconductor Science	√	√		√								
	MSE2122 Quantum and Semiconductor Science Sessional	√	√		√								
	EEE2111 Electrical and Electronic Engineering	√	√	√	√								
	EEE2112 Electrical and Electronic Engineering Sessional	√	√	√	√								
	MATH2111 Numerical, Statistical, and Advanced Mathematical Methods	√	√	√	√								
	PHY2111 Waves, Optics, and Optical Properties	√	√		√								
	PHY2112 Waves, Optics, and Optical Properties Sessional	√	√		√								
	ACCO2111 Industrial Management and Accountancy						√				√	√	

Second Year Second Semester	MSE2211 Phase Diagram and Microstructure of Materials	√	√	√	√								
	MSE2212 Phase Diagram and Microstructure of Materials Sessional	√	√	√	√								
	MSE2221 Transport and Kinetic Phenomena in Materials	√	√		√								
	MSE2231 Mechanical Properties of Materials	√	√	√	√								
	MSE2232 Mechanical Properties of Materials Sessional	√	√	√	√	√							
	CSE2211 Computer Fundamentals and Programming	√	√		√	√							
	CSE2212 Computer Fundamentals and Programming Sessional	√	√		√	√							
	LAW2211 Law and Professional Ethics								√				√
	MSE2210 Board Viva voce									√	√		
Third Year First Semester	MSE3111 Polymeric Materials	√	√		√								
	MSE3112 Polymeric Materials Sessional	√	√		√								
	MSE3121 Electrochemical Engineering	√	√		√								
	MSE3122 Electrochemical Engineering Sessional	√	√		√								
	MSE3131 Composite Materials	√	√	√	√								
	MSE3132 Composite Materials Sessional	√	√	√	√								
	MSE3141 Construction Materials	√	√					√					
	MSE3142 Construction Materials Sessional	√	√					√					
	MSE3151 Production Metallurgy	√				√							
	MSE3152 Production Metallurgy Sessional	√				√							
	MSE3161 Materials Manufacturing Engineering	√	√	√	√	√							
	MSE3162 Materials Manufacturing Engineering Sessional	√	√	√	√	√							

Third Year Second Semester	MSE3211 Physical Metallurgy of Iron and Steels	√	√	√	√								
	MSE3211 Physical Metallurgy of Iron and Steels Sessional	√	√	√	√								
	MSE3221 Welding and Joining Engineering				√	√							
	MSE3222 Welding and Joining Engineering Sessional		√	√	√								
	MSE3231 Corrosion Engineering	√	√	√	√								
	MSE3232 Corrosion Engineering Sessional	√		√									
	MSE3241 Glass and Ceramics	√	√		√								
	MSE3242 Glass and Ceramics Sessional	√	√		√								
	MSE3251 Energy Conversion and Storage Systems	√	√	√	√								
	MSE3252 Energy Conversion and Storage Systems Sessional	√	√	√	√								
	MSE3210 Board Viva voce									√	√		
Fourth Year Second Semester	MSE4111 Materials Characterization-I	√	√	√	√	√							
	MSE4112 Materials Characterization-I Sessional	√	√	√	√	√							
	MSE4121 Plastic and Rubber Technology		√	√	√	√							
	MSE4122 Plastic and Rubber Technology Sessional		√	√	√	√							
	MSE4131 Magnetic and Dielectric Materials	√	√	√		√							
	MSE4132 Magnetic and Dielectric Materials Sessional	√	√	√		√							
	MSE4141 Waste Management, Industrial Safety and Environmental Issues						√	√					
	MSE4151 Surface Science and Engineering	√	√		√								
	MSE4152 Surface Science and Engineering Sessional	√	√		√								

	MSE4162 Industrial Training/Study tour/Field work	√								√	√		
	MSE4172 Research Project		√	√						√	√		
Fourth Year Second Semester	MSE4211 Nano-and Biomaterials	√	√	√									
	MSE4212 Nano-and Biomaterials Sessional	√	√	√									
	MSE4221 Materials Characterization-II	√	√	√	√								
	MSE4231 Computational Materials Science	√	√	√	√	√							
	MSE4232 Computational Materials Science Sessional	√	√	√	√	√							
	MSE4241 Selection of Engineering Materials	√	√					√					
	MSE4251 Fiber and Textile Engineering	√	√										
	MSE4252 Fiber and Textile Engineering Sessional	√	√										
	MSE4272 Research Project		√	√						√	√		
	MSE4210 Board Viva voce									√	√		

17. Structure of the Curriculum/Program Description

The B.Sc. Engineering courses in Materials Science and Engineering (total 4000 marks, 160 credits) shall be divided into four academic years. Each year will be divided into two semesters. The distribution of courses, marks, credits, contact hours per week in Yearly Semester wise Examinations shall be as follows:

First Year First Semester Examination, 2026

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE1111	Introduction to Materials Science and Engineering	50	2	2
MSE1121	Crystallography-I	50	2	2
MATH1111	Matrices, Vector Analysis and Coordinate Geometry	75	3	3
PHY1111	Electricity and Magnetism	75	3	3
PHY1112	Electricity and Magnetism Sessional	25	1	3
CHEM1111	Organic Chemistry	50	2	2
CHEM1112	Organic Chemistry Sessional	25	1	3
ENG1111	Technical and Communicative English	50	2	2
MSE 1132	Engineering Drawing	25	1	3
	Total	**450**	**18**	**26**

First Year Second Semester Examination, 2026

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE1211	Crystallography-II	50	2	2
MSE1212	Crystallography Sessional	50	2	6
MSE1221	Solid and Fluid Mechanics	75	3	3
MSE1222	Solid and Fluid Mechanics Sessional	25	1	3
MATH1211	Calculus and Differential Equations	75	3	3
CHEM1211	Physical and Inorganic Chemistry	75	3	3
CHEM1212	Physical and Inorganic Chemistry Sessional	25	1	3
ECON1211	Industrial Economics	50	2	2
ME1212	Mechanical Engineering Workshop	25	1	3
MSE1210	Board Viva voce	50	2	-
	Total	**500**	**20**	**28**

Second Year First Semester Examination, 2027

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE2111	Materials Thermodynamics	75	3	3
MSE2112	Materials Thermodynamics Sessional	25	1	3
MSE2121	Quantum and Semiconductor Science	75	3	3
MSE2122	Quantum and Semiconductor Science Sessional	25	1	3
EEE2111	Electrical and Electronic Engineering	75	3	3
EEE2112	Electrical and Electronic Engineering Sessional	25	1	3
MATH2111	Numerical, Statistical, and Advanced Mathematical Methods	75	3	3
PHY2111	Waves, Optics, and Optical Properties	75	3	3
PHY2112	Waves, Optics, and Optical Properties Sessional	25	1	3
ACCO2111	Industrial Management and Accountancy	50	2	2
	Total	**525**	**21**	**29**

Second Year Second Semester Examination, 2027

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE2211	Phase Diagram and Microstructure of Materials	75	3	3
MSE2212	Phase Diagram and Microstructure of Materials Sessional	25	1	3
MSE2221	Transport and Kinetic Phenomena in Materials	75	3	3
MSE2231	Mechanical Properties of Materials	75	3	3
MSE2232	Mechanical Properties of Materials Sessional	25	1	3
CSE2211	Computer Fundamentals and Programming	75	3	3
CSE2212	Computer Fundamentals and Programming Sessional	25	1	3
LAW2211	Law and Professional Ethics	50	2	2
MSE2210	Board Viva voce	50	2	-
	Total	**475**	**19**	**23**

Third Year First Semester Examination, 2028

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE3111	Polymeric Materials	75	3	3
MSE3112	Polymeric Materials Sessional	25	1	3
MSE3121	Electrochemical Engineering	75	3	3
MSE3122	Electrochemical Engineering Sessional	25	1	3
MSE3131	Composite Materials	75	3	3
MSE3132	Composite Materials Sessional	25	1	3
MSE3141	Construction Materials	50	2	2
MSE3142	Construction Materials Sessional	25	1	3
MSE3151	Production Metallurgy	75	3	3
MSE3152	Production Metallurgy Sessional	25	1	3
MSE3161	Materials Manufacturing Engineering	50	2	2
MSE3162	Materials Manufacturing Engineering Sessional	25	1	3
	Total	**550**	**22**	**34**

Third Year Second Semester Examination, 2028

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE3211	Physical Metallurgy of Iron and Steels	75	3	3
MSE3212	Physical Metallurgy of Iron and Steels Sessional	25	1	3
MSE3221	Welding and Joining Engineering	50	2	2
MSE3222	Welding and Joining Engineering Sessional	25	1	3
MSE3231	Corrosion Engineering	75	3	3
MSE3232	Corrosion Engineering Sessional	25	1	3
MSE3241	Glass and Ceramics	75	3	3
MSE3242	Glass and Ceramics Sessional	25	1	3
MSE3251	Energy Conversion and Storage Systems	75	3	3
MSE3252	Energy Conversion and Storage Systems Sessional	25	1	3
MSE3210	Board Viva voce	50	2	-
	Total	**525**	**21**	**29**

Fourth Year First Semester Examination, 2029

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE4111	Materials Characterization-I	75	3	3
MSE4112	Materials Characterization-I Sessional	25	1	3
MSE4121	Plastic and Rubber Technology	75	3	3
MSE4122	Plastic and Rubber Technology Sessional	25	1	3
MSE4131	Magnetic and Dielectric Materials	75	3	3
MSE4132	Magnetic and Dielectric Materials Sessional	25	1	3
MSE4141	Waste Management, Industrial Safety, and Environmental Issues	50	2	2
MSE4151	Surface Science and Engineering	50	2	2
MSE4152	Surface Science and Engineering Sessional	25	1	3
MSE4162	Industrial Training/Study Tour/Field Work	50	2	-
MSE4172	Research Project	25	1	-
	Total	**500**	**20**	**25**

Fourth Year Second Semester Examination, 2029

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE4211	Nano-and Biomaterials	75	3	3
MSE4212	Nano-and Biomaterials Sessional	25	1	3
MSE4221	Materials Characterization-II	75	3	3
MSE4231	Computational Materials Science	75	3	3
MSE4232	Computational Materials Science Sessional	25	1	3
MSE4241	Selection of Engineering Materials	50	2	2
MSE4251	Fiber and Textile Engineering	75	3	3
MSE4252	Fiber and Textile Engineering Sessional	25	1	3
MSE4272	Research Project	50	2	-
MSE4210	Board Viva voce	50	2	-
	Total	**525**	**21**	**23**

18. Year/Level/Semester/Term wise distribution of courses

Year-Semester	Theory		Lab and Others		Total	
	No. of Courses	Credits	No. of Courses	Credits	No. of Courses	Credits
First - First	6	14	3	3	9	17
First - Second	5	13	5	7	10	20
Second – First	6	17	4	4	10	21
Second – Second	5	14	4	5	9	19
Third – First	6	16	6	6	12	22
Third – Second	5	14	5	6	20	20
Fourth – First	5	13	5	6	10	19
Fourth – Second	5	14	5	8	10	22
Total	43	115	38	45	81	160

Course Outline

First Year First Semester Examination, 2026

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1111	**Introduction to Materials Science and Engineering**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:
This course is designed to familiarize students with the fundamental concepts of materials science and engineering, which will serve as a foundation for understanding specialized courses in the field of Materials Science and Engineering. Thus, this course introduces the type of materials, structure, properties, characteristics, and applications with special emphasis on the relationships between internal structure and properties.

Intended Learning Objectives (ILOs):

1. To familiarize the students with the importance of materials science in modern civilization.
2. To classify materials in the context of various types of properties.
3. To make the relation among the structure, properties, and processing of materials.
4. To select proper alternative materials when needed.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Classify the materials	PLO1	☒ Lecture ☐ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☒ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand the fundamental properties that characterize the behavior of materials.	PLO1	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☐ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Able to make the relation among the structure, properties and processing of materials.	PLO3	☒ Lecture ☐ Tutorial ☐ Discussion ☒ Interaction ☒ Audio/Video	☒ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Select appropriate materials where needed.	PLO3	☒ Lecture ☐ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☒ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Understanding of Materials:** Basic concepts of materials science and engineering, Development of materials, Uses of materials, Advanced materials, Modern materials' needs, Scope and applications of materials science and engineering.
CLO-1	**2. Types of Solid Materials:** Metal, polymer, ceramics, composites, semiconductor, crystalline and amorphous solids, Superconductor, Characteristics of materials.
CLO-1&2	**3. Properties of Materials:** Electrical and electronic properties, Thermal and thermoelectric properties, Mechanical Properties, Optical properties, Magnetic properties.
CLO-2&3	**4. Solidification of Materials:** Introduction, Nucleation and growth of crystal, Homogeneous and heterogeneous nucleation, Types of solid solution, Ordered and disordered solid solution, Grain and grain boundaries, Effect of cooling rate on grain size and mechanical properties.
CLO-2&3	**5. Diffusion in Solids:** Diffusion mechanisms, Steady-state and non-steady-state diffusions, Diffusion in porous media, Physical origin and rate equations, Transient diffusion, Factors that influence diffusion, Other diffusion paths.
CLO-3	**6. Materials Selection and Design:** Introduction, Importance of materials selection, Factors affecting the selection of materials, Relation of materials selection to design, Product analysis, Activities of product development.

Recommended books:

Author's name		Title of books
1. William D. Callister	:	Materials Science & Engineering- An Introduction
2. William F. Smith	:	Foundation of Materials Science and Engineering
3. L.H. Van Vlack	:	Elements of Materials Science and Engineering
4. R.B. Gupta	:	Materials Science
5. K.J. Pascoe	:	Properties of Engineering Materials

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1121	**Crystallography-I**	**2**	**50**	**2**

Course Types √ □ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

The objective of this course is to present the basic concepts needed to understand the crystal structure of materials. The chapter 1 is designed including different types of primary and secondary bonds that are exist in solid materials. A thorough description of a crystal is assigned in topics of lattice, basis, unit cell, crystal system, atomic packing factor, lattice plane, lattice directions, and crystalline structure of metal, ceramics and polymer.

Intended Learning Objectives (ILOs):

1. To analyze the bonding and stability of crystal structures.
2. To evaluate plane, direction, and model crystal structures
3. To explain different types of defects in crystals.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Calculate packing factor, density, and interplanar spacing, using the geometrical parameters of the crystal system.	PLO2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☒ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Clarify which type of defect has severe impact on material properties.	PLO1,3	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs		Course contents
CLO-1	**1.**	**Crystalline Materials:** Crystalline and non-crystalline materials; Types of crystalline solids: ionic, covalent, molecular and metallic crystals; Cohesive energy of ionic crystals; Crystal potential, Lattice energy; Born-Haber cycle; Isomorphism, polymorphism, enantiotropy and monotropy.
CLO-1	**2.**	**Crystals and Crystal Structures:** Nature of crystalline states; Faces, edges and interfacial angle; Space lattice; Unit cells and patterns; Periodicity in crystals; Atomic packing: hcp and ccp structures; Construction of crystals: closed packed hexagonal and square layers of atoms, body-centred cubic crystal, and some simple ionic and covalent structures; Selected crystal structures: Pure metals, diamond and graphite, co-ordination in ionic crystals, Cation anion radius ratio calculation of different coordination, AB-type compounds, NaCl, CsCl silica, alumina, complex oxides, silicates; Zinc sulfide, Crystallinity in polymers.
CLO-1	**3.**	**Crystal Planes and Directions:** Arrangements of ions in crystals; Lattice planes; Indexing lattice directions and lattice planes; Miller indices and zone axis symbols; Lattice planes in cubic crystals: lattice plane spacing, inter-planar distance, ratio of lattice spacing; Miller indices and Laue indices; Zones, zone axes and the zone law; Addition rule; Indexing in the trigonal and hexagonal systems; Transforming miller indices and zone axis symbols.
CLO-2	**4.**	**Crystal Imperfections:** Effects of imperfection on crystal; Causes of imperfections in crystals; Types of crystal imperfections/defects: Point defect, line defect, plane defects, volume defect.

Recommended books:

Author's name		Title of books
1. F. Donald Bloss	**:**	Crystallography and Crystal Chemistry
2. C. Hammond	**:**	Introduction to Crystallography
3. C. Kittle	**:**	Introduction to Solid State Physics

4. Uma Mukherji : Engineering Physics

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MATH1111	**Matrices, Vector Analysis and Co-ordinate Geometry**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:
This course is introduced to familiarize the students with linear algebra, trigonometry and vector analysis. This course provides the students a natural aid to the understanding of some physical concept in solving engineering problem.

Intended Learning Objectives (ILOs):

1. To introduce the fundamentals of algebra to solve mathematical equations.
2. To familiarize the students to understand trigonometric functions and calculating their value.
3. To understand the fundamental concepts of vector and to develop student understanding and skills in the topic necessary for its applications to science and engineering.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Understand sets, relation and function to solve the systems of linear equation.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Use geometric functions of complex argument to model a variety of real-world problem-solving applications.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Perform basic matrix and vector operations both graphically and algebraically–addition, subtraction and scalar multiplication.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Algebra:** Algebra of sets, De Morgan's rule, relation & function, De Moiver' theorem, Theorem, and relation between roots and coefficients, Solution of cubic equations, Determinants, properties and Cramer's rule.

CLO-2 **3. Co-ordinate Geometry of three Dimensions:** Cartesian, Cylindrical and spherical polar Co-ordinates, Transformation coordinates, Projections: Direction cosines and direction ratios; Angle between two lines; Plane: Different form of the equations of a plane, plane through points and lines, angle between two planes, distance of a point from a plane, Volume of tetrahedron, Derivation of equations of straight lines, Line on a plane, Coplanar lines, Distance of a point from a line, Shortest distance, Equations of sphere and its tangent plane, Circles on spheres, Orthogonality of spheres.

CLO-3 **2. Matrices:** Algebra of matrices, Evaluation of inverse, adjoint and rank of matrices with properties, Echelon, canonical and normal forms, Solution of system of linear equations by Gauss elimination and matrix method, Eigenvalues and eigenvectors, Caley-Hamilton theorem, Similar matrices and diagonalization.

CLO-3 **4. Vector Analysis**: Vector Addition, Multiplication, Scalar and vector products, Differentiation; Gradient of scalar functions, Divergence and curl of vector functions with their physical significance, Vector line, surface and volume integrations, Green's theorem, Stoke's theorem, Divergence Theorem and Gauss's theorem, Applications of vector calculus to engineering problems.

Recommended books:

Author's name		**Title of books**
1. H.S. Hall & S.R. Knight	**:**	Higher Algebra
2. B.C. Das & B.N. Mukherjee	**:**	Higher Trigonometry
3. M.R. Spiezel	**:**	Vector Analysis
4. Barnside & Panton	**:**	Theory of Equations
5. Rahman & Bhattacharjee	**:**	Coordinate Geometry with Vector Analysis
6. Robert J. T. Bell	**:**	An Elementary Treatise on Coordinate Geometry of Three Dimensions

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
PHY1111	**Electricity and Magnetism**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:
It is one of the fundamental or core course of physics those who want to acquire fundamental electricity and magnetism knowledge and to link them up with their studies in fields like engineering, chemistry and mathematics. In this course fundamental laws of electricity, thermoelectricity and magnetism are discussed to know their applications in aspect of modern physics. Problems solving and analytical skills of students will have increased by studying this course. From this course the students will gain primary knowledge on electrical AC and DC circuits of parallel and series combinations as well.

Intended Learning Objectives (ILOs):

1. To deliver knowledge on the fundamental laws of physics based on electrostatics.
2. To deliver idea about parallel plate capacitors using dielectrics and Gauss's law.
3. To give knowledge on electric current based on theory of electron
4. To provide overall concept on electromagnetic induction using Faraday's and Ampere's law, traditional and functional ceramics, types and structural composition of ceramics.
5. To deliver knowledge on principles of thermoelectricity; DC and AC circuits of current in series parallel connections.
6. To provide techniques and knowledge how to analyze and solve physical problems with aids of mathematics

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Know the theory of capacitance, and its application using dielectrics and Gauss law and the electron theory of conductors.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Know the use of Coulomb's law and Gauss' law for the electrostatic force and the relationship between electrostatic field and electrostatic potential.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	(a) Know the use of the Lorentz force law for the magnetic force and the use of Ampere's law to calculate magnetic fields. (b) Know the use of Faraday's law in induction problems and laws of thermoelectricity. (c) Know the basic laws that underlie the properties of electric circuit elements.	PLO2,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Electrostatics:** Electric field, Potential difference and electric potential, Electric field and potential due to various charge distributions, Electric dipole, Electric field due to a dipole, Local electric field of an atom, Electric dipole on external electric field, Gauss's Law and its applications.
CLO-2	**2. Capacitance and Dielectrics:** Parallel plate capacitors, Susceptibility, permeability, and dielectric constant, Theory of dielectric constant, Gauss's theorem in dielectrics, Capacitors with dielectrics, Energy stored in an electric field.
CLO-3	**3. Thermoelectricity:** Thermal e.m.f; Seebeck, Peltier and Thomson Effects, Laws of addition of thermal e.m.f., Thermoelectric power.
CLO-3	**4. Electric Current and Resistance:** Current and current density, Resistance and Ohm's law, The resistivity of different conductors, Electrical energy and power, Electron theory of conductivity: Conductor, semiconductors and insulators, Kirchhoff's laws, Superconductivity.
CLO-3	**5. Electromagnetic Induction:** Biot–Savart Law, Faraday's experiment, Faraday's law, Ampere's law, Lenz's Law, Motional e.m.f., Self and mutual inductance galvanometers-moving coil, Ballistic and deadbeat types.

CLO-3 **6. A.C. Theory and Frequency Domain Analysis:** General AC theory, AC power, average and RMS value of AC voltage and current, resonance phenomena in circuits, Q-value and bandwidth.

Recommended books:

Author's name		**Title of books**
1. Acharyya	**:**	Electricity and Magnetism
2. Admas & Page	**:**	Principles of Electricity
3. Emran *et al.*	**:**	Text Book of Magnetism and Electricity
4. Halliday & Resnick	**:**	Physics (Part-I & II)
5. Kip	**:**	Fundamentals of Electricity and Magnetism
6. Huq *et al.*	**:**	Concept of Electricity and Magnetism

Course Code	**Courses Title**	**Credits**	**Marks**	**Contact Hours/Week**
PHY1112	**Electricity and Magnetism Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. To study the design and construction of a capacitor. 2. To study the capacitive properties of dielectric materials. 3. To study the variation of reactance of R-L series circuit with frequency. 4. To study the variation of reactance of R-C series circuit with frequency. 5. To stud the design, construction and frequency response of a RLC series resonance circuit. 6. To study Faraday's law of electromagnetic induction. 7. To study the design and construction of a galvanometer. 8. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

Recommended books:

Author's name	**Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
CHEM1111	**Organic Chemistry**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:
This course is an introductory course in organic chemistry and intends to transmit basic knowledge of organic chemistry, which is required for the successful completion of other undergraduate courses of general background and/or specialization, such as materials chemistry, polymer chemistry/polymer materials and biomaterials.

Intended Learning Objectives (ILOs):

1. To develop basic skills for the multi-step synthesis of organic compounds and mechanism for a chemical reaction.
2. To understand the structure and reactivity of organic molecules, with examples illustrating the role of organic chemistry in industry.
3. To apply chemical principles in the laboratory setting.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Gather and recall the fundamental principles of organic chemistry that include purification, elemental analysis and bonding.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Extend knowledge on nomenclature, preparation, properties, types of reactions and important uses of aliphatic hydrocarbons.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Understand the basic concept of biochemistry and stereochemistry of organic molecules.	PLO2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. General Concept**: Purification of organic compounds, Detection of elements in organic compounds, Bonding: Covalent bond (σ and π) formation in organic compounds, Molecular shape, Delocalization and resonance.
CLO-2	**2. Aliphatic:** Nomenclature, Preparation, properties, types of reactions and important uses of aliphatic hydrocarbons, Mechanism of reaction and their homologous: Alkyl halides, Grignard reagents, Alchoholes, Aldehydes ethers and ketones, Carboxylie acids and their derivatives, Alkyl amines.

CLO-2	**3.**	**Alicyclic Compounds:** Nomenclature, Preparation and reactions of alicyclic compound: Cyclopropane, Cyclobutane, Cyclohexane and their derivatives, Ring formation and stability, Angle strain, Baeyer strain theory and its weakness, Sachse-Mohr modifications.
CLO-2	**4.**	**Aromatic compounds:** Structure of benzene (Kekule & resonance structure), Aromaticity, Mechanism of electrophilic and nucleophilic substitution, Orientation and resonance, Effects of the substituted groups in the mono-substituted benzene rings (activation & deactivation, orientation).
CLO-3	**5.**	**Biochemistry:** Definition, characteristics classification, structures, and reactions of amino acids (isoelectric points), Proteins and carbohydrates.
CLO-3	**6.**	**Stereochemistry:** Stereoisomers, Asymmetric carbon atoms and optically active compounds, Optical and molecular rotation, R and S configurations, Optical and geometrical isomerisms of simple organic compounds.

Recommended books:

Author's name		**Title of books**
1. R.T. Morrison & R.N. Boyd	**:**	Organic Chemistry
2. I. L. Finar	**:**	Organic Chemistry
3. Bhal & Bhal	**:**	Organic Chemistry Vol. I & II
4. E.L. Eliel	**:**	Stereochemistry of Carbon Compounds
5. P. Sykes	**:**	A Guide to Mechanism in Organic Chemistry
6. K. Barsal	**:**	Organic Reaction Mechanism
7. E.S. Gouldganic	**:**	Organic Reaction Mechanism

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
CHEM1112	**Organic Chemistry Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:
The purpose of the undergraduate general chemistry program is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of material science.

Intended Learning Objectives (ILOs):

1. To plane and implement of advanced organic reactions.
2. To understand basic chemistry techniques, such as how to calculate percent yields, how to use measuring devices properly.
3. To detect the elements in organic compounds.
4. To identify of functional groups organic compounds.
5. To determine and identify of different metal ions.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Identify metal and functional groups in organic compounds.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Purify and characterize of organic compounds.	PLO2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO1	**1.** Detection of elements in organic compounds.
CLO1	**2.** Identification of functional groups organic compounds.
CLO1	**3.** Identification of unknown organic compounds by their physical constants such as melting point and boiling point.
CLO1	**4.** Synthesis of different organic compounds.
CLO2	**5.** Separation, purification and characterization of organic compounds.
CLO2	**6.** Analysis of water and some industrial products.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ENG1111	**Technical and Communicative English**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Technical and communicative English is a part of the regular course and taught in the first year of the engineering degree. This course introduces grammatical principle, speaking, reading and writing section to develop communicative skill of the students.

Intended Learning Objectives (ILOs):

1. To develop and integrate the use of four language skills; listening, speaking, reading and writing abilities of the students.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Use English effectively for academic purposes across the curriculum.	PLO9	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Communicate effectively and appropriately in real life situations.	PLO10	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Grammatical Principle:** Sentences, Tenses, Clauses, Connectors, Understanding long sentences, Conditional sentences, Transformation of sentences, Phrases: Noun phrases, adverbial phrases, prepositional phrases, verb phrases, Modifier, Head word, Appositives, Determiners, Making words with adding suffix and prefix, Phrase and idioms, Modal verbs; Gerund, Infinitive, Bear infinitives, Causative verbs, Words of negation.
CLO-1&2	**2. Spoken English:** Greetings, Dialogues, Responding to a particular situation, Extempore speech.
CLO-1&2	**3. Reading:** Comprehension of technical and non-technical materials-skimming, scanning, inferring and responding to context.
CLO-1&2	**4. Technical Report and Presentation:** Paragraph and composition writing on scientific and other themes, Report writing, Research paper writing, Library references.
CLO-1&2	**5. Professional communication:** Business letter, Job application, Memos, Quotations, Tender notice.

Recommended books:

Author's name		Title of books
1. J. Thomson & A.V. Martinet	:	A Practical English Grammar
2. John M. Lennon	:	Technical Writing
3. A. Ashley	:	Oxford Handbook of Commercial Correspondence
4. J. Swales	:	Writing Scientific English
5. Robert J. Dixson	:	Complete Course in English
6. Rajendra Pal & J.S. Korlahalli	:	Essentials of Business Communications

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1132	**Engineering Drawing**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:
The central issue of this course is to help students to visualize the basics of engineering design and drawing. It is also expected to improve hands-on experiences towards their practical life.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs **Course contents**

1. Introduction to engineering drawing, Lettering and uses of drawing instruments, Concept of projection, First angle and third angle projection, Orthographic drawing, Axonometric projection, Pictorial drawing: Oblique, isometric and perspective drawing; Sectioning, Dimensioning; Introduction to roller cad drawing.

Recommended books:

Author's name **Title of books**

First Year Second Semester Examination, 2026

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1211	**Crystallography-II**	**2**	**50**	**2**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:
The objective of this course is to present the basic concepts needed to understand the crystal symmetry, Brillouin zone, crystal growth, and identification of crystal structures. The first and second chapters are designed including crystal symmetry, projection and reciprocal lattice of solid materials. The three and four chapters cover the topics of various crystal growth techniques and XRD.

Intended Learning Objectives (ILOs):

1. To understand symmetry elements, point group, space group, reciprocal lattice and Brillouin Zones.
2. To familiarize with the stereographic projection in crystallography.

3. To get fundamental knowledge about the crystal growth.
4. To acquire knowledge the origin of X-rays and X-ray diffraction techniques.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Demonstrate the construction of stereographic projection and symmetry of crystal.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Get insight the construction of reciprocal lattice and Brillouin zones.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Get insight about the crystal growth techniques and identification of crystal structures.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Crystal Symmetry and Projection:** Crystal lattice, Bravais lattices and crystal systems, Symmetry elements, Point group and space group, Crystal symmetry and properties, Crystal projections: Stereographic projection and its construction, stereographic projection in small circle, stereographic net, use of stereographic projection in crystallography.
CLO-2	**2. Reciprocal Lattice and Brillouin Zone:** Reciprocal lattice vectors, Reciprocal lattice unit cells, Geometrical relationships, Brillouin Zones, Reciprocal lattice cell for cubic crystal, Brillouin Zone.
CLO-3	**3. Crystal Growth:** Czochralski, Bridgeman and Stockbarger, Floating-zone, and Flux methods; Epitaxial growth and vapour phase transport of single crystal, Electron beam deposition and MBE growth, Sputtering and Spray-pyrolysis methods.
CLO-3	**4. X-rays and X-ray Diffraction (XRD):** Origins and characteristics of X-rays, XRD and Bragg's law, Moseley's law, Laue equations, Methods of diffraction: Powder method, Single crystal method, XRD experiment, Applications of XRD.

Recommended books:

Author's name		Title of books
1. F. Donald Bloss	:	Crystallography and Crystal Chemistry
2. C. Hammond	:	Introduction to Crystallography
3. R. West	:	Solid State Chemistry
4. L.V. Azaroff	:	Introduction to solids
5. D. McKie & C. Mckie	:	Crystalline Solids
6. A. Windle	:	A First Course in Crystallography
7. N.F. Kennon	:	The Structure in Crystals
8. F.C. Phillips	:	An Introduction to Crystallography

9. C. Kittle : Introduction to Solid State Physics

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1212	**Crystallography Sessional**	**2**	**50**	**6**

Course Types ☐ **Theoretical** √☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:
This course is designed to develop an understanding of crystal symmetry, reciprocal lattice, and Brillouin zones. Students will be able to understand different crystal growth techniques. They will gain the knowledge to find out the lattice parameter and defect phase from the XRD pattern of a particular material.

Intended Learning Objectives (ILOs):

1. To be familiar with unit cell, primitive cell, and different crystal structures and systems.
2. To be familiar with symmetry, symmetry elements, and symmetry operations in a unit cell.
3. To understand point and space group symmetry in crystal structures.
4. To get knowledge about the identification of phases of materials using XRD results.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Visualize the unit cell of different crystal structures including symmetry and symmetry elements.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Calculate structure factor, tolerance factor, packing factor, density, and interplanar spacing, using the geometrical parameters of the crystal system.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Identify the various phases of materials.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Clarify which type of defect has a severe impact on material properties.	PLO1,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	1. Concept of different crystal systems including symmetry and symmetry elements.
CLO-2	2. Calculation of tolerance factor and compactness of different structures.
CLO-1	3. Familiar with different types of point groups and space groups.
CLO-3	4. Determination of different phases of materials from the diffraction intensity profile.
CLO-2	5. Determination of lattice parameter, structure factor, and temperature factor of a unit cell
CLO-2	6. Identify Miller indices of direction and plane
CLO-4	7. Identify the formations of voids.

Recommended books:

Author's name		Title of books
1. C. Kittle	:	Introduction to Solid State Physics

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE1221	**Solid and Fluid Mechanics**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. **Statics:** Basic concepts of mechanics, Statics of particles and rigid bodies, Centroids of lines, areas and volumes, Forces in trusses and frames, Friction, Moments of inertia of areas and masses.
2. **Dynamics**: Relative motion, Kinematics of particles-Newton's Second law of motion, Principles of work and energy, System of particles, Kinematics of rigid bodies, Kinematics of plane motion of rigid bodies-forces and acceleration.
3. **Stress, Strain and Torsion:** Introduction, Analysis of internal forces, Tension, compression, shear stress, axial stress in composites, Shearing, bending, centrifugal and thermal stresses, Strain and deformation, Stress-strain diagram, Elasticity and elastic limits, Relation between modulus of elasticity and bulk modulus, Torsion formula, Angle of twist.
4. **Properties of Fluid:** Introduction, Density and specific gravity, Vapor pressure and cavitation, Energy and specific heats, Compressibility and speed of sound, Viscosity, Surface tension and capillary effects.

5. **Pressure and Fluid Statics:** Pressure at a point, Variation of pressure in fluid, Pressure same in all directions of fluid, Measurement of pressure, Forces on submerged planes and curved surfaces, Buoyancy and floatation.
6. **Fluid Dynamics and Machinery:** One-dimensional flow of fluid, Equation of continuity, Euler's equation, Flow of fluid in pipes, Bernoulli's equation, Flow through venturi meter and orifice, Head losses, Open channel flow, Flow through weirs and notches, Centrifugal and reciprocating compressors, Centrifugal and reciprocating pumps.

Recommended books:

Author's name		**Title of books**
1. R. C. Hibbeler	:	Engineering Mechanics: Statics
2. F.P. Beer & E.R. Johnston, Jr.	:	Vector Mechanics for Engineers: Statics
3. R.C. Hibbeler	:	Engineering Mechanics: Dynamics
4. R.S Khurmi	:	Engineering Mechanics

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE1222	**Solid and Fluid Mechanics Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**

1. Determination of moment of inertia of a flywheel.
2. Determination of Young's modulus of a material by the method of bending.
3. Using a Flat Spring:
   i. Verification of Hooke's law and hence determination of stiffness constant;
   ii. Determination of *g* and the effective mass of the spring.
   iii. Determination of modulus of rigidity of the material of a spring.
4. Determination of elastic constants (Y, n, K, σ) of the material of a wire by searle's method.
5. Determination of the surface tension of water by capillary rise method (h′-1/r curve is to be plotted).
6. Determination of the surface tension and angle of contact of mercury by Quincke's method.
7. Determination of radius of a molecule by viscosity measurement.
8. Determination of the density and coefficient of viscosity of a liquid.
9. Determination of tensile properties of materials using stress-strain diagram.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MATH1211	**Calculus and Differential Equations**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course is designed to provide necessary background of differential and integral calculus. Different mathematical problems in this course will help the students building a comprehensive skill for analysing and solving real life engineering problems.

Intended Learning Objectives (ILOs):

1. To Familiarize the students with introductory calculus.
2. To provide necessary background of differential and integral calculus.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Understand the concept of function, limit and continuity and solve the limiting value problem.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Use different method to solve ordinary and partial differentiation.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Calculate the integral of definite and indefinite forms.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Functions:** Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate form.
CLO-2	**2. Ordinary Differentiations:** Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.

CLO-2	**3.**	**Expansion of Functions and Applications:** Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae, Maximum and minimum of functions of one variable.
CLO-2	**4.**	**Partial Derivatives:** Definition, Partial derivatives of multivariable functions, Higher-order derivatives, Euler's theorem for homogeneous functions, Applications in multivariable functions.
CLO-2	**5.**	**Tangent, Normal and Asymptotes:** Tangent and normal lines to curves, Subtangent and subnormal, Horizontal, vertical, and oblique asymptotes.
CLO-3	**6.**	**Integrals and Applications:** Indefinite and definite integrals, Fundamental theorem, Basic properties, Evaluation techniques, Applications to area, arc length, and volume.
CLO-3	**7.**	**Ordinary Differential Equations**: First order first and higher degree differential equations, Higher order differential equations with constant and variable coefficients, Applications of differential equations, Series solution of second order differential equation with variable coefficients.
CLO3	**8.**	**Partial Differential Equations**: Solutions of partial differential equation, Laplace's equation and transformation, Poisson's equation, Helmholtz's equation, Diffusion equation, Green's function solution, Integral equation.

Recommended books:

Author's name		**Title of books**
1. B.C. Das & B.N. Mukherjee	**:**	Differential Calculus
2. B.C. Das & B.N. Mukherjee	**:**	Integral Calculus
3. F. Ayres	**:**	Calculus
4. Edwards	**:**	Differential Calculus
5. Williamson	**:**	Integral Calculus
6. Muhammad & Bhattacherjee	**:**	Differential Calculus
7. Muhammad & Bhattacherjee	**:**	Integral Calculus

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
CHEM1211	**Physical and Inorganic Chemistry**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: Materials science is a unique combination of applied physics and chemistry. This elementary course of chemistry will make the students familiar with the basic knowledge of electrochemistry, chemical equilibrium and kinetics, chemistry of the materials surfaces and colloids. This course will also help the students to understand the basic concept of atomic structure and bonding present in materials.

Intended Learning Objectives (ILOs):

1. To grow the students' ability to understand physio-chemical properties of materials.
2. To provide students the fundamental chemical principles of materials formation.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Understand the elementary laws electrochemistry and apply them in various electrochemical cells.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Determine the rate of chemical changes of materials formation or materials interaction.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Demonstrate the role of surfaces during fluid-materials interaction.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Explain the atomic structure based on quantum mechanics and understand the periodic properties of the atoms.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Explain and predict the structure and bonding in molecules.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Electrochemistry:** Conductors, electrolytes and electrolysis, Faradays laws of electrolysis and their significance, Ohm's law and electrolytic conductance, Arrhenius & Debye-Hükel theories for electrolytic conductance, Ionic mobility, Kohlrausch's law, Transference number and its determination, Activities, activity coefficient and Debye-Hükel limiting law, Electrochemical cells (Electrolytic and Galvanic/Voltaic): Electrode reaction and potentials, Reference electrodes, Reversible and concentration cells, Storage batteries (or accumulators).
CLO-2	**2. Chemical Equilibrium and Kinetics:** Equilibrium and equilibrium constants, K_c, K_p, K_x, Rate of reaction and rate constants, Le Chatelier principle and its application, Order and molecularity of a reaction, Integrated rate expressions and half- lives of zeroeth, first and second order reactions, Determination of order and temperature dependence of a reaction, Energy of activation and Arrhenius equation, Transition-state theory of reaction rates, Characteristics of catalysis, promoters and inhibitors.
CLO-3	**3. Colloids and Catalyst:** Crystalloids, Colloids and their classification, preparation, properties (kinetic, colligative, optical & electrical) and importance, Original pf charge and stability of colloids (sols), Gold number, Colloidal electrolytes, Elementary idea about emulsions and gels.

CLO-4 **5. Atomic Structure:** Modern concept of atomic structure, Stability of orbit, Electron states in atoms, Atomic excitation, Origin of emission and absorption spectra, Ionization potential, electronegativity, electron affinity, atomic and ionic radii of elements.

CLO-5 **6. Electronic Theory of Valence and Chemical Bonding:** Types of bonds (ionic, covalent, co-ordinate, hydrogen and metallic), Classification of solids based on bonding and their properties, Atomic orbitals and their hybridization, Born-Haber-Cycle, Valence bond and molecular orbital theories, Chemistry of transition elements, lanthanides and actinides.

CLO-5 **7. Solution Chemistry:** Introduction to aqueous solution, Acid and base, Colligative properties of dilute solution, Raoult's law (ideal mixture, non-ideal mixture, positive and negative deviation), Lowering of vapor pressure in solution, Boiling point evaluation.

Recommended books:

Author's name		**Title of books**
1. R.D. Madan	**:**	Modern Inorganic Chemistry
2. M.M. Haque & M. A. Nawab	**:**	Principles of Physical Chemistry
3. E.S Gilreath	**:**	Fundamental Concepts in Inorganic Chemistry
4. G.M. Barrow	**:**	Physical Chemistry
5. W.J. Moore	**:**	Physical Chemistry
6. K.J. Laidler & J.H. Meiser	**:**	Physical Chemistry
7. S.R. Palit	**:**	Elementary Physical Chemistry
8. S.Z. Haider	**:**	Modern Inorganic Chemistry
9. Companion	**:**	Chemical Bonding
10. Cotton, Wilkinson & Jones	**:**	Basic Inorganic Chemistry
11. D.K. Sebera	**:**	Electronic Structure and Chemical Bonding

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
CHEM1212	**Physical and Inorganic Chemistry Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √ □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. Standard solution preparation and volumetric analysis, acid-base titration, oxidation-reduction titration, precipitation titration, complexometric titration and gravimetric titration.
2. Determination of cell constant of a conductivity cell.
3. Conductometric and potentiometric titration.
4. Conductometric determination of degree of dissociation.
5. Construction of some electrodes and measurement of their standard potentials.

Recommended books:

Author's name		Title of books
1. W.J. Popiel	:	Laboratory Manual of Physical Chemistry
2. J.B. Yadav	:	Advanced Practical Physical Chemistry
3. D.P. Shoemaker *et al.*	:	Experiment in Physical Chemistry
4. A. Findlay	:	Experimental Physical Chemistry
5. J.N. Gurtu	:	Advanced Experimental Chemistry
6. A.I. Vogel	:	A Text-book of Quantitative Inorganic Analysis

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ECON1211	**Industrial Economics**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The content of this course includes the concept of demand, supply and consumer behaviour, micro and macroeconomics, GDP, GNP budget and development planning. Additionally, the course also covers topics such as depreciation, income tax analysis, inflation, deflation, and estimation of future events.

Intended Learning Objectives (ILOs):

1. To provide the student with advanced concepts of engineering economic analysis and its role in engineering decision making.
2. To realize the effect of the time value of money on engineering problem solving and the capacity to act with ethical and efficient professionalism.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Acquire knowledge on the economic analysis, feasibility and evaluation of enterprises and projects.	PLO6	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-2	Make an economic analysis of an investment and employ concepts such as, Rate-On-Return, Net Present Value, Break-Even analysis, all these, with special application on the design and operation of engineering projects.	PLO11,12	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Realize the theoretical and conceptual basis of upon which engineering projects analysis is built.	PLO11,12	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Basic Concepts of Economics:** Definition and subject matter of Economics, Microeconomics vs macroeconomics, Law of Economics, Central economic problems of every society, Different economic systems, Economics and Engineering.
CLO-1&2	**2. Theory of Demand, Supply and Consumer Behaviour:** Law of Demand, Demand schedule and demand curve, Supply law, Supply schedule and supply curve; Shift in demand and supply, Equilibrium in the market, Elasticity of demand and supply.
CLO-2&3	**3. Production and Costs:** Meaning of production, Factors of production, Concepts of total, average and marginal costs, fixed and variable costs.
CLO-2	**4. Theory of the Firm:** Perfect competition and monopoly, Total, average and marginal revenue of a firm, Average and marginal revenue under perfect competition and monopoly, Firm's Equilibrium, Equilibrium of firm under perfect competition and monopoly.
CLO-3	**5. The Input-Output Analysis:** Meaning of input-output analysis, Input-output analysis model, Balance equation, Coefficient matrix, Determination of final demand vector.
	6. Basic Concepts of Macroeconomics: Growth, Unemployment, Inflation, Philips Curve, Business cycle, Circular flow of economics, Two, three and four sector economics.
CLO-1&2	**7. National Income accounting and determination:** Concepts of GNP, GDP and national income, Methods of national income accounting, Problems of national income accounting, Keynesian model of national income determination, The multiplier, Effect of fiscal policy in the Keynesian model.
CLO-1&2	**8. Budgets and Planning in Bangladesh:** The revenue at the capital budget, Income, expenditure of the government, Direct and indirect taxes, Various five-year plans in Bangladesh, Development strategies in the five-year plans of Bangladesh.

Recommended books:

Author's name		Title of books
1. Semuelson & Nordhous	:	Economics
2. Byrons & Stone	:	Economics

3. K.K. Dewett : Modern Economic Theory
4. H.L. Ahuja : Advanced Economic Theory
5. Government of Bangladesh : Various Five-Year Plans

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ME1212	**Mechanical Engineering Workshop**	**1**	**25**	**3**

Course Types ☐ **Theoretical** √☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: This course introduced the students to make familiar with basic mechanical engineering tools.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs **Course contents**

1. Familiar with engineering tools.
2. Study of Lathe, drill, shaper, grinding and milling machine.
3. Cutting, filing and polishing of solid materials.
4. Preparation of nut, bolt and different solid bodies.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ME1210	**Board Viva voce**	**2**	**50**	**-**

Course Types ☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** √☐ **Viva-voce**

Assessment Strategies: Oral presentation

Rationale of the Course: This course is to assess a student's understanding, communication skills, confidence, and ability to explain or defend their academic work orally.

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Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE2111	**Materials Thermodynamics**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course has two parts with Thermodynamics and Kinetics of materials. First part of this course is thermodynamics of materials and second part also the kinetics. The first component, thermodynamics, includes laws of thermodynamics (0^{th},1^{st} ,2^{nd} and 3^{rd} laws of thermodynamics), solution theory and equilibrium diagrams. The second component, kinetics, includes thermodynamic relation, phase transformations, and kinetic theory of gasses.

Intended Learning Objectives (ILOs):

1. To develop an understand the fundamental thermodynamic and kinetic processes in materials.
2. To develop skill sets needed to evaluate the stability of materials under different external conditions.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	To develop an understanding of the fundamental thermodynamics' lows of materials,	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Evaluate the suitability of using the materials under different external conditions.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Illustrate principle and evaluation of using heat transfer in different process, reversible and irreversible process and Carnot cycle.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	To develop an understanding of the fundamental kinetic processes in materials.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	1. **Fundamental concepts:** Scope of thermodynamics, Thermodynamics systems, states and equilibrium, Equations of state, Thermodynamics process, Isothermal and adiabatic processes, work in isothermal and adiabatic processes, isothermal

and adiabatic equation, Internal energy, Heat capacity, Relation between C_p and C_v, Enthalpy.

CLO-1&2

2. **Laws of Thermodynamics:** First law of thermodynamics, Thermodynamics cycles, Relation among heat, work, internal energy and enthalpy, Second law of thermodynamics, Carnot's cycle and Carnot's theorem, Heat engine, Concept of entropy, Changes of entropy in reversible and irreversible process, Entropy temperature diagram, Debye and Einstein concept of entropy, Third law of thermodynamics, Zeroth law.

CLO-3

3. **Thermodynamics functions and potentials:** The Maxwell's relations, Gibbs-Helmholtz equations, Joule–Thomson effect, Thermodynamics potential functions, Fugacity, activity and equilibrium constant, Chemical potential, Clausius-Clayperon equation, Triple points, Le Chatelier's equation, Vant Hoff's equation, Degree of freedom, Phase diagram of water, One component system.

4. **Thermodynamics in Interfacial Phenomena:** Thermodynamics of electrochemical cells, solid electrolytes, Thermodynamics of surfaces, Adsorption isotherms, Effect of surface energy on pressure and phase transformation temperature, Thermodynamics of defects in solids, Point defects, vacancies and interstitials in solid metals.

CLO-4&5

5. **Thermodynamics in Materials:** The effect of temperature on metal crystals, The specific heat curve and transformations, Heat content and free energy, Free energy of transformation, The variation of free energy with temperature and polymorphism, Relation between free energy and work function, Thermodynamics of lattice defects, The mechanism of phase changes, Thermodynamical statistics.

6. **Thermodynamics of Phase Transitions:** Helmholtz, Gibbs free energy and thermodynamic activity, Phase equation and phase rule, Free energy-composition (G-X) diagram, Construction of binary phase diagram, Three phase equilibria, Intermediate phases, Effect of pressure on the phase transition and phase equilibria, Degrees of Freedom, Phase diagram of one component system.

Recommended books:

Author's name		**Title of books**
1. T. Hossain	**:**	Text book of heat
2. Brizlal	**:**	Heat and Thermodynamics
3. R.E. Smallman	**:**	Modern Physical metallurgy
4. David R. Gaskell	**:**	Introduction to Thermodynamics of Materials
5. B.S. Bokstein *et al*.	**:**	Thermodynamics and Kinetics in Materials Science

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE2112	**Materials Thermodynamics Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. To determine Mechanical Equivalent of Heat, J, by Callender and Barnes constant flow method. **2.** To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charltons disc method. **3.** To determine the temperature coefficient of resistance by Platinum Resistance Thermometer (PRT). **4.** To determine J by Calorimeter. **5.** To determine the specific heat of liquid by the method of cooling. **6.** To determine the specific heat of solid by applying radiation of correction. **7.** Determination the heat of fusion and heat of vaporization of a liquid. **8.** Determination the specific heat of a solid material by determining ΔT using a calorimeter. **9.** Determination of Ksp, ΔG, Δ H, ΔS by the solubility product of an unknown salt. **10.** Determination the amount of heat transfer through a wall made by a composite material.

Recommended books:

Author's name		Title of books
1. B. L. Flint & H.T. Worsnop	:	Advanced Practical Physics for students
2. I. Prakash & Ramakrishna	:	A Text Book of Practical Physics
3. M. Nelson & J.M. Ogborn	:	Advanced level Physics Practicals
4. D.P. Khandelwal	:	A Laboratory Manual of Physics for undergraduate classes
5. F.E. Cardullo	:	Practical Thermodynamics
6. C.P.L. Prasuna & S.E.N. Vinodini	:	A Text Book of Thermodynamics

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE2121	**Quantum and Semiconductor Science**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course offers the students to understand the physical principles underlying the electronic properties of solids, in term of quantum physics application. It covers the fundamental properties of semiconductor, including atomic structure, energy band and electronic

state in solids, charge transport phenomena and pn junction. The course will enhance the students' ability to applying this knowledge in solving a wide range of problems originating in part in semiconductor research.

Intended Learning Objectives (ILOs):

1. To explain the behavior of electron as particle or wave.
2. To introduce energy band theory of semiconductor.
3. To know fundamental properties of semiconductor materials.
4. To gain knowledge about carrier transport mechanism.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Develops an understanding of the fundamentals of electron and energy band theory.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Can utilize the knowledge of drift and diffusion mechanisms in particular device applications as for example of photodetector.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Can apply the knowledge in solving a wide range of problems originating in part in semiconductor research.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Fundamentals of Electron Theory:** Introduction, Uncertainty principle, Energy quanta, Black-body radiations, Wave-particle duality, Photoelectric effect, Wave function and its significance, Schrödinger's equation, Application of Schrödinger's equation: Electron in free space, Electrons in potential steps, One electron atom.
CLO-1	**2. Energy Bands in Solids:** Introduction, Formation of energy bands, Nearly free-electron model, The Bloch theorem, The Kronig Penney model, The tight binding model, Energy bands in metals, semiconductors and insulators, Effect of temperature and pressure on energy band gap.
CLO-1	**3. Electrons in a Crystal:** Fermi level and Fermi surface, Fermi-Dirac Distribution, Density of states, Population density, Complete density of states function within a band, Consequences of the band models.
CLO-2	**4. Carriers in Semiconductors:** Types of semiconductors, Dopant atoms and energy levels, Charge carriers in intrinsic and extrinsic Semiconductors, Fermi Energy level in intrinsic and extrinsic semiconductors, Complete ionization and Freeze-out in semiconductors, Charge compensation in semiconductors.
CLO-2	**5. Carrier Transport Phenomena:** Drift velocity, Drift current density, Mobility effects, Conductivity, Velocity saturation, Carrier diffusion, Diffusion current density, Graded impurity distribution, Induced electric field, The Einstein relation, Hall effect.

CLO-3	**6.**	**PN Junction Diode:** Basic structure of the pn junction, Zero applied bias, Built-in potential barrier, Electric field, Space charge width, Reverse applied bias, Space charge width and electric field, Junction capacitance, pn junction current.

Recommended books:

Author's name		**Title of books**
1. Donald A. Neamen	**:**	Semiconductor Physics & Devices
2. Rolf E. Hummel	**:**	Electronic Properties of Materials
3. H. C. Gupta	**:**	Solid State Physics
4. M. Ali Omar	**:**	Elementary Solid-State Physics
5. K. J. Pascoe	**:**	Properties of Engineering Materials
6. P. Bhattacharya	**:**	Semiconductor Optoelectronic Devices

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE2122	**Quantum and Semiconductor Science Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs **Course contents**

1. To study the temperature-dependent conductivity of metallic/semiconducting materials.
2. To study the DC (I-V) characteristics of a diode.
3. To study the optical properties (absorption, reflection, and transmission) of a metal/ semiconductor.
4. To determine the optical band gap energy of a semiconductor by experimental/theoretical studies.
5. To study the density of states (DOS) of metal/semiconductor materials.
6. To study two and four-probe measurement techniques for a high-conducting thin film.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
EEE2111	**Electrical and Electronic Engineering**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course focuses on developing knowledge, basic concepts, and building blocks of electrical circuits. It is a basis in circuit theory. It is an engineer's fundamental tool in electrical studies. Students will understand fundamental laws, principles, and phenomena in the area of electrical engineering. They will be able to apply the acquired knowledge and skills to learn complex machine systems like transformers, generators, and motors, which will help them in their professional and practical life.

Intended Learning Objectives (ILOs):

1. To understand the basic electrical circuit quantities and theoretical understanding of A.C and D.C. circuit systems.
2. To learn different analytical processes to solve complex A.C. and D.C. circuits and machine systems.
3. To enrich the students' capability to handle electrical circuits as well as A.C. and D.C. machine systems in their daily life as well as in the workplace.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Know basic characteristics of electrical quantities, circuit terminology and associated problems.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand basic circuit laws, and circuit theorems for DC network to analyze complex circuits problems and their solution.	PLO1,2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Basic about AC theory and understand resonance phenomenon in circuits.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Elementary to moderate knowledge of transformer, generator and motor machine systems.	PLO1,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	To understand the current voltage characteristics of semiconductor devices, and analyze dc circuits and relate ac models of semiconductors with their physical operation.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-6	(a) Able to know design principle about transistor and transistor-amplifies in various configuration. (b) Know the concept of feedback amplifier and their characteristics and design the different oscillator circuits for various frequencies (c) Solve the problems using Flip-Flop circuits based on binary codes and design of logic gates.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-7	Design the different oscillator circuits for various frequencies and analysis of data from spectroscopic measurements as well	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs		Course contents
CLO-1	**1.**	**Circuit Models**: Characteristics and applications of linear circuit elements, Ideal and non-ideal voltage and current sources, Series, parallel, and compound circuit analysis, Loading effects, Voltage sources in series and parallel, open and short circuit.
CLO-2	**2.**	**Circuit Theorem and Network Analysis**: Voltage and current divider rule, Superposition, Thevenin's, Norton's, and Maximum power transfer theorem, Reciprocity theorem, Mesh and Nodal analysis, Delta-star transformation.
CLO-4	**3.**	**Transformer**: Working principle of transformer, Elementary theory of an ideal transformer-E.M.F., Equation of transformer-voltage transformation ratio, Transformer with losses but no magnetic loss, Transformer on load-transformer on no load, Transformer with resistance and leakage resistance-simplified diagram, Transformer rating in KVA, Condition for maximum efficiency, Classification and testing of transformer.
CLO-4	**4.**	**D.C. Machines:** D.C. generator: Principle, types, performance and characteristics, D.C. motor: Principles, Types of motor, performance, speed control, starters and characteristics.
CLO-4	**5.**	**A.C. Machines:** Classification of A.C motors, Single-phase induction motor principle, Equivalent circuit of an induction motor, Introduction of synchronous and special types of motor.
CLO-5&6	**6.**	**Semiconductor Diodes and Transistor:** Rectifier diode, Zener diode, Half-and full wave rectifiers, Transistors: PNP and NPN operations and configurations, Amplifier in different bias conditions.
CLO-6	**7.**	**Field effect transistor (FET):** Junction field effect transistor (JFET), Metal-oxide-semiconductor field-effect transistor, E-mode and D-mode MOSFET, CMOSFET.
CLO-6&7	**8.**	**Feedback and Oscillators:** Principles of feedback, Positive and negative feedback, Oscillators: RC, Hartely, and Colpitt's oscillator.

Recommended books:

Author's name		**Title of books**
1. D.R. Resnick & D. Halliday	**:**	Physics, Part-2
2. B.L. Theraza	**:**	Electrical technology (Volume-1&2)

3. R.L. Boylestad : Introductory Circuit Analysis
4. R.P. Ward : Basic Electrical Engineering
5. S.J. Chapman : Electrical Machinery Fundamentals
6. G.F. Corcoran : Alternating Current Circuits

Course Code	Course Title	Credits	Marks	Contact Hours/Week
EEE2112	**Electrical and Electronic Engineering Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. To study series and parallel resistive DC electrical circuits. **2.** To study of Kirchhoff's current law (KCL) and voltage law (KVL). **3.** To study Thevenin's theorem for a resistive DC electrical network. **4.** To study maximum power transfer theorem for a resistive DC electrical network. **5.** To study design and construction of a phase transformer. **6.** To study design and construction of an AC generator **7.** To study design and construction of a DC motor. **8.** To study the rectifying behavior of a diode. **9.** To study AC to DC conversion by a full-wave bridge rectifying circuit. **10.** To study the output characteristics of a bipolar junction transistor (BJT) in a common-emitter configuration **11.** To study the output characteristic of a junction field-effect transistor (JFET). **12.** To study the output characteristic of a D-MOSFET or E-MOSFET. **13** To study the design and construction of logic gates using diode, and transistors.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MATH2111	**Numerical, Statistical, and Advanced Mathematical Methods**	**3**	**75**	**3**

Course Types	**√□ Theoretical**	**□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course introduces the topics of differential equations: first order and second order, and the path to solve the equation.

Intended Learning Objectives (ILOs):

To develop an understanding of various methods in numerical analysis, probability and statistical distribution laws, Fourier and Laplace transformations, the application of differential equations, and some special functions.

Course contents Mapping with CLOs:

CLOs	Course contents

1. **Numerical Analysis:** Interpolation with equal and unequal intervals, Trapezoidal and Simpson's rule, Principle of least squares: Linear, curvilinear and polynomial curve fitting for one independent variable, Bisection and Regula-Falsi method, Newton-Raphson method, Gauss elimination method, Gauss Jordan method, Jacobi method; Gauss Seidal method, Application of numerical analysis.
2. **Probability and Statistics:** Introduction, Sets and probability, Random variables, Properties describing distributions, Treatment of grouped sample data, Some discrete probability distributions (Binomial, Poison and Negative binomial distribution), Normal distributions, Exponential distribution, Sampling theory, Estimation theory, Central limit theorem, Tests of hypotheses, Regression and correlation, Analysis of variance, Statistical distribution function (Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac distribution function).
3. **Fourier Transformations:** Fourier series representation of functions, Conditions for existence of Fourier series, Fourier series for odd and even functions, Half range sine and cosine series, Complex form of Fourier series, Parseval's identity, Fourier integral: Complex form of Fourier integrals, Fourier sine and cosine integral, Fourier transforms: Fourier cosine and sine transform, inverse Fourier transform, solutions of boundary value problems using Fourier series.
4. **Laplace Transformations:** Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Inverse Laplace transform, Unit step function, Dirac delta function, Laplace transform of periodic functions, Convolution theorem, Applications to solve simple linear and simultaneous differential equations.
5. **Special Functions:** Bessel's differential equation, recurrence relations, the generating function of Bessel polynomials, and their key properties. Legendre's differential equation, polynomials, Rodrigues' formula, the generating function, and important properties such as orthogonality, normalization, and recurrence relations.

Recommended books:

Author's name		Title of books
1. M.K. Venkatraman	:	Numerical Methods in Science and Engineering
2. S.S. Sastry	:	Introductory Methods of Numerical Analysis
3. Walpole *et al.*	:	Probability and Statistics for Engineers and Scientists

4. S.M. Ross : Introduction to Probability and Statistics for Engineers and Scientists
5. M.R. Spiegel : Fourier Analysis
6. M.R. Spiegel : Laplace Transforms
7. R. J. Beerends *et. al.* : Fourier and Laplace Transforms

Course Code	Course Title	Credits	Marks	Contact Hours/Week
PHY2111	**Waves, Optics and Optical Properties**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: First part of this course is Optics and Second part of the Optical properties of materials. This course introduces optical science with optical properties of materials and some applications. Topics covered in wave optics include; polarization, interference, and diffraction of light. Last part covered the optical properties, luminescence, reflection and optical materials, optical fibers, optical communications.

Intended Learning Objectives (ILOs):

1. To learn about the interactions of light with materials and the properties of optical materials.
2. To deliver knowledge on the different types of waves and oscillatory motions.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Acquires a thorough understanding of the principle of waves and oscillatory motions in physical objects.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	This course is intended to develop an understanding of the basic fundamental theory of optics of materials.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Identify the suitability of using the optical principle of materials under different conditions.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Understand the different forms of optical properties.	PLO1	☒ Lecture ☒ Tutorial	☒ Class Test ☒ Quiz

			☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Waves:** Types of waves, Speed of a travelling wave, Energy and power of a wave traveling along a string; Standing waves on a string, Energy in a standing wave, Standing waves as the superposition of two travelling waves, Phase velocity, Superposition wave packets and group velocity, Electromagnetic waves: Maxwell's equations, wave equation, Plane electromagnetic waves, Energy-momentum, Electromagnetic waves in conductors, Sound waves.
CLO-1	**2. Oscillations:** Simple harmonic oscillators: Physical characteristics of simple harmonic oscillators, Displacement, Velocity and acceleration, General solutions for simple harmonic motion and the phase angle, Energy of a simple harmonic oscillator, Damped harmonic oscillator: Physical characteristics of the damped harmonic oscillator, The equation of motion for a damped harmonic oscillator, Light damping, Heavy damping, Critical damping, Rate of energy loss in a damped harmonic oscillator.
CLO-4	**3. Optical Properties:** Refractive index, Dispersion, Reflectance, Transmittance characteristics, Penetration depth, Absorbance, Snell's law and total internal reflection, Luminescence, Phosphors, Optical anisotropy.
CLO-1	**4. Interference of light:** Principles of interference, Coherent source, Phase and path differences, Analytical treatment of interference, Theory of interference fringes, Fresnel's bi-prism, Determination of thickness of thin films, Interference in thin films, Color of thin films and Newton's ring method, Newton's ring by reflected and transmitted light, Determination of wavelength of sodium light by Newton's ring.
CLO-2	**5. Diffraction of light:** Principles of diffraction, Fresnel and Franhofer diffraction, Maxima and minima in diffraction patterns, Diffraction at a single and double silt, Plane diffraction grating, Resolving power, Resolving power of a plane diffraction grating, Dispersive power of grating, Diffraction grating, Diffraction by a plane transmission grating.
CLO-2&3	**6. Polarization of light:** Principles of polarization, Polarization of transverse wave, Plane of polarization, Polarization by reflection, Brewster's law, Nicholson prism analyzer, Quarter wave plate, Half wave plate, Optical activity and specific rotation of sugar solution.

Recommended books:

Author's name		Title of books
1. N.S. Brizlal	:	A text Book of optics
2. S.O. Kasap	:	Principles of Optical Materials and Devices
3. M. Fox	:	Optical Properties of Solids
4. R.E. Hummel	:	Electronic Properties of Materials

Course Code	Course Title	Credits	Marks	Contact Hours/Week
PHY2112	**Waves, Optics, and Optical Properties Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. To determine the radius of curvature of a lens and wavelength of a monochromatic light by Newton's rings experiment. **2.** To determine the wavelength of monochromatic light by a spectrometer using a plane diffraction grating. **3.** To determine the dispersive power of a prism/grating. **4.** To determine the specific rotation of sugar solution and hence to determine the unknown concentration of a given sugar solution by means of a Polarimeter. **5.** Determination of g by and K of a Compound Pendulum.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ACCO2111	**Industrial Management and Accountancy**	**2**	**50**	**2**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. **Fundamentals of Management**: Meaning of management, Principles of management, Functions of management, Levels of management, Roles of management, Scientific management and core management skills, Leadership and management in the trade Union.
2. **Factory Location and Plant Layout**: Determining the location of factory, Steps in location, Factors influencing layout, Types of layouts, Problems of layout.
3. **Work-Environment and Plant Utility**: Meaning, importance, factors affecting work environment, Plant utility, Lighting, Ventilation, Air-conditioning, Sanitation and noise control.
4. **Manpower Planning and Motivation**: Need, Objectives, Manpower Planning Process, Recruitment, Selection and training, Issue in managing people, Maslow's need hierarchy, Social needs and productivity, Hygiene and motivators.
5. **Accounting and Transaction:** Meaning and features, Accounting equation, Meaning and classification of accounts, Double entry system, Rules for determining debit and credit, Accounting cycle: Journal, ledger, and trial Balance.
6. **Cost Terms Concepts and Classification:** Meaning of cost, Manufacturing and non-manufacturing costs, Period and product costs, Variable and fixed costs, Direct and indirect costs, Differential, Opportunity and sunk costs, Schedule of cost of goods manufactured, Schedule of cost of goods sold and income statement.
7. **Cost-Volume-Profit Relationship:** Contribution margin and ratio, Break-even analysis, CVP relationship in graphical form and target net profit analysis.

Recommended books:

Author's name		**Title of books**
1. M.C. Shukla	:	Business Organization and Management
2. H. Koontz & H. Weihrich	:	Management
3. Krajewski & Ritzman	:	Operation Management
4. D.A. Decenzo & S.P. Robbins	:	Human Resource Management
5. A.A. Rahman	:	Managing Conflict in Organization
6. H. Etar	:	Accounting Principles
7. R.H. Garrison	:	Managerial Accounting

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Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE2211	**Phase Diagram and Microstructure of Materials**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The course introduced to gather knowledge and understanding of phase equilibria and non-equilibria diagrams and properties of metals, ceramics and alloys, which controlled

by their thermal history. The students will also know basic materials research in such fields as solidification, crystal growth, joining, solid-state reaction, phase transformation, oxidation, etc. They will also get idea on materials design and process to achieve the desired microstructures.

Intended Learning Objectives (ILOs):

1. To provide a guideline about the various crystal growth techniques with their common features.
2. To develop an understanding of the phase transformations and the interpretation of the microstructural evolution of the alloys.
3. To deliver idea on phase equilibrium diagrams related to equilibrium state and microstructure, which are useful to understand non-equilibrium structures, that are often more desirable than those of equilibrium states due to the higher level of properties attained.
4. To introduce materials of interest, range from single to multi-component systems including chemical and geometrical structure as well,
5. To provide knowledge about many industrial important systems that can be adequately represented by binary equilibrium diagrams, ternary or higher order diagrams are often necessary to the understanding of more complex systems, like certain industrial alloys, slag, polymeric or ceramic materials

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Acquire theoretical knowledge on numerous crystal growth techniques and importance's of phase diagrams in the field of materials science and engineering.	PLO1,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Know the relations between the composition, temperature and phase amounts, phase rule concept of different system and the understanding about the formation of microstructure and how this structure influences materials properties.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Know the applications of phase diagrams and able to analyze their crystal structure.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Know the metallographic features of metals and alloys with their microstructure.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO -1	**1. Phase Diagrams:** Phase and phase equilibria, Gibbs phase rule, Lever rule, Binary isomorphous system-interpretation of phase diagram, determination of compositions and phase amounts, Binary eutectic systems equilibrium diagrams having intermediate phases, Congruent phase transformations.

CLO-2&3	**2.**	**Binary Phase Diagrams of Alloy Systems**: Phase diagram of Iron-iron carbide, common stainless steels and non-ferrous systems, Development of microstructure in iron-carbon alloys, Hypo-eutectoid alloys, Hypereutectoid alloys, Non-equilibrium cooling and the influence of other alloying elements, Competitive growth of dendrites and eutectics, Peritectic systems, Effect of temperature on solid solubility.
CLO-2&3	**3.**	**Ternary and Multiphase Phase Diagrams:** Introduction to ternary and quaternary systems and associated phase diagrams, The Gibbs triangle and construction rules for ternary phase diagrams, Space model of ternary systems, The Gibbs triangle, Tie lines, Ternary isomorphous systems.
CLO-2,3&4	**4.**	**Microstructure of Materials:** Development of microstructure in isomorphous and eutectic alloys, Equilibrium diagrams having intermediate phases, Phases and microstructure of non-ferrous metals and their alloys: Cu, Al, Ni, and their alloys.
CLO-2&3	**5.**	**Metallography:** Function of metallurgical microscope, Preparation of specimens for microstructure study, Microstructure of metal and alloys, Sulphur and phosphorous prints.

Recommended books:

Author's name		**Title of books**
1. W.D. Callister	**:**	Materials Science & Engineering –An Introduction
2. W.F. Smith	**:**	Foundation of Materials Science & Engg
3. R.E. Smallman & R.J. Bishop	**:**	Metals and Materials
4. S.H. Avner	**:**	Introduction to Physical Metallurgy
5. J. C. Anderson *et al.*	**:**	Materials Science
6. R.E. Smallman	**:**	Modern Physical Metallurgy
7. D.O.P. Khanna	**:**	A text book of Materials Science and Metallurgy

Course Code	**Courses Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE2212	**Phase Diagram and Microstructure of Materials Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. Selection and preparation of micro, and macro-specimens.
2. Microstudy of common ferrous, non-ferrous metals and alloys.
3. Microstudy of plain carbon steels, cast irons, and MS bar.
4. Determination of micro-hardness of different phases.
5. Study of microstructure of martensitic and annealed steel.
6. Microstructure of composite materials, Quantitative metallography; size distribution, etc.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE2221	**Transport and Kinetic Phenomena in Materials**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. **Basic Heat Transfer Principles**: Physical origins of rate equations of the three principal modes of heat transfer, Thermal resistance concept.
2. **Steady-state Conduction**: The plane wall, Radial systems, Conduction with thermal energy generation, Finite-difference equations (the nodal network, finite-difference form of heat equation, energy balance method).
3. **Transient Conduction and Convection**: Lumped capacitance method, Plane wall with convection, Radial systems with convection, Finite difference methods, Convection boundary layers, Local and average convection coefficients, Laminar and turbulent flow.
4. **Heat Exchangers**: Heat exchanger types, Overall heat exchanger coefficient, Heat exchanger analysis: Use of log mean temperature difference.
5. **Radiation:** Radiation heat fluxes, Radiation intensity, Blackbody radiation, View factor, Blackbody radiation exchange, Network method for radiation exchange in an enclosure.
6. **Mass Transfer and Kinetics**: Mass transfer through chemical reaction, Chemical reaction model, Mass diffusion, Boundary conditions for mass transfer, Mass

transfer in nonstationary media, Conservation of species for a stationary medium, Boundary conditions and discontinuous concentrations at interfaces, Kinetics of homogeneous and heterogeneous reactions, Solid state transformation kinetics.

Recommended books:

Author's name		**Title of books**
1. M. Lguchi, O.J. Ilegbusi	**:**	Basic Transport Phenomena in Materials Engineering
2. David R. Gaskell	**:**	An Introduction to Transport Phenomena in Materials Engineering
3. T. Bergman *et al*.	**:**	Fundamentals of Heat and Mass Transfer
4. M.N. Ozisik	**:**	Heat Transfer: A Basic Approach

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE2231	**Mechanical Properties of Materials**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course introduced to give students an understanding of the underlying mechanisms of plastic deformation, creep, fatigue and fracture behavior.

Intended Learning Objectives (ILOs):

1. To assess the role of dislocations in plastic deformation, and to quantitatively predict creep, fatigue and fracture behavior in materials failure.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	**Details of CLO**	**PLOs**	**Delivery Methods**	**Assessment Tools**
CLO-1	Explain and describe basic concepts and mechanisms of deformation in metallic structural materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand the fundamental concepts of stress and strain and the relationship between them.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Identify and describe the basic creep, fracture and fatigue mechanisms and apply that knowledge to failure analysis.	PLO2,3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Dislocations in Crystals:** Dislocations in crystals, Edge and Screw dislocations, Mechanism of slip and climb, Imperfect dislocations, Dislocation mobility, Extended and sessile dislocations, Interaction of Solute atoms with dislocations, Intersection of dislocations.
CLO-1	**2. Deformation of metals and alloys:** Introduction, Elastic and plastic deformation, Deformation in single and polycrystalline materials, Deformation by slip, Deformation by twining, The effect of impurities on twinning, The effect of restrain on twinning.
CLO-2	**3. Elastic and Plastic Properties of Materials:** Elasticity and plasticity; Toughness; Resilience; Tensile Strength; Ductility; Malleability; Brittleness; Hardness; Destructive and non-destructive testing.
CLO-3	**4. Creep:** Introduction, Creep mechanisms (Transient creep, Steady state creep, Creep due to grain boundaries, Tertiary creep and fracture), Metallurgical factors affecting creep, Super plasticity.
CLO-3	**5. Fatigue:** Introduction, Engineering consideration of fatigue, Metallurgical factors affecting fatigue, The structure charges accompanying fatigue, The formation of fatigue cracks and fatigue failure, Fatigue at cleaved temperatures.
CLO-3	**6. Fracture:** Introduction, Griffith micro crack criterion, The mechanism of fracture, Facture affection brittleness, Fracture toughness, Inter granular fracture, Ductile fracture, Fracture at cleaved temperature, Fracture mechanism maps, Twinning fracture.

Recommended books:

Author's name		Title of books
1. R.E. Smallman	:	Modern Physical Metallurgy
2. G.K. Narula *et al.*	:	Materials Science
3. O.P. Khanna	:	Materials Science and Metallurgy

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE2232	**Mechanical Properties of Materials Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Determination of compressive properties of metallic and composite materials. 2. Determination of Hardness, Compression, Impact and Fatigue properties of materials. 3. Analysis of wear and creep damage on common metals and alloys.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
CSE2211	**Computer Fundamentals and Programming**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The prime target of this course is to make students familiar to computer systems and associated basic concepts. They will also acquire basic programming knowledge. As a consequence, finally, they will be able to run software programs to solve basic computing problems.

Intended Learning Objectives (ILOs):

1. To understand the basic structure and relation of different versions of computer system.
2. To learn different software, programming language and networking system.
3. To enrich the students' capability to handle computer system effectively for their practical life.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Knowledge about computer and its application.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand and identify computer organization, architecture and associated units.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Develop skills to use different types of software application.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Learn the concepts of data communication and networking.	PLO1	☒ Lecture ☒ Tutorial	☒ Class Test ☒ Quiz

			☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Knowledge about computer languages, and structure of a programing language.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-6	Analyze mathematical problem and hence design a computational solution to the problem in an algorithmic way and convert the algorithm effectively and intelligibly into a procedural program for real life applications.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1,2,4	**1. Computer Hardware and Software:** Computer organization and architecture, CPU, memory units, I/O devices, system software, operating system, spreadsheet database, presentation software, network topologies.
CLO-3&5	**2. Programming Basics:** Different types of computer language, structured and unstructured programming, algorithms and flowcharts, Overview of C programming languages, C program structure, compiler, interpreter, C tokens, keywords, identifiers, data types, constants, variables.
CLO-5	**3. Operation and Expressions:** Classification of operators, statements, conditional statements, if and loops; for, while and do-while, decision making and branching, arrays, pointer
CLO-6	**4. User-defined Function:** Definition of function, Function declaration, Function arguments: call-by-value, call by reference, Returning from function: returning value, recursion, passing array to functions.
CLO-6	**5. File Management:** Introduction, defining and opening a file, closing a file, input/output operation on files.
	6. Python Basics: Introduction, syntax, variables, numbers, casting, lists, tuples, set, dictionaries.
	7. Operations and Expressions in Python: While loop; for loop; function; arrays; class; file handling; modules (NumPy, Pandas, SciPy); Python for machine learning.

Recommended books:

Author's name		Title of books
1. P. Norton's	:	Introduction to Computers
2. T.L. Booth	:	Introduction to computer Engineering Hardware and Software Design
3. E. Balagurusamy	:	Programming in ANSI C
4. MerbertSchildt	:	The complete Reference C & C++

Course Code	Course Title	Credits	Marks	Contact Hours/Week
CSE2212	**Computer Fundamentals and Programming Sessional**	**1**	**25**	**3**

Course Types ☐ **Theoretical** √☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: This course concentrates on practical coverage of the computer science area. It introduces general application software, tools and computer usage concepts as well as real-life problem solving with the help of the C programming language. Besides, this lab provides a basic practical understanding of electrical circuits and machine systems.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Computer programming and its applications to solving simple problems. **2.** Writing and running programs for the solution of Engineering and Mathematical problems. **3.** Solution of simple problems using C language.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
CSE2211	**Law and Professional Ethics**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

CLO-1&2	**1.**	**Law:** Principle of law of contract, agency, partnership, sale of goods negotiable instruments, insurance-insolvency.
CLO-3&4	**2.**	**Company law**: The companies act with special reference to the amendments and ordinances applicable to Bangladesh, Law regarding formation, Incorporation, Management and winding up of companies.
CLO-5&6	**3.**	**Labor Law**: The scope and sources of labor law, Law in relation to wages, hours, health, safety and other condition to work, the legislation effecting employment in factories, The trade union legislation arbitration, the policy of the state in relation to labor, Elementary principle of labor law.
CLO-5	**4.**	**History and Development of Engineering Ethics**: Study of Ethics in Engineering. Applied Ethics in engineering. Human qualities of an engineer. Obligation of an engineer to the clients and to other engineers. Measures to be taken in order to improve the quality of engineering profession.
CLO-6	**5.**	**Ethical Expectations**: Employers and Employees inter-professional relationship, maintaining a commitment of Ethical standards, desired characteristics of a professional code, Institutionalization of Ethical conduct.

Recommended books:

Author's name		**Title of books**
1. K. Sen	**:**	A Hand Book of Commercial Law
2. A.B. Siddique	**:**	The Law of Contract
3. A.A. Khan	**:**	Labour and Industrial Law
4. E. Durkheim	**:**	Professional Ethics and Civics Morals
5. J.D. Mabboth	**:**	An Introduction to Ethics
6. A.G. Maitra	**:**	Laws of Contract
7. Coopers	**:**	Outline of Industrial Law
8. A. Zulfiquar	**:**	A Text Book on the Bangladesh Labour Act-2006
9. P. Narayanan	**:**	Intellectual Property Law
10. A.R. Khan	**:**	Business Ethics
11. G.E. Moore	**:**	M. Radar:Ethics and the Auman Community Principia Ethicia

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
ME2210	**Board Viva voce**	**2**	**50**	**-**

Course Types	**☐ Theoretical**	**☐ Sessional/Practical**	**☐ Project/Training**	**√☐ Viva-voce**

Assessment Strategies: Oral presentation

Rationale of the Course: This course is to assess a student's understanding, communication skills, confidence, and ability to explain or defend their academic work orally.

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Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3111	**Polymeric Materials**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The course gives a general introduction to the concept of polymers. It also focuses on the classification, characteristics, and structure-properties relation of polymers. This module is designed to provide students with an understanding of both the formation and applications of polymers.

Intended Learning Objectives (ILOs):

1. To demonstrate fundamental knowledge of polymeric materials, including types, characteristics, recycling, and waste disposal.
2. To gain knowledge of the synthesis, formation mechanism, and kinetics of polymer preparation.
3. To apply critical thinking and problem-solving skills to the design, failure analysis, and application of polymeric.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Gather knowledge on the general introduction and concept of polymers.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☒ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understanding of polymer reaction mechanisms and kinetics of radical, ionic, and condensation polymerization.	PLO1,2	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☐ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Preparation and processing of the polymers for special applications.	PLO3	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Analyze the structure-property relation of polymers for advanced applications.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Testing, evaluating, and interpreting the obtained data.	PLO4,5	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☒ Audio/Video	☐ Class Test ☐ Quiz ☐ Assignment ☒ Final Exam ☒ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Concept of Polymer:** Introduction and definition of polymer, Classification of polymers, Nomenclature of polymers, Characteristics of different types of polymers, Natural and synthetic polymers, Organic, inorganic, and organic-inorganic hybrid polymers, Simple molecules and macromolecules, Inter-molecular forces and chemical bonding in polymers, Important uses of polymeric materials, Polymer waste disposal and remedies.
CLO-2(a)	**2. Polymer Formation Reactions:** Addition polymerization, Condensation polymerization, Coordination polymerization, Ring opening polymerization, Copolymerisation, Degree of polymerization, Mechanism of polymerisation (free radical, cationic and anionic), Kinetics of polymerisation.
CLO-2(b)	**3. Specialty Polymers:** Polyelectrolytes, Ion-containing polymers, Conducting polymers, Biomedical polymers, Thermally stable polymer, Thermoplastic, Elastomers (TPE), Polymer composites, Polymers for combating environmental pollution.
CLO-3	**4. Characterization of Polymers:** Nature of polymer molecules in solution, Size and shape of macromolecules in solution, Molecular weight, number average and weight average molecular weight, Molecular weight distribution, Isolation and purification, fractionation, determination of molecular weight of polymer, Molecular weight distribution cases.
CLO-3	**5. Structure and Rheology of Polymers:** Viscous flow, Viscoelasticity, Mechanical model of a viscoelastic material, Glassy state and glass transition, Amorphous and crystalline polymers, Crystallinity, Crystallisability, Factors affecting on crystallisability of polymers, Mechanical properties of crystalline polymers, Crystalline melting point, Relation between T_m and T_g, Property requirements and polymer utilization.
CLO-3	**6. Analysis and Testing of Polymers:** Chemical analysis of polymers, Spectroscopic analysis, X-ray diffraction analysis, Microscopic analysis, Thermal analysis, Physical testing.

Recommended books:

Author's name		Title of books
1. V.R. Gowariker *et. al.*	**:**	Polymer Science
2. P. Bahadur & N. V. Sastry	**:**	Principles of Polymer Science
3. S.L. Rosen	**:**	Fundamental Principles of Polymeric Materials
4. M.G. Aurora & M. Singh	**:**	Polymer Chemistry
5. P. Ghosh	**:**	Polymer Science and Technology of Plastics & Rubber

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3112	**Polymeric Materials Sessional**	**1**	**25**	**3**

Course Types	□ Theoretical	√□ Sessional/Practical	□ Project/Training	□ Viva-voce

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents

1. Preparation of polystyrene by a free radical polymerization process.
2. Preparation of solid epoxy resin.
3. Determination of the epoxide equivalent of the given epoxy resin by the pyridinium chloride method.
4. Determination of melting point, storing time and gel time of phenolic resins.
5. Determination of molecular weight of polymer by end group analysis and viscometry.
6. Estimation of number average molecular weight by hydroxyl end group analysis.
7. Determination of tensile strength/breaking strength, elongation of synthetic and natural fibres, fabrics and composite materials.

Recommended books:

Author's name		Title of books
1. A.I. Vogel	:	A Text Book of Quantitative Inorganic Analysis
2. G.D. Cheistain	:	Analytical Chemistry
3. F.J. Welcher	:	Standard Methods of Chemical Analysis

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3121	**Electrochemical Engineering**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: At least to some extent, most materials experience some kind of interaction with their diverse surrounding environment, causing deterioration with time. These deterioration processes involved some special types of electrochemical phenomena. Prior to design, a materials engineer needs to know such types of interaction, either to avoid or to minimize deterioration. The first three chapters of this course will introduce different types of thermodynamic, electrode kinetics and electrochemical phenomena of various electrochemical cells. The fundamentals of electrodeposition, electrode and cell design for industrial uses, and electroplating of various metals and their alloys will be studied in chapters four, five and six, respectively.

Intended Learning Objectives (ILOs):

1. To understand some special electrochemical phenomena of electrodes and electrochemical cells.
2. To learn about the thermodynamics and kinetics of electrode reactions.
3. To enrich theatrical knowledge about different electrodeposition processes.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Utilize their knowledge of natural science to understand the thermodynamics and kinetics of electrochemical cell.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Get advanced knowledge about the electrodeposition of metals and alloys.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Batch calculation and electroplating.	PLO2,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Application of theoretical knowledge to about protect and beautify of several of materials especially metals.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Electrode Processes:** Electrochemical cells and reactions, Faradaic and nonfaradaic processes, Mass-transfer-controlled reactions, Nernstian reactions.
CLO-1	**2. Potentials and Thermodynamics of Cells:** Basic electrochemical thermodynamics: Reversibility, cell emf, emf and concentration, formal potentials, Interfacial potential differences, Liquid junction potentials, Types of liquid junctions, Conductance, Transference number and mobility, Calculation of liquid junction potentials, Selective electrodes.
CLO-1	**3. Kinetics of Electrode Reactions:** Electrode reactions, Electrode reaction models, The exchange current at equilibrium conditions, Current-over potential relationship, Reversible behavior, Effects of mass transfer on electrode reactions, Derivation of general mass transfer equation, Migration.
CLO-2	**4. Electrodeposition of Metals:** Introduction, Adhesion, cohesion, continuity and uniformity of electrodeposits, Electrodeposition of alloys, Plating corrodible metals, Mechanism and kinetics of electrodeposits, Mode of growth of electrodeposits, Deposition of bright metal coatings, Nucleation of coatings, Growth morphology, Internal stresses in electrodeposits, Hardness and wear resistance, Porosity, Metal surface preparation, Electrodeposition of metals from non-aqueous electrolytes.
CLO-3&4	**5. Electrodes and Cell Design for Industrial Processes:** Introduction, Lead dioxide anode, Magnetite anode, Lead alloy anodes, Carbon and graphite anodes, Noble

		metal coated anodes, Cathodic materials, Diaphragms, Ion-exchange membranes, General ideas of cell design, Detailed consideration of cell design.
CLO-3&4	**6**	**Electroplating:** Electroplating of Ni, Cr, Cu, Al, Co, brass, bronze, Ni-Cr alloy, Al-Cr alloy and Al-Co alloy, Refractory metals, Electrodeposition of metals on plastics, Design of tools, Electrolytes, Electrochemical grinding.

Recommended books:

Author's name		**Title of books**
1. A.J. Bard & L.F. Faulkner	:	Electrochemical Methods
2. C.M.A. Brett & A.M.O. Brett	:	Electrochemistry
3. K.J. Vetter	:	Electrochemical Kinetics
4. J.O.M. Bockris & A.K.N. Reddy	:	Modern Electrochemistry
5. A.T. Kuhn	:	Industrial Electrochemical Processes
6. E.C. Potter	:	Electrochemistry
7. W.Blum & G.B. Hogaboom	:	Electroplating and Electroforming
8. F.A. Lowenheim	:	Modern Electroplating
9. R.W. Weiner & A. Walmsley	:	Chromium Plating

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3122	**Electrochemical Engineering Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: This course is designed to enrich the practical skill of purification of metal, electrodeposition of metal and alloys, and corrosion behavior of metals.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. Electrorefining of metals. **2.** Electrodeposition of Ni, Cu, Co and determination of current efficiency. **3.** Plating of Sn, brass, brong, and determination of the plating quality by measuring thickness.

Recommended books:

Author's name		**Title of books**
1. E.C. Potter	:	Electrochemistry
2. W.Blum & G.B. Hogaboom	:	Electroplating and Electroforming
3. F.A. Lowenheim	:	Modern Electroplating

4. R.W. Weiner & A. Walmsley : Chromium Plating

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3131	**Composite Materials**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: Composite materials is an introductory course focusing on students learning of hybrid composites and mechanics of composites, and design guidelines of fiber reinforced composite materials. Moreover, the basics of composite carbon-carbon are introduced.

Intended Learning Objectives (ILOs):

1. To understand the fundamental concepts of composite materials including the types, properties, fabrication and applications of the materials.
2. To learn the design of composite materials and advanced field of nanocomposite.
3. To understand the mechanism and interfacial chemical reaction of composite.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Gain knowledge of the general concept of composite materials, including the types, properties, fabrication and applications of the materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Increase knowledge about metal, polymer, ceramic, and carbon matrix composite materials, as well as nano-composite materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Understand the design of composite materials, different bonding mechanisms and interfacial chemical reactions.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. General Concepts:** Introduction, Types of composite materials, Matrix materials, Reinforcements, Types of fibers, Laminar composites, Flake composites, Filled composites, Particulate reinforced composites, Cermet's, microspheres, Economics of composites and reinforcements.
CLO-3	**2. Design of Composite Materials:** Introduction, Hybrid composites, Angle-plied composites, Mechanics of composites, Calculation of properties; Unidirectional

fibre composites, critical volume fraction, discontinuous fibre composites, rule-of mixtures equation, critical angle.

CLO-1&2 **3. Carbon-Carbon- and Nano-composites:** Introduction, carbon matrix and reinforcement, properties, graphite, fabrication processes, interface, applications of carbon-carbon composites, nanocomposites, classification of nanocomposites, polymer nanocomposite, fabrication of nanocomposite, applications.

CLO-1&2 **4. Metal and Ceramic Matrix Composites:** Reinforcements, Matrix selection, Matrix-reinforcements interface, Fabrication, Whisker reinforcements, Whisker composite properties, Chemical bounding, Fibre surface treatment, Matrix modification, Continuous fibre reinforced composites, Chopped fibre composites, Fabrication processes, Applications of metal and ceramic matrix composites.

CLO-1&2 **5. Polymer Matrix Composites:** Matrix resins, Thermosetting resins, Thermoplastic resins, Polyaryl ethers (PAE), Thermoplastic polyimides (TPI) poly arylene sulfide, Molecular composites, Fabrication of polymer composites, Applications of polymer matrix composites.

CLO-3 **6. Mechanics of Composites:** Bonding mechanisms- adsorption and wetting, Inter-diffusion and chemical reaction, Electrostatic attraction, Mechanical keying, Residual stresses, Experimental measurement of bond strength, Control of bond strength-coupling agents and environmental effects, Toughness-reducing coatings, Interfacial chemical reaction and diffusion barrier coatings, The interphase region.

Recommended books:

Author's name		**Title of books**
1. D. Hull & T.W. Clyne	**:**	An Introduction to Composite Materials
2. S.C. Sharma	**:**	Composite Materials
3. T.W. Clyne & P.J. Withers	**:**	An Introduction to Metal Matrix Composites
4. K.K. Chawla	**:**	Ceramic Matrix Composites
5. G. Lubin	**:**	Hand Book of Composites

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3132	**Composite Materials Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: In this hands-on laboratory course, students will gain practical experience in the fabrication, characterization, and testing of composite materials. Through a series of structured experiments, students will explore various manufacturing techniques, including hand-layup, compression molding, and the use of recycled materials. Emphasis will be placed on understanding how processing methods influence the mechanical, thermal, and environmental properties of composites.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Hand-layup fabrication of fiber/fabric/particle-reinforced thermoset composites and their property characterization. **2.** Fabrication and analysis of compression-molded composites using fiber/fabric/filler and thermoset/thermoplastic matrices. **3.** Fabrication of short fiber composites via hand-layup, vacuum bagging, injection molding, and extrusion. **4.** Fabrication of composites from recycled materials. **5.** Different types of testing of composite materials: mechanical, hardness, thermal, water, absorption, soil degradation, flammability and electrical.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3141	**Construction Materials**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The First part of this course is basic building stones, building stones materials, and the second part is the preservation of wood and processing, and cement, concrete: This course introduces construction materials. Topics covered in basic construction materials, Building Stones, Bricks, Tiles, Terra cotta, and other clay products, and Asphalt, Bitumen and Tar.

Intended Learning Objectives (ILOs):

To understand the primary construction materials currently used in the industry and building materials.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Explain the fundamentals of construction materials, their classifications and applications.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Identify the quality of construction materials by using suitable components in construction.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-3	Illustrate principles and use of different clay products as construction materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Select the suitable preservation technique for preserving construction materials.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Building Stones:** Introduction, Classification of Rocks, Common rock forming minerals, Characteristics of good building stones, uses of stones and their selection, Deterioration and preservation of stones, testing of stones, common building stones, their composition, properties, uses and occurrence, Artificial stones.
CLO-2	**2. Bricks, Tiles and Terra Cotta:** Introduction, Bricks, composition of brick earth, properties of good brick earth, analysis of some brick earth, test of clay, brick making, strength of bricks, Quality of good bricks, Fireclay and firebricks, Strength of refractory bricks, color of bricks, Testing of bricks, Tiles, Terra cotta, porcelain.
CLO-3	**3. Asphalt, Bitumen and Tar:** Definition, properties, uses, constituents and types of asphalt, Definition, properties, uses and forms of bitumen, Definition, properties, uses and types of tar, pitch, comparison between asphalt, bitumen and tar.
CLO-4	**4. Wood Seasoning and Preservation:** Wood seasoning methods, relative suitability's of different seasoning methods, seasoning defects and their prevention, objects and benefits of seasoning; methods of preservative treatments, non-pressure and pressure treatments, preservative materials and their applications, factors affecting penetration and absorption, prospects and problems of wood preservation.
CLO-4	**5. Timber and Wood-based Products:** Introduction, definition and characteristics of good timber, advantages and disadvantages of timber, uses, classification and defects in timber, testing of timber, plywood, laming board, block board, Fiber board and hard boards.
CLO-4	**6. Cement and Concrete:** Introduction, Sources, Properties and uses of lime, classification, properties and uses of cement, Comparison between cement and lime, chemical constituents and functions of ingredients of cement, manufacture of Portland cement, Setting and hardening of cement, testing of Portland cement, storage of cement, Functions, properties and uses of a good building mortar, characteristics, Classification and properties of concrete, Reinforced cement concrete

Recommended books:

Author's name		Title of books
1. K.P. Roy Chowdhury	:	Engineering Materials
2. R.K. Rajput	:	Engineering Materials
3. W.H. Brown	:	Introduction to the Seasoning of Timber
4. G.M. Hunt	:	Wood Preservation
5. F.P.P. Kollman & W.P. Cote	:	Principles of Wood Preservation Science &Technology

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3142	**Construction Materials Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Acid test /Attrition test /Crystalline test / Hardness Test /Impact test of stone. **2.** Compressive strength test of bricks/ structure and soundness test of bricks. **3.** Determination of the structural and strength test of bricks. **4.** Determination of the water absorption test of stones, bricks and tiles. **5.** Consistency/Compression/Compressive test of cement **6.** Compressive test of wood.

Recommended books:

Author's name		Title of books
1. K.P. Roy Chowdhury	:	Engineering Materials
2. R.K. Rajput	:	Engineering Materials

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3151	**Production Metallurgy**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course will provide a modern and thorough introduction to unit operation and processes to extract metals and to produce important engineering alloys. First three chapters mainly focus on theories and principles of different unit processes and necessary equipment and allied techniques for metal extraction and alloy production. Later chapters include how actually iron, steel and other important engineering alloys are being produced industrially.

Intended Learning Objectives (ILOs):

1. To familiarize with the main isolation and separation techniques of metal ores.

2. To know the key equipment, unit operations and processes to extract metals from their parent ores.
3. To understand the theories behind the metal extraction and manufacturing processes.
4. To know the techniques to produce important engineering alloys like iron and steel and some non-ferrous alloys.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Choose optimum techniques to separate a metal from its ore by utilizing basic thermodynamic knowledge of metal separation.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Select an appropriate way to refine a crude metal.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	(a) Produce pig iron in blast furnace and manufacture steel through different techniques. (b) Produce other engineering non-ferrous metals and alloys. (c) Materials solidifies and takes shape of the mold.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Processes of ore Preparation:** Unit operation and unit process, Isolation and separation techniques, Equipment, Diagrams and applications, Ore deposits, Mining of ores, Iron ores, Aluminium ores, Copper ores, Lead ores, Zinc ores, Precious metal ores and other metals ores, Physical methods of ore preparation, Concentration processes, Thermal methods of ore preparation.
CLO-1&2	**2. General Methods of Metal Production:** Pyro-metallurgical techniques, Physical chemistry of thermal reaction processes, Hydrometallurgical extraction, Thermo-electric extraction, Metal refining techniques, Theoretical consideration of electrochemical processes.
CLO-3(a)	**3. Production of Pig Iron:** Blast furnace, Raw materials for the blast furnace, Blast-furnace design and operation, Chemical reactions taking place in blast furnace, Products of the blast furnace, Recent developments in blast furnace practice.
CLO-3(a)	**4. Steel Making and Alloys of Steels:** Production of steel-cement and crucible steel from scrap and pig iron, Bessemer process, Open hearth process, Duplex steel making process, Plain carbon steels, Low-alloy steels, High-alloy steel.
CLO-3(b)	**5. Modern Furnaces of Steel Making:** Electric Arc Furnace (EAF): Working principle and construction of EAF, charged/raw materials, Induction Furnace (IF): Working principle and construction of IF, Operation and use of IF, charged materials/raw materials, Ladle Refining Furnace (LRF): Working principle and construction of LRF, Equipment design and operation.
CLO-3(c)	**6. Metal-Casting Processes:** Sand casting, Shell-mold casting, Expandable pattern casting, Plaster-mold casting, Ceramic mold casting, Pressure casting, Die casting,

Centrifugal casting, Casting techniques for single crystal components, Inspection of castings, Foundries and foundry automation.

CLO-3(c) **7. Continuous Casting Machine (CCM):** Objective and diagram of CCM, Step involved in continuous casting process, Casting phenomenon, Turret, Tundish, Casting Mould, Primary cooling, Secondary cooling, Cutting torch, Cooling Bed, Advantages, Disadvantages, Applications.

Recommended books:

Author's name		**Title of books**
1. A.R. Baily	:	A Text Book of Metallurgy
2. J. Newton	:	Extractive Metallurgy
3. R.B. Leighou	:	Chemistry of Engineering Metals
4. Bodsworth	:	Physical Chemistry of Iron and Steel Making
5. Rhines	:	Phase Diagrams in Metallurgy
6. Brick & Philips	:	Structure and Properties of Alloys
7. Kalpakjian	:	Manufacturing Engineering and Technology
8. B.W. Niebel et. *al.*	:	Modern Manufacturing Process Engineering
9. R. Asthana, *et. al.*	:	Materials Processing and Manufacturing Science
10. W.R. Irving	:	Continuous Casting of Steel

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3152	**Production Metallurgy Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. Determination of the wettability of a powder by the Washburn capillary rise method for measuring the efficiency of froth flotation concentration of ores.
	2. Preparation of metal sinter.
	3. Construction of an Ellingham diagram from a given set of data.
	4. Analysis of pig, wrought and cast iron.
	5. Analysis of steel/stainless steel/austenitic stainless steel.
	6. Analysis of nonferrous alloys.
	7. Casting of metals and alloys.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3161	**Materials Manufacturing Engineering**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course provides students with fundamental knowledge of modern manufacturing engineering, emphasizing material-removal processes, semiconductor device fabrication, and computer-integrated manufacturing systems. It introduces contemporary manufacturing technologies such as CAD/CAM, additive manufacturing, automation, and Industry 4.0, enabling students to understand the principles and applications of advanced manufacturing in materials engineering. The course equips students with the knowledge and skills required to select appropriate manufacturing processes, understand digital manufacturing technologies, and address current industrial challenges. It also provides a strong foundation for professional practice, research, and advanced studies in manufacturing and materials engineering.

Intended Learning Objectives (ILOs):

1. Understand the fundamental principles of material-removal processes, machining operations, and metal cutting mechanisms used in manufacturing engineering.
2. Explain the characteristics, selection criteria, and applications of cutting-tool materials, cutting fluids, and conventional as well as non-traditional machining processes.
3. Describe the manufacturing processes involved in semiconductor and microelectronic device fabrication, including wafer preparation, thin-film deposition, lithography, etching, diffusion, metallization, and packaging.
4. Demonstrate an understanding of computer-integrated manufacturing (CIM) systems and the applications of CAD, CAE, CAM, CAPP, and additive manufacturing in modern production environments.
5. Analyze modern manufacturing technologies, including flexible manufacturing systems (FMS), computer simulation, artificial intelligence (AI), Industry 4.0, and smart manufacturing for improving industrial productivity and sustainability.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Explain the principles of material-removal processes, metal cutting mechanisms, cutting-tool materials, and cutting fluids, and select appropriate machining processes for engineering materials.	PLO 1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Compare conventional and non-traditional machining processes and evaluate their advantages, limitations, and industrial applications for manufacturing engineering.	PLO 1,2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-3	Describe the fabrication processes of semiconductor and microelectronic devices, including wafer preparation, thin-film deposition, lithography, etching, diffusion, metallization, testing, packaging, and printed circuit board (PCB) manufacturing.	PLO 1,2,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Analyze computer-integrated manufacturing (CIM) systems and apply the concepts of CAD, CAE, CAM, CAPP, additive manufacturing, automation, artificial intelligence (AI), and Industry 4.0 in modern manufacturing.	PLO 1,2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Material Removal Processes and Machine Tools:** Introduction to material-removal processes, classification of machining processes, mechanics of metal cutting, chip formation, cutting forces, cutting-tool geometry, tool wear and tool life, machinability of engineering materials, cutting-tool materials, cutting fluids, their functions, types and applications.
CLO-2	**2. Conventional and Non-Traditional Machining Processes:** Principles, working mechanisms, advantages, limitations and industrial applications of conventional machining processes including turning, drilling, milling, shaping, grinding and broaching. Introduction to advanced machining processes including Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), Water Jet Machining (WJM), Electrochemical Machining (ECM), Electrical Discharge Machining (EDM), Laser Beam Machining (LBM).
CLO-3	**3. Fabrication of Microelectronic Devices:** Introduction to semiconductor manufacturing, semiconductor materials and silicon wafers, crystal growth and wafer preparation, thin-film deposition techniques, thermal oxidation, photolithography, wet and dry etching, diffusion and ion implantation, metallization, testing, bonding and packaging, reliability and yield analysis, and basic concepts of printed circuit board (PCB) fabrication.
CLO-4	**4. Computer-Integrated Manufacturing (CIM) Systems:** Introduction to manufacturing systems and automation, Computer-Integrated Manufacturing (CIM), Computer-Aided Design (CAD), Computer-Aided Engineering (CAE), Computer-Aided Manufacturing (CAM), Computer-Aided Process Planning (CAPP), three-dimensional (3D) modelling, additive manufacturing (3D printing), computer simulation of manufacturing processes, group technology, cellular manufacturing, flexible manufacturing systems (FMS), Just-in-Time (JIT) production, Artificial Intelligence (AI), Industry 4.0, Digital Twin and Smart Factory concepts.

Recommended books:

Author's name		Title of books
1. S. Kalpakjian and S. R. Schmid	:	Manufacturing Engineering and Technology (8th Edition), Pearson

2. P. N. Rao : Manufacturing Technology, Volume II: Metal Cutting and Machine Tools, McGraw-Hill Education

3. T. C. Chang, R. A. Wysk and H. P. Wang : Computer-Aided Manufacturing, Pearson

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3162	**Materials Manufacturing Engineering Sessional**	**1**	**25**	**3**

Course Types ☐ **Theoretical** √☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/Report (60%)

Rationale of the Course: This laboratory course complements the theoretical course Materials Manufacturing Engineering by providing practical experience in computer-aided manufacturing, digital product development, and modern manufacturing technologies. It enables students to develop engineering skills in CAD/CAM, CNC programming, manufacturing simulation, PCB design, and additive manufacturing. The course prepares students to use modern engineering software and manufacturing tools commonly employed in smart manufacturing environments and Industry 4.0.

Intended Learning Objectives (ILOs):

1. Develop engineering drawings and three-dimensional models using CAD software.
2. Generate machining programs and manufacturing plans using CAM and CNC technologies.
3. Apply manufacturing simulation and process planning techniques for engineering products.
4. Design simple printed circuit boards (PCB) and understand basic electronic manufacturing practices.
5. Demonstrate the applications of additive manufacturing and digital manufacturing technologies in engineering.

Course Learning Outcomes (CLOs):

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	**Computer-Aided Design (CAD):** Introduction to CAD software (e.g., AutoCAD or SolidWorks), sketching, geometric constraints, 2D engineering drawings, dimensioning, tolerancing, 3D solid modelling, assembly modelling, and generation of engineering drawings.	PLO 1,2,3,5	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	**Computer-Aided Manufacturing (CAM):** CNC machine fundamentals, coordinate systems, G-code and M-code programming, tool-path generation, machining simulation, process	PLO 1,2,3,4,5	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam

	planning, machining parameter selection, and CNC program verification.		☐ Audio/Video	☐ Presentation
CLO-3	**PCB Design and Manufacturing:** Schematic design, PCB layout, component placement, routing, Gerber file generation, introduction to PCB fabrication and soldering techniques, and PCB inspection.	PLO 1,2,4,5	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	**Digital Manufacturing and Additive Manufacturing:** Introduction to 3D printing technologies, slicing software, printer operation, additive manufacturing workflow, manufacturing simulation, digital manufacturing concepts, and mini design project using CAD/CAM and additive manufacturing tools.	PLO 1,2,3,4,5, 6	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLOs	Course contents
CLO-1	1. Develop engineering drawings and 3D models using CAD software and prepare manufacturing-ready designs.
CLO-2	2. Generate CNC machining programs, perform manufacturing simulations, and prepare process plans for engineering components.
CLO-3	3. Design simple printed circuit boards (PCB) and demonstrate the basic principles of digital manufacturing technologies.
CLO-4	4. Apply additive manufacturing and computer-integrated manufacturing tools to solve practical manufacturing problems.
	5. Introduction to 3D printing technologies, slicing software, printer operation, additive manufacturing workflow, manufacturing simulation, digital manufacturing concepts, and mini design project using CAD/CAM and additive manufacturing tools.

Recommended books:

Author's name		Title of books
1. Mikell P. Groover	:	Automation, Production Systems, and Computer-Integrated Manufacturing, 5th Edition, Pearson Education
2. Ibrahim Zeid	:	**CAD/CAM: Theory and Practice**, McGraw-Hill

Third Year Second Semester Examination, 2028

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3211	**Physical Metallurgy of Iron and Steels**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The course will provide the fundamental concepts of steel, tool steel, stainless steel, and their different types of identification methods. Also, focus on the theory of heat treatment process that covers the iron-carbon phase diagram, isothermal and continuous cooling curves, annealing, quench and tempering, and surface hardening treatments. The more common metallurgy of mechanical working process will also be discussed in detail.

Intended Learning Objectives (ILOs):

1. To understand the fundamental concepts of steel, tool steel, stainless steel, and their different types of identification methods.
2. To learn the different theories of heat treatment process that covers the iron-carbon phase diagram, isothermal and continuous cooling curves, annealing, quench and tempering, and surface hardening treatments.
3. To improve the student's capability of metallurgy of mechanical working process.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Gain knowledge of steel, tool steels, and stainless steels with their alloying elements and identification methods.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand heat treatment processes used in the steel industry and know transformations with time-temperature-transformation diagrams.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Apply various mechanical working processes used in the steel industry.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	1. **Steels and Tool Steels:** Introduction, Alloy steels, Effects of alloying elements, Nickel, Chromium, Nickel-chromium, Manganese, Molybdenum, Tungsten and silicon steels, Tool steels: Classification of tool steels, properties of different tool steels, Cast Iron: Type of cast iron, white cast iron, malleable cast iron, gray cast iron, alloy cast iron.

CLO-1	**2.**	**Stainless Steel:** Introduction, Martensitic, ferritic and austenitic stainless steel, Ni and Cr equivalent, Schaeffler diagram of stainless steel and super alloys.
CLO-1	**3.**	**Testing of Steels:** Identification tests, Appearance test, Sound test, Spark test, Weight test, Bend test and Filling test.
CLO-2	**4.**	**Heat Treatment of Steel:** Introduction, Full annealing, Spherodising, Normalizing, Isothermal transformation diagram, Transformation to pearlite and bainite, Cooling curves and the I–T diagram, Transformation on continuous cooling, Homogeneity of austenite, Mechanisms of heat removal during quenching, Tempering, Austempering.
CLO-2	**5.**	**Hardening and Surface Treatment**: Introduction, Precipitation hardening, Work hardening, Case hardening, Induction hardening, Flame hardening, Carburising: Pack carburizing, gas carburizing, liquid carburizing, steel for carburizing, Applications of carburizing, Cyaniding, Nitriding, Carbonitriding.
CLO-3	**6.**	**Metallurgy of Mechanical Working:** Introduction, Principle of hot and cold working, Effects of hot and cold working on properties, Various working processes: Rolling, forging, extrusion, spinning, drawing, stamping, machining, welding and casting.

Recommended books:

Author's name		**Title of books**
1. R.E. Smallman	**:**	Modern Physical Metallurgy
2. S.H. Avner	**:**	Introduction to Physical Metallurgy
3. R.B. Leighou	**:**	Chemistry of Engineering Materials
4. R. Kumar	**:**	Physical Metallurgy of Iron and Steel
5. R.E. Reed-Hill	**:**	Physical Metallurgy Principles
6. J.F. Lancaster	**:**	Metallurgy of Welding, Brazing and Soldering
7. D.S. Clark & W.R. Varney	**:**	Physical Metallurgy for Engineers
8. V.K. Manchanda & G.B.S. Narang	**:**	Materials and Metallurgy

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3221	**Welding and Joining Engineering**	**2**	**50**	**2**

Course Types	√□ **Theoretical**	□ **Sessional/Practical**	□ **Project/Training**	□ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course presents the concepts behind welding and joining technology. These include welding and joining techniques, and also the weldability of engineering materials, standards in welding, health and safety. The concepts are then applied to the design and fabrication of engineering components and structures. The importance of selecting the correct welding process and parameters for a particular application will be demonstrate by investigating several case studies.

Intended Learning Objectives (ILOs):

1. To enrich the concepts to assist in the selection of processes and parameters to make appropriately designed, sound joints, fit for service in the operating environment.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	This course is intended to develop an understanding of the fundamentals of welding and joining processes.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Identify the evaluation of the suitability of using different welding and cutting processes.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Illustrate the principle and evaluation of using electricity and heat treatment considerations in different welding and cutting processes.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	This course is intended to develop an understanding of the fundamentals of joining and bonding processes in materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Fundamental Concepts:** History and recent advances in welding and joining technology, Different types of welding and joining techniques, Common terms used in welding and joining, Equipment and machines for welding, Cutting and joining, Hazards and safety standards in welding, Joining and allied processes.
CLO-1	**2. Gas Flame Processes for Welding and Cutting:** Definition and classification of welding, Oxyfuel gas welding, Definition and classification of cutting process, Oxygen torch cutting, Fuel gases for oxyfuel gas cutting, Stack metal powder, Chemical flux and underwater torch cutting, Flame straightening.
CLO-1&2	**3. Arc Processes for Welding and Cutting:** Basic circuit and mode of metal transfer for arc welding, Different types of arc welding, Shielded metal arc welding, Submerged arc welding and plasma arc welding, Power sources for arc welding, Cutting-tool materials and cutting fluids, Arc cutting, Metallurgical and heat considerations in thermal cutting, Machining process for producing various shapes, Non-traditional machining processes.
CLO-3	**4. Resistance and other welding:** Introduction, Theory of resistance welding, Effect of temperature, pressure and current in resistance welding, Power supply for resistance welding, Different types of resistance welding processes, Different types of solid-state welding processes, Welding of plastics, thermal spray coating or metalizing.
CLO-4	**5. Brazing and Soldering:** Introduction, definition of brazing, nature and strength of brazed joints, Brazing metals, methods of applying braze metal, Heating methods used in brazing, Flux and flux removal, Post braze operations and inspections, braze

welding, definition of soldering, solder metals, soldering fluxes, heating for soldering, engineering materials and their compatibility with soldering, Design and strength of soldered Joints, Flux removal and flux less soldering.

CLO-4&5 **6. Adhesive Bonding and Mechanical Fasteners:** Adhesive materials and their properties, Nonstructural and special adhesives, Design considerations, Advantages and limitations, Introduction and methods for mechanical fastening, Features for mechanical fastening, Manufacturing concerns, design and selection in mechanical faster ring.

Recommended books:

Author's name		**Title of books**
1. E. Paul De Garmo *et. al.*	**:**	Materials and Processes in Manufacturing

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3222	**Welding and Joining Engineering Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. Welding: Metal joints: riveting, grooving, soldering, welding, Welding practice: electric arc steel, aluminum, fabrication of electrode, Welding defects: visual, destructive and non-destructive tests of welding **2.** Gas welding and equipment, types of flame, welding of different types of materials. Gas welding defects. Test of gas welding **3.** Hard Coating of Materials by Welding Process

Recommended books:

Author's name	**Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3231	**Corrosion Engineering**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The metallic materials, at least to some extent, experience some kind of interaction with their diverse surrounding environment causing deterioration with time. Prior to design, a material engineer needs to know such types of interaction either to avoid or to minimize deterioration. First two chapters of this course will make the students familiarize with the basic theories of corrosion. Corrosion testing, the most important part of corrosion engineering, will be taught in chapter three. Students will learn different types of corrosion and their preventive measures in Chapter four, five and six respectively.

Intended Learning Objectives (ILOs):

1. To understand the basic principle and theoretical background of different forms of corrosion.
2. To learn different preventive, protective and monitoring measures against corrosion.
3. To develop students' capability to protect metallic structures effectively from the risk of corrosion.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Utilize their basic electrochemical knowledge to understand corrosion.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☐ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Identify the different types of corrosion and understand their mechanism.	PLO1,2	☒ Lecture ☐ Tutorial ☒ Discussion ☒ Interaction ☐ Audio/Video	☐ Class Test ☒ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Measure and test of corrosion.	PLO4,5	☒ Lecture ☒ Tutorial ☐ Discussion ☐ Interaction ☒ Audio/Video	☒ Class Test ☐ Quiz ☐ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Design devices or systems to protect the structures from corrosion.	PLO3	☒ Lecture ☒ Tutorial ☒ Discussion ☐ Interaction ☐ Audio/Video	☐ Class Test ☐ Quiz ☒ Assignment ☒ Final Exam ☒ Presentation

Course contents Mapping with CLOs:

CLOs		Course contents
CLO-1	**1.**	**General Concepts:** Definition and importance of corrosion, Cost of corrosion, Corrosion damages, Classification of corrosion, Future outlook, Electrochemical aspects of corrosion, Corrosion cells, Environmental effects, Metallurgical and other aspects.
CLO-1	**2.**	**Theory of Corrosion:** Thermodynamic aspects of corrosion: Free energy, cell potentials and EMF series, diffusion processes and double layer, Pourbaix diagram, Electrode kinetics: Exchange current density, limiting current, hydrogen over voltage, activation polarization, concentration polarization, combined polarization, mixed-potential theory, mixed electrodes, passivity, passivator, flade potential, active-passive cells and behavior of metals, Mechanisms of the growth and breakdown of passive films.
CLO-2	**3.**	**Forms of Corrosion:** Galvanic corrosion, Crevice corrosion, Pitting, Inter-granular corrosion, Selective leaching, Erosion corrosion, Stress corrosion, Corrosion fatigue, Fretting corrosion, Hydrogen damage, Atmospheric corrosion, Underground corrosion, High temperature corrosion.
CLO-2		**Corrosion in Industries:** Corrosion in boiler plants; Gas-turbine blades; Chemical industries; Petroleum, building and fertilizer industries.
CLO-3	**4.**	**Corrosion Testing:** Classification, purpose, surface preparation, measuring and weighing, exposure techniques, standard expression for corrosion rate; NACE test methods; Linear polarization; AC impedance; Tafel polarization technique; In-vivo corrosion; Paint tests; Seawater test.
CLO-4	**5.**	**Corrosion Prevention:** Materials selection: Alteration of environment, design, cathodic and anodic protection; Inhibitors and passivators; Prevention of corrosion by coatings.

Recommended books:

Author's name		Title of books
1. Mars G. Fontana	**:**	Corrosion Engineering
2. H.H. Uhlig & R. Revie	**:**	Corrosion and Corrosion Control
3. U.R. Evans	**:**	An Introduction to Metallic Corrosion
4. E.C. Potter	**:**	Electrochemistry

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3232	**Corrosion Engineering Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: This course is designed to enrich the practical skill of purification of metal, electrodeposition of metal and alloys, and corrosion behavior of metals.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Determination of corrosion rates of carbon steels, galvanized steel, aluminium and nickel in various aggressive media. **2.** Measurement of corrosion rates of base metals galvanically couples with different area ratios of the noble metals. **3.** Microstructural study of some corroded specimens.

Recommended books:

Author's name		Title of books
1. E.C. Potter	**:**	Electrochemistry
2. W.Blum & G.B. Hogaboom	**:**	Electroplating and Electroforming
3. F.A. Lowenheim	**:**	Modern Electroplating
4. R.W. Weiner & A. Walmsley	**:**	Chromium Plating

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3241	**Glass and Ceramics**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course provides an overview of the glass specimens with their composition, structure, properties and relevant characterization techniques. It also deals with various manufacturing processes of glasses with their home and advanced applications. This course also discusses the raw materials, properties, structure, manufacturing and design, films and coatings of ceramics and refractory materials. Three main topics are covered: Properties, manufacturing processes with emphasis on achieving the desired properties, as well as the basis for design. Properties: Bulk: elasticity, hardness, strength, fracture toughness and creep in relation to composition, structure and thermal properties. Films/coatings: mechanical performance. Manufacturing: Synthetic ceramic powders, the stabilization of dispersions, forming by pressing, casting, extrusion and injection molding, sintering and heat treatment. Deposition of films and coatings. Design: Principles of design with brittle materials, Weibull statistics, analysis of fracture and toughening of ceramics. Finite size effects in ceramic materials.

Intended Learning Objectives (ILOs):

1. To provide knowledge about the glassy state, their properties, chemical durability of glasses and glass-metal seal technology.

2. To deliver idea about laboratory synthesis, various manufacturing processes, characterization of structure and properties and applications of glasses in various sectors.
3. To give knowledge on fiber form of glasses, manufacturing process, textile form of glass and crystal and metallic glasses.
4. To provide overall concept on traditional and functional ceramics, types and structural composition of ceramics.
5. To deliver knowledge on raw materials of ceramics and clays, their manufacturing methods, property characterization techniques.
6. To know about refractory materials, their specific applications and their physical, thermal and mechanical properties at ambient and high temperatures

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Describe the glass theory, basic properties of glasses and how glass-ceramics are prepared and their applications in different sectors.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Explain the definition of physical properties of ceramic materials (density, heat capacity, thermal conductivity, thermal expansion) and describe which parameters these properties are dependent on.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	(a) Describe the process of how ceramic materials are produced from powder synthesis to the firing of the green bodies to achieve a dense material. b) Describe processes for the preparation of ceramic films and coating. Understand the importance of how the preparation process affects the properties of the finished product. (c) Describe typical properties of different ceramic materials and compare these with other types of materials. Understand how finite size effect influences the properties of ceramics.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1&2	**1. Glass Science:** Definition of glass, the enthalpy-temperature diagram, Structural and kinetic theory of glass formation, Phase separation of glass, Compositions and properties of commercial glasses.
CLO-2&3	**2. Properties of Glass:** Rheological properties: viscosity, characteristic points, Thermal properties: specific heat, thermal conductivity, thermal expansion; density, Chemical properties: glass surface, acid and alkaline attack, water attack and weathering, Electrical properties: ionic and electronic conductivity, Optical properties: refraction, reflection, absorption, transmission, colored glasses, photochromic glasses, photosensitive glasses, electrochromic glasses, optical fibers.

CLO-2&3 **3. Glass Technology:** Raw materials and calculation of batch composition, Melting, homogeneizing, fining and conditioning, Classical forming methods, Specialized forming Methods, Glass to metal seals.

4. Fibrous Glass: Composition and properties of fibre, Manufacturing processes and products, Application of fibrous-glass wool, Applications of fibrous-glass textile products, Fibrous-glass-reinforced plastics, Metallic glass and crystal glass.

CLO-2&3 **5. General Concept and Structure of Ceramics:** Introduction, Traditional and engineering ceramics, Types of ceramics, AX-type crystal structures, A_mX_p-type crystal structures, $A_mB_nX_p$-type crystal structures, Crystal structures from the close packing of anions, Ceramics density computations, Imperfections in ceramics, Silicate ceramics: Silica, silica glasses, silicates, layered silicates, diamond, graphite and fullerences.

CLO-2&3 **6. Raw materials of Ceramics and Clays:** General consideration, Clay minerals, Talc and related minerals, Silica and silicate minerals; Other raw materials, The role of various kinds ceramic material to the ceramic ware, Composition and plasticity of clays, Burning of clays, Colour of clay products, Brick making methods, Efflorescence on bricks, Terra-cotta ware, and sanitary ware.

CLO-2&3 **7. Processing and Characterization of Ceramics:** Material preparations, Powder pressing, Extrusion; Soft plastic forming, Slip casting, drying, firing, glass forming methods, Ceramic strain sorting, Polishing, glazing, decorating, coating of the ware and special processes of ceramics.

CLO-2&3 **8. Refractory Materials:** Fire clay, High alumina refractories, Silica, magnesite and magnesia, Chrome refractories, Fosterite, dolomite, mortar materials, Pyrometric cones, Chemical reactions of refractories, Physical behaviour of refractories, Thermal conductivity and specific heat of refractories.

Recommended books:

Author's name		**Title of books**
1. E.B. Shand	**:**	Glass Engineering Handbook
2. W.F. Smith	**:**	Foundation of Materials Science & Engineering.
3. William D. Callister	**:**	Materials Science & Engineering–An Introduction
4. J.C. Anderson *et al*.	**:**	Materials Science
5. Robert B. Leighou	**:**	Chemistry of Engineering Materials
6. W.D. Kingery *et. al.*	**:**	Introduction to Ceramics
7. P. William Lee	**:**	Ceramics

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3242	**Glass and Ceramics Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/ Design work/ Report (60%)

Rationale of the Course: This course is outlined for the laboratory experience in design, processing, and characterization of glasses and ceramics. Glasses are formulated, melted and characterized to correlate composition and properties. The students examine the properties and behavior of molten glass along with basic forming techniques, including quenching method, off-hand shaping, molding and casting. Chemical durability measurements of the synthesized glasses are also performed in this laboratory. Moreover, Clay-based ceramics are formulated to meet performance specifications, prepared by slip casting/extrusion, and fired.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Fabrication of glasses, ceramics and refractory materials. **2.** Forming and shaping of ceramics. **3.** Characterizations of glass and ceramics by XRD, IR analysis, TG-DTA and Impedance measurement. **4.** Microstructure and micro-hardness analysis of glass and ceramics.

Recommended books:

Author's name		Title of books
1. E.B. Shand	**:**	Glass Engineering Handbook
2. W.D. Kingery *et. al.*	**:**	Introduction to Ceramics

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE3251	**Energy Conversion and Storage Systems**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course targets students to give a sound knowledge about engineering materials that are used to the field of renewable energy conversion and storage systems. Particular relevance is given to energy storage materials for primary cells, secondary cells and fuel cells and also energy conversion materials for solar cell, bioconversion cells. This course covers fundamental properties of materials and performance characterization, pack design, system integration, control, diagnostics and, safety energy conversion devices.

Intended Learning Objectives (ILOs):

1. To understand the importance of the implementation of renewable energy sources.
2. To learn the fundamental electrochemical, optoelectronic and thermodynamic properties of materials used for energy conversion and storage devices.

3. To enhance the students' capability to design and select appropriate materials for a particular energy device

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Classify the source of energy.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Design and enhance the performance of different types of cells for energy conversion and storage.	PLO2,3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	(a) Gain an insight of the basic principle of photovoltaic (PV) system and advance PV system by improving design and selecting appropriate materials. (b) Known the photosynthesis process and use biomass for energy generation by bioconversion process. (c) Known about the sources of nuclear energy and the energy generation process.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1&2	**1. Source of Energies and Fundamentals of Fuel Cells:** Conventional and Non-Conventional Energy, Energy storage and Conversion, Direct and indirect energy conversion, Fuel cells and related systems, Air-depolarized fuel cells, Electrode processes, Choice of cell reactions, Thermodynamic efficiency of fuel cells, Electromotive force of fuel cells, Rates of electrode processes, Temperature dependent fuel cells, Application of fuel cell systems and future of the fuel cells.
CLO-2	**2. Storage Cells:** Leclanche cell: Construction, shelf life, cell reactions and performance, Flat type dry Leclanche cell, Magnesium dry cell, Air-depolarised cell, Various oxide-depolarised cells, Lead-acid accumulator: Construction, capacity, efficiency, cell reactions, Lithium, sodium, and zinc ion batteries, Lithium polymer batteries, Supercapacitors for energy storage.
	3. Photocatalytic and Hydrogen storage: Photocatalytic water splitting for hydrogen generation, Carbon dioxide (CO_2) capture and storage, Hydrogen storage: Metal oxide framework (MOF), organic frameworks, simple and complex hydrides, Carbonaceous materials: Graphene, carbon nanotube, fullerenes, carbon nitride, zeolites.
CLO-2&3(a)	**4. Materials for Solar and heat Energy Conversion:** Introduction, Solar radiation, Selective surface for solar energy conversion, Characteristics of surface, Types of solar selective materials, Solar reflector materials, Anti-reflection materials, Preparation of selective black surface, Production methods of coatings, Photovoltaic system: Solar cell, thermophotovoltaic cell.

CLO-3(b) **5. Biomass and Biogas Conversion:** Introduction, Photosynthesis, Biogas Generation, Digester and their Designs, Materials for Biogas and Biomass, pyrolysis of biomass, applications.

CLO-3(c) **6. Materials for Nuclear Energy Conversion:** Introduction, Nuclear energy and nuclear forces, Nuclear fission and fusion, Nuclear fuels: uranium, plutonium, thorium, Fission process: Homogenous and heterogeneous reactor systems, Cladding materials, Fission wastes, Muon catalysed fusion, Pyroelectric fusion, Condensation fusion in solids, Fusion reactor materials, Fusion wastes.

Recommended books:

Author's name		**Title of books**
1. E. C. Potter	**:**	Electrochemistry
2. G.W. Vinal	**:**	Storage Batteries
3. A. McDougall	**:**	Fuel Cells
4. K.R. Williams	**:**	An Introduction to Fuel Cells
5. B.L. Theraja	**:**	Basic Electronics Solid State
6. C.D. Rai	**:**	Solar Energy Utilization
7. PrabirBasu	**:**	Biomass Gasification, Pyrolysis and Torrefaction

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE3252	**Energy Conversion and Storage Systems Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. To study the design and simulation of a solar cell by SCAPS1D simulator. 2. To study the I-V characteristics of different LEDs, find threshold voltages, and energies to emit the light. 3. To study photocatalytic water splitting with TiO_2 under UV Light for hydrogen fuel generation. 4. To study the design and construction of a supercapacitor for energy storage. 5. To study the design, construction of electrochemical cells. 6. Experiments on Leclanche cells, magnesium dry cells, lead-acid accumulators, and lithium-ion batteries involve demonstrating their functionality.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ME3210	**Board Viva voce**	**2**	**50**	**-**
Course Types	**☐ Theoretical ☐ Sessional/Practical ☐ Project/Training**			**√☐ Viva-voce**
Assessment Strategies: Oral presentation				
Rationale of the Course: This course is to assess a student's understanding, communication skills, confidence, and ability to explain or defend their academic work orally.				

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Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4111	**Material Characterizations-I**	**3**	**75**	**3**
Course Types	**√☐ Theoretical ☐ Sessional/Practical ☐ Project/Training**			**☐ Viva-voce**
Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video				
Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)				

Rationale of the Course: They will also learn the details about the characterization stages. This course can explain how to analyze samples by using a scanning electron microscope (SEM), Transmission electron microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), DTA and TGA. It can also name the parts of those instruments. The course will enrich the students about the microscope and spectrometer parameters and what to do to obtain best and correct images and chemical analysis.

Intended Learning Objectives (ILOs):

1. To understand the basic principles and theoretical background of different materials characterization, their instruments and characterization techniques.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Exploit their basic knowledge to understand the methods of surface study, the principle of various light microscopes, the surface treatment process, followed by morphological analysis, and comparison of the optical microscope with other conventional microscopes.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-2	Principles, instrumentation, applications, advantages and disadvantages, sample preparation and their modification of scanning electron microscopy (SEM) and transmission electron microscopy (TEM).	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Explain different methods used to characterize materials and the basic operation of the equipment.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Basic operation of the method and practical aspects of the thermo-gravimetric analysis of differential thermal analysis.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Characterizations of magnetic materials and superconducting devices.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Metallurgical Microscopy**: Types of optical microscope; Principle of dark field and bright field illumination; Instrumentation of compound light microscope; Magnification by brightfield microscope; Advantage, disadvantage and applications of brightfield and darkfield microscope; Surface treatment process followed by morphological analysis.
CLO-2	**2. Scanning Electron Microscopy (SEM):** Principle of the SEM, SEM instrumentation and their function; Signal generation process and image formation; Sample preparation and their modification; Advantages and disadvantages of SEM; Practical aspects of SEM or applications; Comparison of SEM with other microscopes, DEX.
CLO-2	**3. Transmission Electron Microscopy (TEM):** Working principle of the method; Image formation by TEM; Advantages and disadvantages of TEM; Practical aspect of the method; Instrumentation and their functions; Uses; Method automation; Ion milling, Ultramicrotomy, Sample preparation and their modification.
CLO-3	**4. Atomic Force Microscopy (AFM):** Principle of operation; Atomic force imaging; Biological molecules; Nanoscale surface forces; Non-contact imaging.
CLO-3	**5. Scanning Tunneling Microscopy (STM):** Principles of STM; Practical aspect of STM; Methods of automation; Data analysis; Sample preparation.
CLO-4	**6. DTA and TGA:** Differential thermal analysis (DTA): Principles of method, practical aspect of the method, data analysis, sample preparation; Thermogravimetric analysis (TGA): Principles of method, practical aspect of the method, data analysis, sample preparation.
CLO-5	**7. Characterizations of Magnetic Materials:** Superconducting quantum interference device (SQUID); Vibrating sample magnetometer (VSM); B-H Meter; Gauss Meter.

Recommended books:

Author's name		Title of books
1. P.F. Kane	:	Characterization of Solid Surfaces
2. Yang Leng	:	Materials Characterization

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4112	**Material Characterizations-I Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Analysis of the percentage of copper in BRB cables and Paradise cables by UV-visible spectrophotometric techniques in material characterizations. **2.** Analysis of the percentage of copper in brass by spectrophotometric analysis. **3.** Estimation of the percentage of calcium from eggshell by materials characterization. **4.** Metal detection by atomic absorption spectrophotometric (AAS) and flame photometric techniques in material characterizations. **5.** Study the thermal behavior of materials by DTA (Differential Thermal Analysis) and TGA (Thermogravimetric Analysis).

Recommended books:

Author's name	Title of books
1. A.I. Vogel	A Text-book of Quantitative Inorganic Analysis

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4121	**Plastic and Rubber Technology**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course clarifies, informs and explains each aspect of plastic and rubber technology. This course is divided into three main aspects of plastic and rubber technology, namely introduction to plastic and rubber materials, synthesis, and processing of plastics, manufacturing, identification, and testing of plastics, rubber materials. This course deals with plastic processing operations such as injection, compression, transfer and blow molding. This course is also to make the students familiar with the concepts of manufacturing operations, finishing, machining, characterization, quality control, research and development technology.

Intended Learning Objectives (ILOs):

1. The course will help the students to understand the fundamental concepts on plastics and rubber materials.
2. Students will also help to learn the compounding, master batching, processing techniques of plastics and rubber.
3. This course will help to learn how to get expertise in manufacturing, characterizing rubber and plastic products.
4. The course will improve the student's ability on testing and quality development of industrial plastic and rubber products.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Explain the concepts of plastics and rubber materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	(a) Preparations of raw materials for the processing and manufacturing of plastics and rubber products. (b) To learn about the finishing and machining of plastic and rubber products manufacturing.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	To understand about identification, testing and quality analysis of plastics and rubber materials.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Fundamental of Plastic Materials:** Introduction; Classification of plastic; Copolymer of ethylene; Polyethylene and polypropylene; Polyethylene terephthalate; Polyvinyl chloride (PVC); Polyamide(PA)/Nylon; Polytetrafluoroethylene (PTFE); Polystyrene; Additives for plastic compounding; Ploy urathanes; Polycarbonates; Epoxy resin; Phenolic resin; Cellulose plastic; PU and Vinyl based ink; PU and vinyl based adhesive; Solvent chemicals in packaging; Important terms in plastic and packaging.
CLO-2(a)	**2. Processing of Plastics:** All types of moulding process (*e.g.* Blow moulding, Extrusion moulding, Injection moulding), Mould construction for all type of moulding; Troubleshooting of moulding; All process of packaging manufacturing (*e.g*. Film making/LLDPE, HDPE production, printing, inspection rewinding,

lamination-dry, wet and extrusion, curing, slitting, pouch); Thermoforming and vacuum forming, Polymer powder and coatings.

CLO-2(b) **3. Finishing and Machining of Plastics:** Introduction to finishing; Filing, tumbling, Grinding and sanding; Ashing; Buffering; Polishing machining; Plastics: Tapping and threading, turning and milling, sawing, piercing, trimming and routing, banking and die -cutting, counter boring and spotfacing, feeding devices.

CLO-2(a) **4. Manufacturing of Plastic Products:** Blow moulded HDPE products; Polyurethane foam; Synthetic shoes and soles; PVC wires and cables; Polyester capacitors; Plastic bangles; Pressure sensitive tapes; PVC pipes and conduits; Zip fasteners; Nylon watch straps; Artificial acrylic teeth; Bakelite electrical parts; Spectacle frames; Vinyl asbestos floor tiles; Contact lenses; Plastic welding and sealing.

CLO-1 **5. Basic Concept of Rubbers:** Natural rubber; Synthetic rubbers; Thermoplastic elastomers (TPE); Rubber compounding and processing technology; Sulphur vulcanization and non-sulphur vulcanization; Hard rubber; Latex technology.

CLO-2(b) **6. Rubber Manufacturing:** Manufacture of rubber footwear, beltings, hoses, wires and cables, rubber to metal bonded articles, mechanical seals, cellular products, foam articles, latex thread, tyre, and weather resistant rubber.

CLO-3 **7. Testing of Plastics and Rubbers:** Identification of common plastics and rubbers; Physical/Mechanical test; Optical test; Chemical test; Melt flow index (MFI), WVTR; MVTR and OTR test of plastic films/resins; Electrical test; Glass transition; Rehology of polymers: Diffraction patterns, microscopy and spectroscopy of polymers.

Recommended books:

Author's name		**Title of books**
1. C.M. Blow	**:**	Rubber Technology and Manufacture
2. Hofman	**:**	Rubber Technology Hand Book
3. Frankly	**:**	Rubber Processing
4. R. Chandra & S. Mishra	**:**	Rubber and Plastic Technology
5. P. Ghosh	**:**	Polymer Science and Technology of Plastic and Rubbers

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE4122	**Plastic and Rubber Technology Sessional**	**1**	**25**	**3**

Course Types	**□ Theoretical**	**√□ Sessional/Practical**	**□ Project/Training**	**□ Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course: This laboratory course is aim to facilitate the student's skill to the synthesis of different type of polymers and their processing. Students will acquire the knowledge on how to study the microstructures, physical and thermal properties of the prepared polymeric materials.

Separation and estimation of the different compositions of wood and jute will also be demonstrated in this laboratory course.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Identification of different rubbers and plastics. **2.** Preparation and characterization of polysulphide rubber (Thiokol). **3.** Preparation and characterization urea-formaldehyde Resin. **4.** Preparation and characterization of phenol-formaldehyde resins (Novolac and Resole). **5.** Preparation and characterization of acrylonitrile, butadiene and styrene (ABS). **6.** Preparation and characterization of polymethyl methacrylate (PMMA). **7.** Preparation and characterization of polystyrene resin. **8.** Preparation and characterization Urea-Formaldehyde Resin **9.** Preparation and characterization of plastic materials.

Recommended books:

Author's name **Title of books**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4131	**Magnetic and Dielectric Materials**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course covers the physical principles underlying the dielectric and magnetic properties of solids. Classification of magnetic materials and their uses in different applications are assigned. Introduction of dielectric materials, relative permittivity with respect to dc and ac field, dielectric strength and the applications of dielectric materials are included.

Intended Learning Objectives (ILOs):

1. Introduce basic principles of dielectric and magnetic properties of solids.
2. Introduce the ferroelectricity, piezoelectricity and pyroelectricity phenomena of materials.
3. Discuss dielectrics in DC and AC fields.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Develops understanding of the fundamentals of polarizable solids, ferroelectricity, and magnetism.	PLO1	☒ Lecture ☒ Tutorial	☒ Class Test ☒ Quiz

			☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Is able to relate this to the functioning of device that exploit these properties.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Understand how these properties may be used in device design.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1&2	**1. Diamagnetic and Paramagnetic Materials:** Magnetic dipoles; Types of magnetic materials; Origin of magnetism; Classical and quantum theory of diamagnetism; Diamagnetic substances; Classical and quantum theory of paramagnetism; Paramagnetism for free electrons; Paramagnetic substances; Hunds rules; Crystal field splitting; Curie law.
CLO-1&3	**2. Ferromagnetic Materials:** Ferromagnetism; Magnetic domain & Bloch wall; Hysteresis; Weiss molecular field theory and exchange integral; Ferromagnetic alloys; Thermal effects.
	3. Antiferromagnetic and Ferrimagnetic Materials: Antiferromagnetism; Neel's theory; Two Sub lattice model; Antiferromagnetic alloys; Ferrimagnetism: Structure of ferrites and garnets, Molecular field theory of ferrimagnetism; Soft and hard magnetic materials, Influence of temperature on magnetic behavior.
CLO-1	**4. Matter Polarization:** Electronic polarization; Local field and Clausius-Mossotti equation; Ionic, orientation and interfacial polarization.
CLO-1&3	**5. Dielectric Constant and Loss:** Dielectric loss, Debye equations, Cole-cole plots and equivalent series circuit; Dielectric strength; Dielectric Breakdown for gases, liquids and solids.
CLO-1,2&3	**6. Piezoelectricity, Ferroelectricity and Pyroelectricity:** Non-linear dielectrics; Typical capacitor constructions; Piezoelectricity; Quartz, oscillators and filters, Ferroelectric, Landau-Devonshire theory ferroelectricity and phase transitions; Pyroelectric crystals.

Recommended books:

Author's name		Title of books
1. S.O. Kasap	:	Principles of Optical Materials and Devices
2. S.O Pillai	:	Solid State Physics
3. A.J. Dekkar	:	Solid State Physics
4. C. Kittle	:	Introduction to Solid State Physics
5. M.A. Omar	:	Elementary Solid-State Physics
6. L.L. Hench & J.K. West	:	Principles of Electronic Ceramics
7. D.A. Neaman	:	Semiconductor Physics and Devices

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4132	**Magnetic and Dielectric Materials Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. To study fabrication and polarization characteristics of ferroelectric materials. **2.** To study the fabrication and polarization characteristics of ferromagnetic materials. **3.** To analyze hysteresis loss of ferroelectric and ferromagnetic materials. **4.** To study the design and fabrication of a capacitor and measure capacitance. **5.** To determine the normal/relaxor ferroelectrics materials using dielectric/hysteresis behaviors. **6.** To study the effects of defect dipoles on the hysteresis curves of ferroelectric materials

Recommended books:

Author's name	Title of books

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4141	Waste Management, Industrial Safety and Environmental Issues	**2**	**50**	**2**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course introduces industrial waste treatment, hazardous waste management, pollution control, industrial hazards, and environmental management. Students will learn essential wastewater treatment, waste recycling, air and water pollution control, industrial safety, and environmental sustainability concepts. The course also covers environmental regulations, risk assessment, and strategies for sustainable industrial practices.

Intended Learning Objectives (ILOs):

1. Understand key concepts of industrial waste treatment and hazardous waste management.
2. Learn methods for wastewater treatment, recycling, and resource recovery.
3. Understand sources, causes, and effects of air, water, and soil pollution.
4. Develop knowledge on industrial hazards, risk assessment, and safety measures.
5. Understand environmental management, regulatory compliance, and sustainable development.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Identify types of industrial and hazardous wastes and explain treatment and disposal methods.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Apply basic recycling and waste-to-resource techniques.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Analyze sources and impacts of air, water, and soil pollution and suggest control measures.	PLO2,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Identify industrial hazards and recommend preventive and safety measures	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Explain environmental management systems, environmental policies, and sustainable practices.	PLO7	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-6	Understand environmental regulations and compliance strategies.	PLO12	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Industrial Wastes and Treatment:** Sources, types, and characteristics of industrial wastes; Wastewater characterization: BOD, COD, TSS; Principles of industrial waste treatment: physical, chemical, biological; Treatment methods: primary, secondary, tertiary; Ultimate disposal methods (landfill, incineration, deep well injection)
CLO-1	**2. Hazardous Waste Management:** Common hazardous wastes: chemical, biomedical, radioactive, e-waste; Health and environmental impacts; Hazardous

waste management strategies: storage, segregation, secure landfills; Microbial treatment of wastes; Case studies of industrial hazardous waste accidents.

CLO-2 **3. Recycling and Resource Recovery:** Recycling of metals, plastics, glass, concrete, and rubber; Conversion of agricultural and urban wastes into energy or materials; Waste-to-energy technologies: biogas, biomass, incineration; Fertilizers, construction materials, and fuel from wastes; Role of circular economy in industrial sustainability.

CLO-3 **4. Pollution and Environmental Effects:** Air pollution: sources, major pollutants and their effects; Water pollution: sources, major pollutants, impacts on ecosystems and human health; Global environmental issues: greenhouse effect, ozone depletion.

CLO4 **5. Industrial Hazards and Safety:** Types of hazards: fire, chemical, mechanical, electrical, radiation, dust explosion; Industrial safety principles and risk assessment; Personal protective equipment (PPE) and safe handling of chemicals; Emergency procedures, first aid, and accident prevention; Industrial plant layout, ventilation, and lighting for safety.

CLO-5&6 **6. Environmental Management and Sustainability:** Environmental Management Systems (EMS) and audits; Environmental policies, laws, and regulatory compliance (local & international); Sustainable development principles for industry; Environmental management plan (EMP): components and implementation; Role of industries in achieving sustainability goals.

Recommended books:

Author's name		**Title of books**
1. S.E. Manahan	**:**	Hazardous Waste: Chemistry, Toxicology and Treatment
2. S.E. Manahan	**:**	Environmental Chemistry
3. C. Baird	**:**	Environmental Chemistry
4. B.K. Sharma & H. Kaur	**:**	Environmental Chemistry
5. T. Sawyer & E. Martell	**:**	Industrial Environmental Chemistry
6. J.M. Dallavalle	**:**	The Industrial Environment & its Control
7. E. Jogensen	**:**	Industrial Waste Water Management
8. R.K. Sapru	**:**	Environmental Planning & Management
9. D. Jacob	**:**	The Analytical Chemistry of Industrial Poisons,Hazards and Solvents
10. S.M. Mosters	**:**	Introduction to Environmental Engineering and Science
11. Metcalf & Eddy	**:**	Wastewater Engineering

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE4151	**Surface Science and Engineering**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The first part of this course is surface engineering, and the second part is coating technology. This course provides an introduction to surface engineering. Topics covered in basic surface engineering include surface phenomena, surface active agents, tribology and different types of coatings.

Intended Learning Objectives (ILOs):

1. This course aims to impart knowledge about various failure of metals such as adsorption, absorption, wear, and friction also surface modification through various coating technologies to improve the functionality and life of components.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Explain the fundamentals of surface engineering.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Identify the surface modification of components using suitable surface-active agents.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Illustrate principle and evaluation of surface tribology such as friction, Wear and lubrication.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Select the suitable coating technique for surface treatment.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Surface and Interface Phenomena:** Adsorption and Sorption, films of insoluble substances, adsorption by solids from solutions, Characteristics of physical and chemical adsorptions; Freundlich and Langmuir isotherms; Electro kinetic potential. Liquid-gas interfaces; Solid-gas interfaces: surface reactions in moist atmosphere; Solid-solid interfaces.
CLO-2	**2. Surface Texture and Surface-Active Agents:** Fundamentals of surface texture; Application of surface-active agents in metal technology; Special cleaning operations, rust and corrosion inhibition; Electroplating; Application in the textile and other industries.
CLO-3	**3. Tribology:** Mechanisms of wear–adhesive; Abrasive, corrosive, fatigue and fracture wear; Surface coating tribology; Design for wear prevention; Lubrication; Laser and their interaction with surfaces; Laser modification effects and applications.
CLO-4	**4. Metallic Coatings:** Preparation of metal surfaces for coatings; Methods used in applying metallic coatings: Hot dipping, electrodeposition, vapour deposition,

spraying, cementation, cladding, sputtering, powder coating; zinc coatings; tin coatings; nickel coatings and other metal coatings; Electrodeposition on plastics.

CLO-4&5 **5. Inorganic Coatings:** Vitreous or porcelain enamels; Anodized oxide coatings on aluminum; Surface conversion or chemical-dip coatings.

CLO-4&5 **6. Organic Coatings:** Introduction, definition, function, constituents, preparation, characteristics, and types of paints; Electrodeposition of paint; Failure of paint; Definition, functions, constituents, characteristics and types of varnishes; Process of varnishing; Furniture polish, lacquer and enamels; Properties and types of distempers; Distempering process.

Recommended books:

Author's name		**Title of books**
1. R.B. Leighou	**:**	Chemistry of Engineering Materials
2. N.K. Adam	**:**	The Physics and Chemistry of Surfaces
3. S. Glasstone	**:**	Textbook of Physical Chemistry
4. Schwatz and Perry	**:**	Surface Active Agent

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE4152	**Surface Science and Engineering Sessional**	**1**	**25**	**3**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	**Course contents**
	1. Study of refractive index, extinction coefficient and thickness of semiconducting thin films using absorption, reflection, and transmission data. **2.** Estimation of some optical properties: Absorption coefficient, optical bandgap, and urback energy from transmission/reflection spectra of a semiconducting thin film. **3.** Determination of adsorptive power of an absorbent and verification of the Langmuir isotherm. **4.** Wear and frictional behavior of materials. **5.** Preparation of metal surfaces for coatings. Electrodeposition processes: copper, nickel and chromium plating, effect of deposition parameters on coating properties, effect of additives. **6.** Conversion coating processes including anodizing/hot dip galvanizing. **7.** Organic Coatings: Process of paints, varnish, lacquer and enamels.

Recommended books:

Author's name		Title of books
1. S. Glasstone	:	Textbook of Physical Chemistry
2. F.N. Jones, M.E. Nichols	:	Organic Coatings: Science and Technology
3. S.X. Zheng	:	Principles of Organic Coatings and Finishing

Course Code	Courses Title	Credits	Marks	Contact Weeks/Credit
MSE 4162	**Industrial Training/Study Tour/Field Work**	**2**	**50**	**1-2**

Course Types □ **Theoretical** □ **Sessional/Practical** √□ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Internal examiner/supervisor (30%); External examiner (any teacher from the panel of examiners) (30%); Presentation and oral examination (40%

Rationale of the Course: This project is introduced to make students familiar with actual industrial environments and what they may need to do in industry, and to make them realize how a material is produced in industry.

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4172	**Research Project**	**1**	**25**	**-**

Course Types □ **Theoretical** □ **Sessional/Practical** √□ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Internal examiner/supervisor (30%); External examiner (any teacher from the panel of examiners) (30%); Presentation and oral examination (40%)

Rationale of the Course: This course is designed for a year-long extensive research study involving modelling, design, and/or construction of materials, processes, equipment, and devices of Materials Science and Engineering interests, using the structure-processing-properties-performance relationship of materials to solve complex engineering and industrial problems related to Materials Science and Engineering.

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Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4211	**Nano- and Biomaterials**	**3**	**75**	**3**

Teaching-learning strategies: Lectures/Exercises/Quizzes/Class Tests/Attendance

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This course actually deals with two different types of materials; one is nanomaterials, and the other is biomaterials. These two classes of materials are used in cutting-edge research in materials science. This course will provide introductory knowledge of these two special types of materials to the students.

Intended Learning Objectives (ILOs):

1. This course will help the students to critically evaluate the promise of nanomaterials and technology.
2. Students will learn chemical structure, properties and morphology of different types of biomaterials.
3. To help the students to explain methods to modify the surfaces of biomaterials.
4. They can choose a material for a desired biological response.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Understand fundamental knowledge of nanomaterials and thereby recognize why and how physico-chemical properties of nanomaterials are different than their bulk counterpart.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Fabricate nanostructures.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	(a) Demonstrate an understanding of approaches to nanomaterials characterization. (b) Figure out different applications of nanomaterials.	PLO4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Understand scientific vocabulary related to biomaterials other than layman language.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Design, synthesis and fabrication strategy to generate new biomaterials to correct any functional disorder.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

CLO-6	Learn proteins and cells interactions with various biomaterials and thereby host responses to implants, including toxicity and health implications.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Nanomaterials:** Introduction; Carbon fullerenes and nanotubes; Micro and mesoporous materials; Core-shell structures; Organic and inorganic hybrids; Intercalation compounds; Nano composites and nano-grained materials.
CLO-2&3(a)	**2. Fabrication and Characterization of Nanomaterials:** Nanomanipulation and nanolithography; Soft lithography; Assembly of nanopartices and nanowires. Structural characterization; Chemical characterization; Physical properties of nanomaterials
CLO-3(b)	**3. Applications of Nanomaterials:** Introduction; Molecular electronics and nanoelectronics; Nanobots; Biological applications of nanoparticles; Catalysis by gold nanoparticles; Quantum well and quantum dot devices; Nano-mechanics: Carbon nanotube emitters, photo electrochemical cells, photonic crystals and plasmon waveguides.
CLO-4	**4. Concepts of Biomaterials:** Historical evolution of biomaterials; Biocompatibility, bulk and surface properties of biomaterials; Host reaction to biomaterials and their evaluation; Testing, selections and different standards for biomaterials; Sterilization of biomaterials.
CLO-5	**5. Metallic, Polymeric and Ceramic Biomaterials:** Microstructure and properties of metallic implants; Stainless steel, Co-based, Ni-based and Ti-based alloys for implants; Molecular weight, crystallinity and properties of polymeric implants; Ultra-high molecular weight polyethylene (UHMWPE); Hydrogels, bio-resorbable and bio-erodable polymers; Characteristics of bio-ceramics, bio-inert, bio-reactive and bio-resorbable ceramics; Degradation of materials in biological environment and its effect.
CLO-6	**6. Protein Adsorption and Cellular/Tissue Interactions with Implants:** Structure, properties and adsorption on surfaces of proteins; Cell membrane, adhesion, spreading and locomotion and its thermodynamics with materials interaction; Cell and tissue compartmentalization; Cell differentiation, basic tissues and organ formation.

Recommended books:

Author's name		Title of books
1. G. Cao	**:**	Nanostructures and Nanomaterials synthesis, Properties & Applications
2. S. Bhat	**:**	Introduction to Biomaterials

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4212	**Nano- and Biomaterials Sessional**	**1**	**25**	**2**

Course Types □ **Theoretical** √□ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course:

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Synthesis of metallic and metal oxide nano particles like Ag, Fe, Zn, Ti, Si etc. and their oxides. **2.** Synthesis of organic nano particles. **3.** Preparation of nano composites. **4.** Characterization of nano particles. Analysis of FTIR, TGA and DTA data of nanomaterials. **5.** Synthesis of ceramic biomaterials like hydroxyapatite (artificial bone material). **6.** Degradation study of different biomaterials in in-vivo and in-vitro condition. **7.** Behavior of materials in biophysical stimuli.

Recommended books:

Author's name	Title of books

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4221	**Materials Characterizations-II**	**3**	**75**	**3**

Course Types √□ **Theoretical** □ **Sessional/Practical** □ **Project/Training** □ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: Materials characterization is very important to tailor new and/or improve the properties of materials. Therefore, a materials engineer should have sound knowledge about different characterization techniques. X-ray is a very fundamental tool; first three chapters of this course will enrich knowledge about the internal structural of the material by using X-ray. Fourth chapter introduce the technique to study vibrational properties of materials. Students will learn about in Chapter five and seven.

Intended Learning Objectives (ILOs):

1. This course will help the students to understand the basic principle and theoretical background of different spectroscopic technique for material analysis.
2. By using these technique students will able to study internal structure, vibrational properties and compositional analysis of materials.
3. The course will enrich the students' capability to tailor new and/or improve materials.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Utilize their knowledge of natural science to understand basic principle of different spectroscopic method.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Identify the phase and internal structure of different types of materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Get information about the vibrational properties of materials.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Determine the chemical composition of different types of materials.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1&2	**1. X-ray Diffraction-I:** Optical grating and diffraction of light; Crystals and diffraction of X-rays; Diffraction under non-ideal conditions, scattering by an electron, scattering by an atom, scattering by a unit cell; Application to powder method; Multiplicity factor, Lorentz factor, absorption factor, temperature factor, intensities of powder pattern. X-ray optics; Counters; Pulse-height analysis; Special kinds of diffractometry; Scalars; Rate meters and monochromatic operation.
CLO-1&2	**2. X-ray Diffraction-II:** Orientation and quality of single crystals structure of poly crystalline aggregates; Determination of crystal structure; Precise parameter measurements; Phase-diagram determination; Order-disorder transformations and chemical analysis by X-ray diffraction.
CLO-3	**3. Spectroscopic Analysis:** Theoretical principles for visible, UV-visible, microwave, IR, NMR, Raman spectroscopy; Instrumentation and their measurement principles; Application of spectroscopic techniques for qualitative and quantitative analyses.
CLO-4	**4. Electron Spectroscopy for Chemical Analysis (ESCA):** Theoretical aspects, instrumentation, chemical shifts, factors related to the use of ESCA for surface analysis; Application of ESCA to surface studies.
CLO-4	**5. Auger Electron Spectroscopy:** Introduction, the Auger process, the secondary electron energy distribution, experimental apparatus, data interpretation and surface

analysis, special problems, some recent developments, some related spectroscopic techniques.

CLO-4 **6. Atomic Absorption Spectrophotometry:** Atomisation, graphic furnace atomisers, volatile hydride, sources of radiation, background correction, detection limits, interferences; Application of atomic absorption.

Recommended books:

Author's name		**Title of books**
1. P.F. Kane & G.B. Larrabee	:	Characterization of Solid Surfaces
2. B.D. Cullit	:	Elements of X-ray Diffraction
3. M.H. Loretto	:	Electron Beam Analysis of Materials
4. Galen W. Ewing	:	Instrumental Methods of Chemical Analysis
5. E.R. Greef *et. al.*	:	Instrumental Methods in Electrochemistry

Course Code	**Course Title**	**Credits**	**Marks**	**Contact Hours/Week**
MSE4231	**Computational Materials Science**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: Materials become more valuable when they are made into products with design. The first part of this course focuses on the fundamentals of materials modelling. Later chapters include the theoretical background of computational materials science and their exercise in different materials systems.

Intended Learning Objectives (ILOs):

1. The students will be able to know the basic of materials designing and manufacturing process.
2. The students will be able to acquire strong theoretical background about computational material science.
3. The students will understand computer-integrated manufacturing system.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	**Details of CLO**	**PLOs**	**Delivery Methods**	**Assessment Tools**
CLO-1	Understand the fundamentals of materials design and manufacturing.	PLO1,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Understand the movement of atoms and molecules into materials.	PLO2,3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam

			☐ Audio/Video	☐ Presentation
CLO-3	Identify the martials including various physical and optical properties using the DFT exercises.	PLO2,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-4	Understand the fabrication of microelectronics devices.	PLO1,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1&5	**1. Materials Modelling and Simulation:** Computational materials science; Methods in computational materials science, Basic procedures of computational materials science, Monte Carlo method, Molecular dynamics, The random-walk model, Simulation of finite systems, Statistical modelling by Python to find unknown materials parameters.
CLO-2	**2. Molecular Dynamics:** Basics of molecular dynamics for atomic systems, Velocity rescaling, Molecular dynamics in other ensembles, Accelerated dynamics, Limitations of molecular dynamics, Molecular dynamics in materials research, Potentials, Solutions for Newton's equations of motion, Initialization, Integration/equilibration, Data production.
CLO-1	**3. First-principles Methods:** Quantum mechanics; Eigen functions; Eigen values; Operators; Hamiltonian (H); Schrödinger wave equation for many-body problems; Early first-principles calculations: Born-Oppenheimer approximation, Hartree and Hartree-Fock approximation.
CLO-3	**4. Density Functional Theory:** Electron density, Hohenberg–Kohn theorems, Kohn–Sham approach, Kohn–Sham equations, Exchange-correlation functional: Exchange-correlation hole, Local density approximation (LDA), Generalized gradient approximation (GGA), Other XC functionals; Solving Kohn–Sham equations, DFT extensions and limitations, DFT exercises.

Recommended books:

Author's name		Title of books
1. J.G. Lee	:	Computational Materials Science: An introduction
2. Daan Frenkel	:	Understanding Molecular Simulation: From Algorithms to Applications

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4232	**Computational Materials Science Sessional**	**1**	**25**	**2**

Course Types ☐ **Theoretical** √☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course: This course offers the concept of modelling and design. Students will get hands-on experience with density functional theory-based (DFT) software to create precision modelling of two-dimensional (2D) and three-dimensional (3D) models, as well as calculating various properties of design products.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. MD exercises: Examples- potential curve of Al, Melting of Ni cluster, Sintering of Ni nanoparticles, Yield mechanism of an Au nanowire, Carbon nanotube tension and other relevant exercises based on MSE 4232 2. DFT exercises: Convergence test, Band structure, Density of states, Vacancy diffusion, Adsorption energy, and other relevant exercises based on MSE 4232

Recommended books:

Author's name		Title of books
1. Z. A. Siddiqui	:	Basics of Engineering Drawing

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4241	**Selection of Engineering Materials**	**2**	**50**	**2**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: This unit takes a detailed look at various engineering materials and the essential properties behind them. Students will learn how to select engineering materials and their properties for designing a particular material system. There is also an emphasis towards energy-related properties and forming properties. Materials studied in detail include alloy compounds, energy ceramics, ferrous metal systems, non-ferrous metal systems and polymers used for sports, ship structures, airframes, automobile structures, engines and power generation. This course will also familiarize the students with the properties of metal, ceramic, polymer and composite engineering materials and methods to protect materials and alter their properties.

Intended Learning Objectives (ILOs):

1. To give students the background required to pursue further studies in materials processing, design and related engineering fields.
2. To develop an understanding about the engineering materials to determine their various physical and mechanical behavior for advanced applications.

3. To introduce students the failure modes, best criteria for performance and the alloying composition of engineering materials for deriving numerous properties.

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Acquire knowledge on electrochemical, mechanical and physical properties of engineering materials to design engineering structures and devices.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	Select appropriate materials for various engineering applications.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Identify characteristic properties of engineering materials made of alloys, metals, ceramics composites and polymers and how these can be changed.	PLO3	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Materials Selection Strategy:** Introduction, motivation for selection, deriving property limits and material indices, material index examples, materials selection case studies.
CLO-2&3	**2. Materials for Sports:** The revolution in sports products, the tradition of using wood, tennis rackets, golf clubs, archery bows and arrows, bicycle for sports, fencing foils, materials for snow sports, safety helmets.
CLO-2&3	**3. Materials for Ship Structures:** The ship girder, factors influencing materials selection for ship hulls, materials of construction.
CLO-2&3	**4. Materials for Air Frame:** Principal characteristics of air craft structures, properties requirements of aircraft structures, requirements for high-speed flight, candidate materials for aircraft structures.
CLO-2&3	**5. Materials for Engine and Power Generation:** Internal combustion engine, external combustion engine, materials for bearing, materials for springs, materials for extra high voltage transmission.
CLO-2&3	**6. Materials for Automobile Structures:** The use of steel, the introduction of plastics, aluminum and its alloys, corrosion damage to automobiles, surface treatment of steel for car bodies, future trend in body construction and materials, Exhaust systems.

Recommended books:

Author's name		Title of books
1. Michael F. Ashby	:	Materials Selection in Mechanical Design
2. V. B. Bhandari	:	Design of Machine Elements
3. V. M. Faires	:	Design of Machine Elements

4. E. Alfredo Campo : Selection of Polymeric Materials
5. F. A. A. Crane *et. al.* : Selection and Use of Engineering Materials
6. R. E Smallman, R. J Bishop : Modern Physical Metallurgy and Materials Engineering
7. Flake Cambell Jr : Manufacturing Technology for Aerospace Structural Materials

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4251	**Fibre and Textile Engineering**	**3**	**75**	**3**

Course Types √☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** ☐ **Viva-voce**

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes/Class Test/Presentation/Assignment (20%); Final Examination (70%)

Rationale of the Course: The course begins with the fundamental concepts, structure and properties of fiber, and then gives a brief overview of existing natural, regenerated, and synthetic fibers with the main focus on common characteristics, applications and sustainability issues. The production methods for natural, regenerated and various synthetic fibers will be discussed in detail. The critical process parameters will be discussed that can affect the fiber properties and the environmental impact of the processing methods. The more common technical fibers, their characteristic properties and uses will also be discussed in detail.

Intended Learning Objectives (ILOs):

1. Understand the structure, properties, and classification of fibres and textiles.
2. Learn production methods of natural, regenerated, synthetic, high-performance, and speciality fibres.
3. Acquire knowledge of textile processing (spinning, weaving/knitting, finishing) and its effect on material properties.
4. Understand basic fibre and textile characterization techniques
5. Explore advanced textile applications in composites, smart textiles, protective textiles, biomedical, and industrial uses

Course Learning Outcome (CLO) Mapping with PLO, Delivery Method, and Assessment Tool:

CLOs	Details of CLO	PLOs	Delivery Methods	Assessment Tools
CLO-1	Explain the fundamental concepts, classification, structure, and properties of fibres and textiles.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-2	(a) Identify natural fibres from plant and animal sources and describe their applications. (b) Explain regenerated fibres, their origin, and fabrication from natural materials	PLO1,3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-3	Describe synthetic, high-performance, and speciality fibres, including their processing, properties, and applications.	PLO1,2	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam

			☐ Audio/Video	☐ Presentation
CLO-4	Demonstrate understanding of textile processing, including yarn and fabric manufacturing, wet processing, and finishing.	PLO3,4	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation
CLO-5	Explain common characterization techniques for fibres and textiles and interpret basic results.	PLO1	☒ Lecture ☒ Tutorial ☐ Discussion ☒ Interaction ☐ Audio/Video	☒ Class Test ☒ Quiz ☒ Assignment ☒ Final Exam ☐ Presentation

Course contents Mapping with CLOs:

CLOs	Course contents
CLO-1	**1. Structure and Properties of Fibres:** Fundamental concepts; Classification; Requirements of Fibre-forming polymers; Polymer orientation and crystallinity; General fibre properties.
CLO-2(a)	**2. Natural Fibres:** Introduction, Cellulosic fibres: seed fibres- cotton, coir; bastfibres- jute, flax, hemp, ramine; leaf fibres- sisal, manilla, abaca; protein fibres: wool fibres, silk fibres; polysaccharide fibres- alginate fibres, chitin and chitosan fibres.
CLO-2(b)	**3. Regenerated Fibres:** Introduction, regenerated cellulose fibres, cuprammoniumrayons, viscous rayon, cellulose acetate rayon, chemically modified natural fiber, regenerated protein fibres, alginate fiber, casein fiber.
CLO-3	**4. Synthetic Fibres:** Introduction, Processing of synthetic fibres, polyamide fibres: nylon 6, nylon 6,6, nylon 6,10; polyester fibres: PET; acrylic and modacrylicfibres, polyolefin fibres: Polypropylene, Polyethylene; elastomeric fibres: Spandex, Lycra.
CLO-4	**5. High-Performance Fibres:** Aramid, aromatic polyester, polybenzimidazole, fluoropolymer, carbon, ceramic, nanofibres, conducting fibres, optical fibres, luminescent fibres, biodegradable fibres.
CLO-5	**6. Textile Processing:** Yarn production; Fabric manufacturing: Weaving, knitting, non-wovens; Wet processing: Dyeing, printing, finishing.
CLO-6	**7. Characterization of Fibres and Textiles:** Visual/microscopic observation; Fibre/Yarn/Fabric physical properties; Basic mechanical testing; Moisture and thermal behaviour; Colour and appearance evaluation.
CLO-7	**8. Advanced Applications of Textile:** Functional and smart textiles; Fibre-reinforced composites; Protective textiles; Biomedical, aerospace, and industrial applications.

Recommended books:

Author's name		Title of books
1. R.W. Monchieff	:	Man-Made Fibres
2. R. R Mather & R.H Wardman	:	The Chemistry of Textile Fibres
3. J. Gordon Cook	:	Handbook of Textile Fibres
4. V.R. Gowariker	:	Polymer Science
5. E.P.G. Gohl & L.D. Vilensky	:	Textile Science

6. A.R. Kamal : Textile Science and Technology

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4252	**Fibre and Textile Engineering Sessional**	**1**	**25**	**3**

Course Types	☐ Theoretical	√☐ Sessional/Practical	☐ Project/Training	☐ Viva-voce

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Attendance (10%); Quizzes, Viva-voce and Continuous Assessment (30%); Practical Examination/Design work/ Report (60%)

Rationale of the Course: In this course, students will gain practical experience in analyzing and processing fibers. Through a series of structured experiments, they will explore various methods to assess the physical, mechanical, and chemical properties of fibers. Emphasis will be placed on understanding how these properties influence fiber behavior during processing and end-use performance. Students will engage in hands-on sessions covering fiber identification, moisture content determination, length measurement, tensile strength testing, bleaching, and dyeing. By the end of the course, students will have a comprehensive understanding of fiber characteristics and the processes that influence their performance in various applications.

Intended Learning Objectives (ILOs):

Course Learning Outcomes (CLOs):

CLOs	Course contents
	1. Determination of moisture content and regain in fibers using the oven-drying method. **2.** Measurement of fiber length: determining staple, effective and span lengths. **3.** Tensile strength testing of single fibers and fiber bundles. **4.** Bleaching of textile fibers: lab preparation and whiteness analysis. **5.** Textile fiber dyeing: methodologies and color fastness evaluation.

Recommended books:

Author's name	Title of books

Course Code	Course Title	Credits	Marks	Contact Hours/Week
MSE4272	**Research Project**	**2**	**50**	**-**

Course Types	☐ Theoretical	☐ Sessional/Practical	√☐ Project/Training	☐ Viva-voce

Teaching-learning strategies: Lectures/Exercises/Tutorial/Interaction/Audio-Video

Assessment Strategies: Internal examiner/supervisor (30%); External examiner (any teacher from the panel of examiners) (30%); Presentation and oral examination (40%)

Rationale of the Course: Continuation of **MSE4172**

Course Code	Course Title	Credits	Marks	Contact Hours/Week
ME4210	**Board Viva-voce**	**2**	**50**	**-**

Course Types ☐ **Theoretical** ☐ **Sessional/Practical** ☐ **Project/Training** √☐ **Viva-voce**

Assessment Strategies: Oral presentation

Rationale of the Course: This course is to assess a student's understanding, communication skills, confidence, and ability to explain or defend their academic work orally.

Academic Ordinance of Undergraduate Program for Faculty of Engineering

University of Rajshahi

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URL: http://www.ru.ac.bd/engfaculty/engg/

Faculty of Engineering

University of Rajshahi

October 28, 2025

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Faculty of Engineering

University of Rajshahi

Academic Ordinance of Undergraduate Program
for the Award of the Degree of Bachelor of Science in Engineering

1. Definitions

1.1 'University' means the University of Rajshahi, Bangladesh, abbreviated as RU, Rajshahi.

1.2 'Syndicate' means the Syndicate of the University.

1.3 'Academic Council' means the Academic Council of the University.

1.4 'Curriculum Committee' means the Curriculum Committee for Undergraduate and Postgraduate Studies of a Degree Awarding Department of the University formed as per rules of the University.

1.5 'Faculty' means the Faculty of Engineering of the University.

1.6 'Academic Committee' means academic committee of the department formed as per statute of the University.

2. Departments

2.1 Degree Awarding Departments

The Faculty shall consist of the following Degree Awarding Departments:

2.1.1 Department of Applied Chemistry and Chemical Engineering (abbreviated as **ACCE**),

2.1.2 Department of Computer Science and Engineering (abbreviated as **CSE**),

2.1.3 Department of Information and Communication Engineering (abbreviated as **ICE**),

2.1.4 Department of Materials Science and Engineering (abbreviated as **MSE**),

2.1.5 Department of Electrical and Electronic Engineering (abbreviated as **EEE**),

2.1.6 Any other department to be instituted by the Syndicate on the recommendation of the Academic Council.

2.2 Related Teaching Departments

The Faculty may require the participation of some or all of the following Departments to teach Humanities, Mathematics and Basic Science courses:

2.2.1 Department of Chemistry, RU,

2.2.2 Department of Physics, RU,

2.2.3 Department of Mathematics, RU,

2.2.4 Department of Statistics, RU,

2.2.5 Department of English, RU,

2.2.6 Department of Law and Justice, RU,

2.2.7 Department of Economics, RU,

2.2.8 Department of Management, RU,

2.2.9 Department Accounting and Information System, RU,

2.2.10 Department of Sociology, RU,

2.2.11 Department of Psychology, RU,

2.2.12 Any other department as per requirements of syllabus of any department of the Faculty.

3. Degree Offered

The Faculty shall offer courses leading to the award of the following degrees:

3.1 Bachelor of Science in Applied Chemistry and Chemical Engineering abbreviated as B. Sc. Engg. (ACCE),

3.2 Bachelor of Science in Computer Science and Engineering abbreviated as B. Sc. Engg. (CSE),

3.3 Bachelor of Science in Information and Communication Engineering abbreviated as B. Sc. Engg. (ICE),

3.4 Bachelor of Science in Materials Science and Engineering abbreviated as B. Sc. Engg. (MSE),

3.5 Bachelor of Science in Electrical and Electronic Engineering abbreviated as B. Sc. Engg. (EEE)

3.6 Any other degree that may be awarded by a department on the approval of the Syndicate on the recommendation of the Faculty and the Academic Council.

4. Curriculum Structure

4.1 The B. Sc. Engg. programs shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into 2 Semesters; (details are given in Section 7 of the ordinance).

4.2 The curricula of the B. Sc. Engg. Degree in the different departments shall be proposed by the Curriculum Committee and recommended by the IQAC, FQAC and faculty of engineering and finally approved by the Academic Council and Syndicate.

4.3 The Curriculum Committee shall review the curricula at least once in every **Academic Year** and recommend changes and revisions, if any, to the Faculty, and then the Faculty will recommend to the Academic Council .

4.4 Teaching of the courses is reckoned in terms of credits and the credits allotted to various courses will be determined by the Committee of Courses under the following guidelines;

Nature of course	Duration
Theoretical	: 1 hour/week/credit
Laboratory/Project	: 2 - 4 hours/week/credit
Industrial Training/ Industrial Attachment/ Professional Training/ In-plant Training /Field work/ Seminar	: 1-2 weeks /credit

4.5 **Contact Hours/week:** The total contact hours for the regular students including lecture, tutorial and laboratory shall be between **24 - 42** periods per week, each period being **40 to 60** minutes in duration.

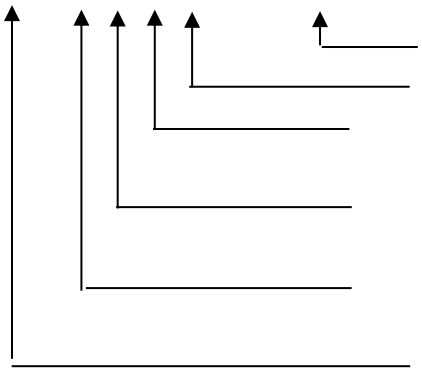
4.6 **Course Adviser**: In each degree-awarding department, one of the teachers nominated by the Academic Committee shall act as **Course Advisor** for each academic year.

4.7 With the approval of Academic Committee, Course Advisor will prepare and announce the class routine, showing details of the lectures, course plan, class test, etc. at the start of each semester.

4.8 C**ourse Designation:** Each course is designated by **a two to four letter** word usually identifying the course offering department followed by **a four-digit** number with the following criteria without any space between letters and numerical.

(a) The first digit will correspond to the year in which the course is normally taken by the students, (b) The second digit will correspond the semester (**1 for first and 2 for second**) in which the course is normally taken by the students, (c) The third digit will be reserved for departmental use for such things as to identify different areas within a department, (d) The last digit will be **odd for theoretical, even for laboratory courses and '0' for Board Viva voce** and (e) The course designation system is illustrated by the following example.

EEE 2 1 3 1 Electronic Devices & Circuits



Course title

Last odd digit represents a Theoretical course

3rd digit is reserved for departmental use

2nd digit signifies semester number (here **1** is for first semester 2 is for second semester)

1st digit signifies the Year (here **2** is for Second Year)

Dept. identification code (*Electrical and Electronic Engineering)*

5. Distribution of Courses

The programme of study for the B. Sc. Engg. shall carry a total of **160** credits. Suggested distribution of courses is as follows:

Course type		Marks	% of Marks	Credits
GEd Courses	[a] Humanities	100 – 300	2.5 – 7.5	4–12
	[b] Basic Sciences and Mathematics (with Lab)	600 – 900	15 – 22.5	24 – 36
		800-1200	20-30	32-48
Engineering Courses	(i) Non Departmental Engineering (with Lab)	100-300	2.5 – 7.5	4– 12
	(ii) Core Engineering (a) Theoretical (b) Board Viva-voce (c) Laboratory	 1500 – 2400 100 - 300 700 – 1200	 37.5 – 60 2.5 – 7.5 17.5 - 30	 60- 96 4 -12 28 - 48
		2800-3200	70-80	112-128
	Total	**4000**	**100%**	**160**

[a]Each department must include a course on English.

[b]Each department must include courses on Physics, Chemistry and Mathematics.

6. Marks and Credits Distribution

6.1 Limits of Marks, Credits and Contact Hours Distribution

(as per Semester):

6.1.1

First/Second Year (First /Second Semester)

Nature of course		Marks	Credits
Humanities		0 - 100	0 - 4
Basic Sciences and Mathematics		50 - 250	2- 10
Engineering	Theoretical	50- 300	2 - 12
	Laboratory	50 - 150	2 - 6
	Board Viva voce	25- 75	1- 3

	(Second Semester)		
Total		**375-550**	**15-22**

6.1.2

Third/Fourth Year (First /Second Semester)

Nature of course		Marks	Credits
Humanities		0 - 100	0 - 4
Engineering	Theoretical	200 - 400	8 - 16
	Laboratory	50 - 200	2 - 8
	Board Viva voce (Second Semester)	25 - 75	1-3
Total		**375-550**	**15-22**

*Laboratory (Practical/Sessional/ Project/ Field Work/ Industrial Training/ In-Plant Training/ Workshop/ Seminar/ Similar courses).

6.2 Distribution of Marks (as per course types)

6.2.1 **Theoretical Courses:**

Continuous Assessment (**CA**)	Class Attendance	10%	30%
	Quizzes/Class Test	20%	
Semester Final Examination			70%
Total			100%

6.2.2 **Laboratory(practical/sessional)**

Class Attendance	10%
Quizzes, viva-voce and continuous assessment	30%
Practical examination/ Design work/ Report	60%
Total	100%

6.2.3 **Project Work/Field Work//Industrial Training/…. Professional Training**

Internal Examiner (Supervisor)	60%
External Examiner (Any teacher from the panel of examiners)	
Presentation and Oral Examination	40%
Total	100%

6.2.4 **Basis for awarding marks for class participation and attendance:**

Attendance	Marks (%)
90% and above	100
85% to less than 90%	90
80% to less than 85%	80
75% to less than 80%	70
70% to less than 75%	60
65% to less than 70%	50
60% to less than 65%	40
less than 60%	0

6.3 Duration of Examination

Duration of Theoretical **examination of different courses** at the end of semester sha as

follows :

Courses less than or equal to 2 Credits	2 Hours
Courses greater than 2 credits but less than or equal to 4 Credits	3 Hours

7. Academic Calendar

7.1 The academic year shall be divided into two semesters each having duration of **14 teaching weeks**

7.2 There shall be final examinations at the end of each semester conducted by the respective Examination Committee of the Departments.

7.3 **An academic schedule** for the academic year shall be announced for general notification before the start of the academic year, on the approval of the Academic Committee. The schedule may be prepared according to the following guidelines:

First Semester (24 weeks)	Number of weeks
Teaching	**14**
Preparatory Leave	**2**
Examination Period	**2 - 4**
Result Publication	**2 - 4**
Inter Semester Recess	**1**
Second Semester (24 weeks)	
Teaching	**14**
Preparatory Leave	**2**
Examination Period	**2 -4**
Result Publication	**2- 4**
Inter Year Recess	**1**

8. Admission

8.1 The rules for admission of new students shall be framed by the academic council on the recommendation of admission committee of the university.

8.2 There will be four academic years and eight semesters of study for the degree of B.Sc. Engg. Academic Years and Semesters will be designated as the First Year: First Semester & Second Semester, Second Year: First Semester & Second Semester and so on, respectively. Students shall generally be admitted into the First Year. In special cases, students may be admitted into a higher class on the recommendation of the appropriate Equivalence Committee and Department concerned, only in case of transferred students.

8.3 A candidate for admission into the First Year class must have passed the HSC or equivalent Examination (with a minimum GPA as decided by the Admission Committee of RU) from a Board of Intermediate and Higher Secondary Education/equivalent in Bangladesh (after 12 years of Schooling) with Physics, Chemistry and Mathematics. The candidate must also fulfill all other requirements as prescribed by the Admission committee of the University.

9. Admission on Transfer

A candidate seeking admission on transfer from other Institutes or Universities should apply to the Registrar of the University. The Registrar will refer the case to the **Chairman** of the Department concerned and also to the Equivalence Committee. On receiving the opinions of the academic committee of the Department and of the Equivalence Committee, the matter will be placed to the Vice-Chancellor. The Vice Chancellor's decision will be communicated to the **Chairman** of the Department and the candidate.

10. Medical Examination at the Time of Admission

Every student after being admitted to the University shall be examined by a competent medical officer as may be provided in the admission rules.

11. Registration

University Registration: Every student admitted into the University shall be required to register on payment of the prescribed fees within the stipulated time.

12. Change of Department

Change of department is not allowed in general. However, under very special circumstances if a student wants to change a subject of study in First Year, the Dean of Faculty may only consider the prayer after getting opinions from the Academic Committee of the concerned Departments. No change will be allowed in Second Year, Third Year and Fourth Year.

13. Attendance

13.1 In order to be eligible for appearing, as a regular candidate, at the semester final examinations, a student shall be required to have attended at least 75% of the total number of periods of lectures/tutorials/laboratory classes held during the semester. The laboratory courses mean all laboratory/project/fieldwork/in-plant training and any other similar courses.

13.2 A student whose attendance falls short of 75% but not a below 60% as mentioned above may be allowed to appear at the semester final examinations as **non-collegiate** student. A student, appearing at the examination under the benefit of this provision shall have to pay, in addition to the regular fees, the requisite fine prescribed by the syndicate for the purpose.

13.3 Students having **less than 60% attendance** in lecture/tutorial/ laboratory **will not be allowed to sit** at the final examinations of the semester.

13.4 An attendance report of the students shall be prepared by the concerned course teacher for his/her Class. The class attendance report will be handed over to the **Chairman of concerned department** within two days of the last class of the course and will be preserved as examination record to the examination committee. Awarded marks for class attendance of the students will be posted in the prescribed marks sheet. Class attendance will be recorded electronically in every class and finally be handed over to the chairman of the department and will be preserved as examination record to the examination committee.

14. Grading System

14.1 The letter grade system for assessing the performance of the students shall be as follows:

Marks*	Letter Grade (LG)	Grade Point (GP)
80% and above	A+	4.0
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.5
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.0
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.5
45% to less than 50%	C	2.25
40% to less than 45%	D	2.0
less than 40%	F	0.0

14.2 A **Semester Grade Point Average (SGPA)** shall be calculated for each semester as follows:

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

where, n is the number of courses offered during the semester, C_i is the number of credits allotted to a particular course and G_i is the grade point earned for that course.

14.3 A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$\text{YGPA} = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{n} C_j} \qquad \text{(ii)}$$

where 2 is the number of semesters, C_j is the number of credits allotted to a semester and G_j is the SGPA earned for that semester.

14.4 The **Cumulative Grade Point Average (CGPA)** gives the cumulative performance of the students from the 1st year up to the end of the year to which it refers, and will be calculated as follows:

$$CGPA = \frac{\sum_{k=1}^{m} C_k G_k}{\sum_{k=1}^{m} C_k} \qquad \text{(iii)}$$

where, m is the total number of years being considered, C_k is the total number of credits registered during a year and G_k is the YGPA of that particular year.

14.5 Both SGPA and YGPA will be rounded off to the third place of decimal for reporting. For instance, SGPA=3.2149 shall be rounded off as SGPA=3.214, similarly YGPA=3.2108 shall be rounded off as SGPA=3.210. The CGPA will be rounded up to the second place of decimal for result. For instance, CGPA=3.485 shall be rounded up as CGPA=3.49, similarly CGPA=3.354 shall be rounded off as CGPA=3.35.

14.6 **Earned Credit:** The minimum passing grade will be 'D' in each course. Any course in which a student obtains 'F' grade will not be counted towards his/her earned credit.

15. Conducting Examination and Rules for Promotion

15.1 The academic year shall be divided into two semesters each having duration of **14** teaching weeks.

15.2 There shall be final examinations conducted by the concerned Examination Committee of the Departments at the end of each semester.

15.3 The results shall be finalized at the end of each semester of the academic year.

15.4 **Promotion to higher class:** In order to be promoted to higher class a student must obtain the following requirements:

(i) First Year: YGPA $\geq$ 2.00
(ii) Second Year: YGPA $\geq$ 2.25
(iii) Third Year: YGPA $\geq$ 2.50
(iv) Fourth year: YGPA $\geq$ 2.50
(v) A maximum of 9 credits can be relaxed in one year. If a student fails to meet the annual YGPA and Credit requirement s(he) will be re-admitted in the same year in the next academic year. If a student loses more than 9 credits in first semester he/she will be readmitted in the same semester in the next academic year.

15.5 **Course Improvement**:

(i) A student fulfilling annual YGPA and credit requirements will be allowed to improve theoretical course grades or clear F-grades for a maximum of 9 credits altogether. The student will be allowed to appear once in the theoretical course improvement examination in the immediate next similar semesters. To clear F-grades in theoretical/practical/sessional/viva-voce etc. courses, the candidate will be allowed to appear in the examination for maximum two times in immediate consecutive similar

semester. For fourth year this opportunity to clear F-grades will be allowed only once in the next immediate similar semester.

(ii) All improvements and F-clearance must be completed within 6 years of admission.

(iii) Theoretical course improvement will only be allowed if the earned grade is less than letter grade B minus (B^-,< 2.75).

(iv) In practical/sessional/studio/viva-voce etc. courses a student will be allowed only to clear F grades.

(v) A readmitted student unable to attend classes or class tests will carry his/her previous marks in continuous assessment (CA).

(vi) In case of a student's failure to improve course grade in the course improvement examination, the previous grade will remain valid.

(vii) Course improvements or F-clearance after award of degree will be treated as 'Result Improvement'.

15.6 **Course Exemption:** Students who fail to be promoted to the next higher class shall be exempted from taking the theoretical and laboratory courses where they obtained G.P of 2.75 or more**.** These grades would be counted in calculating GPA in the next year's examination results.

15.7 **Merit Position:** The YGPA obtained by a student in first year, second year and third year and CGPA obtained in the fourth year will be considered for determining the **merit position for the award of scholarships, stipends etc.**

16. Class Test / Class Assessment

16.1 For theoretical courses of less than or equal to 2 credits there shall be at least **three class tests** and **at least four class tests** for course greater than 2 credits in a semester.

16.2 The class test/class assessment will be evaluated by the class teacher and marks with scripts will be submitted to the examination committee for preservation.

16.3 Previous class test marks will remain valid for the reported/ course improvement/ readmitted student if he/she is unable to appear at class test.

17. Publication of Results

17.1 **Award of degree**: In order to obtain Bachelor Degree a student must fulfill the following conditions:

(i) Bachelor Degree program must be completed within minimum period of 4 and maximum of 6 academic years from the date of admission for all Faculties/Institutes. No student will be allowed to stay for more than two consecutive terms in the same semester/year.
(ii) The minimum CGPA for awarding Bachelor Degree is 2.50 out of 4.00.
(iii) Total Credit Point required for awarding Bachelor Degree is 160 with exemption of maximum 8 credits.
(iv) Fourth year candidates eligible for Course Improvement (minimum YGPA 2.50 and maximum credit loss of 9 credits), but not eligible for Award of Degree will have a result status 'Incomplate'.

17.2 **Degree with Honours**: Candidates for Bachelor degree in engineering will be awarded the degree with Honours if their earned credit is 160 and **CGPA is 3.75 or higher.**

17.3 **Final Result (CGPA) Improvement:** A student obtaining B.Sc. Engg. Degree within 4 or 5 academic years will only be allowed to improve result in the immediate next regular examination. A student will only be allowed to take part in result improvement examination for a maximum of two theoretical courses (maximum of 6 credits) in fourth year if the earned letter grade is less than B (CGPA<3.0). If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

17.4 **Readmission:** If a student fails to obtain the degree within 4 or 5 academic year, he/she will be readmitted in fourth year and will appear for the examination.

17.5 Dean's List: **As a recognition of excellent performance, the names of students obtaining a** CGPA **of 3.75 or above in the final examination may be published in the Dean's List in the faculty. Students who have received an 'F' grade in any course will not be considered for Dean's List.**

17.6 **Recording of Result:** The transcripts in English will show the course designation, course title, credit, letter grade, and grade point of individual courses, YGPA of first year, second year, third year, and finally, CGPA of fourth year.

17.7 **Credit Transfer:** A student will be allowed at best one semester in his/her undergraduate program with the relevancy of course curriculum from a designated university under exchange program. Credit of a semester completed from the foreign university will be added which will not be more than the assigned credit for a semester and maximum 8 credit can be adjusted in the immediate next semester. Subject and course should be approved through the relevance committee of the faculty.

18. Examination Committee

18.1 The Examination Committee shall be proposed by the departmental Academic Committee and is subject to the approval of Vice-Chancellor. There shall be one examination Committee for each academic year (for both semester) of examinations in each degree-awarding department. The committee shall consist of five members.

i) Chairman of the examination committee from the concerned department
ii) Three other members belonging to the concerned department,
iii) One expert member from outside the department/university,
iv) There will be one to three additional committee members for the related courses from the relevant department (if applicable).

18.2 **Functions of the Examination Committee**

18.2 1 Propose the names of the question setters and script//dissertation/project/ in-plant training report examiners from panel of examiners.

18.2.2 Moderate examination questions of all courses,

18.2.3 Propose examination schedule (for approval of the departmental Academic Committee) to conduct the examinations properly,

18.2.4 Make necessary arrangements for holding the examination of all **Theoretical and Laboratory courses as well as Board Viva voce**.

18.2.5 Process Continuous assessment (class test and attendance) marks sent by the course teacher.

18.2.6 Recommend the names of three tabulators (for approval of the Vice-Chancellor). Tabulators will post marks both in the rough and the final tabulation sheets, the rough copy will be kept by the Chairman of the Examination Committee and the final sheets will be submitted to the Controller of Examinations

18.2.7 Finalize the results and

18.2.8 Related department members may only propose the names of the question setters or moderate the related courses and they are not able to be involved in other function of the examination committee.

18.3 **The major duties of the Chairman of an Examination Committee shall be as follows:**

18.5.1 Call meetings of the Examination Committee,

18.5.2 Either to send the moderated question papers to the Controller of Examinations for printing or to take necessary steps for printing the questions in his/her own care.

18.5.3 Issue instructions to the examiners as per approval of the Examination Committee concerned and to see that instructions issued are properly followed and

18.5.4 Hand over the marks received from the examiners to the tabulators.

19. Theoretical Examination and Board Viva-voce

19.1 (i) For each theoretical course there will two question setters and two script examiners from the enlisted panel of examiners.

(ii) Third Examination: In case the marks awarded by the two examiners differ by 20% or more, the examination committee will recommend a third examiner (approved by Vice-chancellor) and arithmetic mean of the two nearest marks will be counted. In case both the extreme marks differ from the middle mark by exactly the same margin, the arithmetic mean of the two higher marks (advantage to the student) will be taken. If the number of scripts be third-examined is fifty percent or more of the total number of script of a course, all the scripts of that course will have to be third-examined.

19.2 In each theoretical course examination, the students shall be allowed a choice of question (6 out of 8 for 3 or 4 credit course and 4 out of 6 for 2 credit course) to the extent of not more than **33%** of the total number questions to be answered.

19.3 Absence of a candidate in an examination of a **course** in which he/she ought to have been present will be considered as if the candidate obtained zero marks **('F' grade)** in that **course**.

19.4 The concerned Examination Committee will conduct the **Board Viva voce.**

20. Laboratory Examination/Field Work/Professional Training/Research Project

20.1 The concerned Lab teachers nominated by the Examination Committee will conduct **quizzes, Viva voce and continuous assessment.**

20.2 The departmental academic committee will assign a teacher or a group of teachers to conduct a particular laboratory class or all the laboratory classes of a particular semester of a particular year. For the examination, there shall be five examiners including one external from outside of the department or university. However, if the number of examinees in the practical examination is less than 10 (ten) per day, there shall be three examiners including the external examiner. The duration of practical examination shall be 2-3 hours per credit. Remuneration shall be provided by the University rule.

20.3 One copy of the marks of the laboratory examination will be sent to the Chairman of the concerned Examination Committee, and another copy will be sent to the Controller of Examinations of the University.

20.4 Depending on each department's own requirements, a student may have to complete a prescribed number of days of industrial/professional training in addition to minimum credits and other requirements, to the satisfaction of the concerned department.

20.5 The examination committee in cooperation with departmental chairman will conduct the placement of students for field work/professional training. The in-plant training/ professional training/ field work /similar courses report will be evaluated by examiners appointed by the examination committee.

20.6 (i) Field reports/Excursion reports/Research project reports and the likes will be examined by two examiners (preferably other than the examination committee) selected by examination committee.

(ii) Third Examination: In case the marks awarded by the two examiners differ by 20% or more, the examination committee will recommend a third examiner and arithmetic mean of the two nearest marks will be counted. In case both the extreme marks differ from the middle mark by exactly the same margin, the arithmetic mean of the two higher marks (advantage to the student) will be taken.

21. Medium of Questions and Answers

The medium of questions and answers in the examination of all written, laboratory and other courses of each subject will be in English.

22. Duties and Responsibilities of Question Setters and Script Examiners

22.1 If a question setter or a script examiner is unable to accept the appointment before or during the examination, he/she should immediately inform the Controller of Examinations. In case an examiner cannot finish marking the scripts received by him/her or within two weeks, he/she should immediately return the scripts to the Chairman of the Examination Committee. The Examination Committee has all the rights to change and set the script examiner immediately in that case.

22.2 The question setters and the script examiners should send their remuneration bills to the Controller of Examination. All postal and other incidental expenses incurred by the setters/examiners in connection with the examination will be paid by the University on presentation of duly signed bill for the same, supported by vouchers.

22.3 If any examiner is unable to accept or has to relinquish his/her appointment, the Examination Committee concerned shall recommend to the Controller of Examinations new question setter or script examiner.

22.4 All manuscripts/question papers shall be sent by the setters in a sealed covers to the Chairman of the Examination Committee who shall then call a meeting of the Examination Committee who will arrange for moderation of the papers.

22.5 The question papers, scripts and any other documents in connection with the examination would be handed over officially/personally or sent by insured post to the Chairman of the respective Examination Committee.

22.6 The marks of all examinations shall be submitted to the Chairman of the Examination Committee, either personally in a sealed cover or in a doubly sealed insured cover, if sent by post. A copy should also be submitted separately to the Controller of Examinations of the University.

22.7 The question setter shall as far as practicable, avoid in marked change of standard from year to year but shall not be required to set the same type of questions every year. The question shall be so framed that there shall be no ambiguity of meaning. The questions should be set in such a way that originality and individuality of the candidates may be encouraged.

22.8 The question setters are requested to set the questions according to the Blooms taxonomy level and course learning outcome according to the curriculum and indicate in the initially submitted questions. The question setter shall be guided as to the standard extent of knowledge required and scope of the courses of examination by the curriculum prescribed and the textbook, if any, recommended by the University from time to time.

22.9 All corrections and alterations in the manuscripts, question papers, marks placed in the scripts and marks entered in the marksheets must invariably be initiated by the person making the correction. Over-writing in the case of marks should be avoided. The wrong figures should be crossed out and the correct figures written in convenient places. Doubtful entries should be indicated by words as well.

22.10 If in the course of examining the answer scripts the examiner have reasons to suspect that unfair means have been adopted by any candidate, he/she should at once submit confidential report to the Chairman of the respective Examination Committee giving the grounds for his/her suspicion.

22.11 The marks of each course of examination or a section are to be submitted to the Chairman of the respective Examination Committee. A copy should also be submitted separately to the Controller of Examinations of the University.

22.12 If any examiner is unable to examine answer script, he/she should return the packet of answer scripts immediately to the Chairman of Examination Committee.

22.13 Immediately on receipt of each packet containing answer scripts of candidates, the examiner should count the script and verify the figures given in the statement regarding the details of the answer scripts sent. Should any discrepancy be discovered, it should at once be brought to the notice of the Chairman of the Examination Committee with a report of the statement which should be filled in and returned to the Chairman of the Examination Committee immediately after receiving the answer scripts, so that prompt action may be taken about the matter. If no report is received within three days of receipt, it will be assumed that the statement sent is correct.

22.1 **The question setters are particularly requested**

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22.14.1 The manuscripts of the questions are to be written in English. To make sure that the manuscripts of questions are as clear and legible as possible, taking special care in writing, so as to ensure accuracy in printing,

22.14.2 No copy of the question paper framed by him/her shall be retained and all rough draft and memorandum connected therewith should be destroyed immediately after being used properly, and,

22.14.3 Sign at the bottom of each sheet of the manuscript question paper set by him.

23. Eligibility for Examination

23.1 A candidate may not be admitted to any semester final examination unless he/she has

23.1.1 Submitted application in the prescribed form to the Registrar/Vice-Chancellor for appearing at the examination,

23.1.2 Paid the prescribed examination fees, and all outstanding University and Hall dues,

23.1.3 Fulfilled the conditions for attendance in class and

23.1.4 Been barred by any disciplinary rule.

23.2 On special circumstances the Vice-Chancellor may permit a student to appear at the examination.

23.3 A student whose attendance falls short of 75% but not below 60% in any course as mentioned above may be allowed to appear at the final examinations as a non-collegiate student.

24. Amendment

Any amendment of this ordinance shall be proposed through the Faculty of Engineering and passed by the Academic Council

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