B. Sc. in Materials Science and Engineering

The University of Rajshahi

Faculty of Engineering

Department of Materials Science and Engineering

Curriculum for B. Sc. Engineering

Session: 2023-2024

Examination

B. Sc. Engg. First Year	**2024**
B. Sc. Engg. Second Year	**2025**
B. Sc. Engg. Third Year	**2026**
B. Sc. Engg. Fourth Year	**2027**

B. Sc. in Materials Science and Engineering

The University of Rajshahi

Vision of the University:

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

Mission of the University:

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

Department of Materials Science and Engineering

Faculty of Engineering

Vision

Is to be a center of education and research to create innovative engineers who can meet the global challenges of Tomorrow's Materials Science and Engineering arena.

Mission

To achieve the vision, we want to

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

Objectives of the Program Offering Entity (POE)

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

Name of the Degree: B. Sc. Engineering

Description of the Program:

The B.Sc. Engineering in Materials Science and Engineering program shall 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 in every course to appear as a regular candidate at that semester final examinations. The courses offered for Materials Science and Engineering department will consist of theoretical, practical, viva-voce, quizzes/class tests, attendance, and research project and are of 4000 marks (160 credits).

Program Educational Objectives (PEOs)

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

1. be compatible for employment and research in industry, laboratories, as well as academia and allied professions.
2. be engaged in materials discovery and/or processing to meet national or global challenges.
3. demonstrate ethical responsibility for their profession and community.
4. serve the society through science and technology.

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 meet specified needs with appropriate consideration for public health, and 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 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.

Mapping mission of the University with PEOs

PEOs	Mission 1	Mission 2	Mission 3
PEO 1	√		√
PEO 2			√
PEO 3		√	
PEO 4		√	

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	√	√		

Structure of the Curriculum

1. **Duration of the Program:** The B. Sc. Engineering program shall extend over a period of four academic years, each of a normal duration of one calendar year, divided into 2 Semesters.
2. **Admission Requirements:**
   - **2.1** The rules for admission of new students shall be framed by the academic council on the recommendation of admission committee of the university.
   - **2.2** 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.
   - **2.3** 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.
3. **Requirements to complete the program**: In order to qualify for the B. Sc. Engineering degree, a student must have to earn minimum 152 credits and a minimum CGPA of 2.50 within a maximum of six academic years.

4. Academic Calendar:

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**

5. Distribution of Courses:

Course Type	Marks	Percentage of total marks	Credits
Humanities	**200**	**5**	**8**
Technical English	50		2
Economics	50		2
Industrial Management and Accountancy	50		2
Law and Professional Ethics	50		2
Basic Science with Lab	**775**	**19.375**	**31**
Mathematics	225		9
Physics	275		11
Chemistry	225		9
Statistics	50		2
Basic and Major Engineering	**3025**	**75.625**	**121**
(i) Basic Engineering with Lab	**250**	**6.25**	**10**
Computer Science and Engineering	125		5
Electrical and Electronic Engineering	75		3
Mechanical Engineering	50		2
(ii) Major Engineering	**2775**	**69.375**	**111**
(a) Theoretical	1825		73
(b) Laboratory with Project	750		30
(c) Board Viva-voce	200		8
Total	**4000**	**100**	**160**

Grading Systems:

1. Grading Scale

1.1 The letter grade system for assessing the performance of the students shall be as follows:

Marks	Letter Grade (LG)	Grade Point (GP)
80% or 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
Incomplete	I	0.0

*The total marks of each theoretical/laboratory/project courses shall be rounded up to second place of decimal for LG and GP calculation, for example 60.542 marks shall be rounded up to 60.55.

1.2 A **Semester Grade Point Average (SGPA)** shall be calculated for each semester as follows:

$$SGPA = \frac{\sum_{i=1}^{n} C_i G_i}{\sum_{i=1}^{n} C_i} \qquad \text{(i)}$$

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.

1.3 A **Yearly Grade Point Average (YGPA**) shall be calculated for each academic year as follows:

$$YGPA = \frac{\sum_{j=1}^{2} C_j G_j}{\sum_{j=1}^{n} C_j} \qquad \text{(ii)}$$

Where 2 is the number of semester, C_j is the number of credits allotted to a semester and G_j is the GPA earned for that semester.

1.4 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.

1.5 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.

1.6 **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.

2. Attendance

2.1 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.

2.2 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.

2.3 Students having less than 60% attendance in lecture/tutorial/ laboratory will not be allowed to sit at the final examinations of the semester.

2.4 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.

3. Conducting Examination and Rules for Promotion

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

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

3.3 The results shall be finalized at the end of each semester of the academic year.

3.4 **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: minimum YGPA $\geq$ 2.50
(iv) Minimum grade point of laboratory course/project/fieldwork/in-plant training/viva-voce etc. is 2.0

3.6 **Course Improvement**:

3.6.1 A promoted student only be allowed to appear in the theoretical course improvement examination in the immediate next academic year for one time in order to improve a maximum of 6 credits (two theoretical courses). To clear F grade the candidate will be allowed to appear in the examination for maximum of two times in the immediate consecutive similar semesters. In such case, the student has to give his/her choice of course/courses for course improvement in writing. In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid. This will be applicable up to third year second semester.

3.6.2 Theoretical course improvement will only be allowed if the earned letter grade is less than "B-" (GP < 2.75).

3.6.3 In practical courses a student will not be allowed to appear in clearing F grade or improvement examination.

3.6.4 A student will carry his/her previous marks on continuous assessment (CA).

3.6.5 In case of student's failure to improve course grade at the course improvement examination, the previous grade will remain valid.

3.7 **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.

3.8 **Class Test/Class Assessment**

3.8.1 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.
3.8.2 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.

3.9 **Duration of Examination:** Duration of Theoretical **examination of different courses** at the end of the semester shall be as follows:

Course less than or equal to 2 credits	: 2 Hours
Course greater than 2 credits but less than or equal to 4 credits	: 3 Hours

4. Publication of results

4.1 **Award of degree**: In order to obtain B.Sc. Engg. Degree a student must fulfill the following conditions:

(i) Bachelor degree program must be completed within ~~4~~ 6 academic years from the date of admission. A student will not be allowed to stay for more than two consecutive years in the same academic year.
(ii) The minimum CGPA for awarding B.Sc. Engg. Degree is 2.50 out of 4.00.
(iii) The total credit point required for awarding B.Sc. Engg. Degree is 160 with the exemption of maximum 8 credits. The result will be published in accordance with merit.

4.2 **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.

4.3 **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.

4.4 **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.

4.5 **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.

4.5 **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.

5. Distribution of Marks (as per course types)

5.1 Theoretical Courses:

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

5.2 Laboratory(practical/sessional)

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

5.3 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%

5.4 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. Duration of Course and Course Structure

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	**Contact hour/credit (in a semester)**
Theoretical Lecture	1 hour/week
Laboratory/Project	2 - 3 hours/week
Field work	2 weeks of field work

Summary of number of courses for the degree of B.Sc. Engineering

Year-Semester	Theory		Lab and Others		Total	
	No. of Courses	Credits	No. of Courses	Credits	No. of Courses	Credits
1st – First	6	16	2	4	8	20
1st – Second	5	12	4	8	9	20
2nd – First	6	16	2	4	8	20
2nd – Second	6	14	3	6	9	20
3rd – First	5	14	3	6	8	20
3rd – Second	5	14	3	6	8	20
4th – First	5	14	3	6	8	20
4th – Second	5	12	4	8	9	20
Total	43	112	24	48	67	160

Summary of Courses

First Year First Semester Examination, 2024

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE1111	Introduction to Materials Science & Engineering	75	3	3
MSE1121	Crystallography-I	50	2	2
MATH1111	Algebra , Trigonometry & Vector Analysis	75	3	3
PHY1111	Mechanics & General Properties of Matter, Waves and Sound	75	3	3
CHEM1111	Physical and Inorganic Chemistry	75	3	3
ENG1111	Technical and Communicative English	50	2	2
MSE1112	Qualitative and Quantitative Analysis of Materials **Laboratory**	50	2	4
CHEM1112	Physical Chemistry **Laboratory**	50	2	4
	Total	500	20	24

First Year Second Semester Examination, 2024

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE1211	Crystallography-II	50	2	2
PHY1221	Electricity & Magnetism	75	3	3
MATH1211	Differential and Integral Calculus	75	3	3
CHEM1211	Organic Chemistry	50	2	2
ECON1211	Industrial Economics	50	2	2
MSE1212	Crystallography **Laboratory**	50	2	4
MSE 1222	Engineering Drawing **Laboratory**	50	2	4
ME1232	Mechanical Engineering **Workshop**	50	2	4
MSE1210	Viva-Voce	50	2	-
	Total	500	20	24

Second Year First Semester Examination, 2025

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE2111	Phase Diagram and Microstructure of Materials	75	3	3
MSE2121	Construction Materials	50	2	2
MSE2131	Electronic Properties of Materials	75	3	3
MATH2111	Matrices and Differential Equations	75	3	3
PHY2111	Basic Electronics and Instrumentations	75	3	3
ACCO2111	Industrial Management and Accountancy	50	2	2
MSE2112	Metallography and Microstructure **Laboratory**	50	2	4
PHY2112	General Physics **Laboratory**	50	2	4
	Total	500	20	24

Second Year Second Semester Examination, 2025

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE2211	Materials Thermodynamics and Kinetics	50	2	2
MSE2221	Materials for Energy Conversion and Storage	50	2	2
EEE2211	Electrical Engineering	75	3	3
CSE2211	Computer Fundamentals and Programming in C & C++	75	3	3
STAT2211	Statistics for Engineers	50	2	2
LAW2211	Law and Professional Ethics	50	2	2
CSE2212	Computer Programming and Electrical **Laboratory**	50	2	4
CHEM2212	General Chemistry **Laboratory**	50	2	4
MSE2210	Viva-Voce	50	2	-
	Total	500	20	22

Third Year First Semester Examination, 2026

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE3111	Polymeric Materials	75	3	3
MSE3121	Glass and Ceramics	75	3	3
MSE3131	Composite Materials	75	3	3
MSE3141	Mechanical Properties of Materials	75	3	3
MSE3151	Production Metallurgy	50	2	2
MSE3112	Polymer Synthesis and Characterization **Laboratory**	50	2	4
MSE3122	Glass and Ceramic Processing **Laboratory**	50	2	4
MSE3132	Mechanical Property Testing **Laboratory**	50	2	4
	Total	**500**	**20**	26

Third Year Second Semester Examination, 2026

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE3211	Physical Metallurgy of Iron and Steels	75	3	3
MSE3221	Materials Manufacturing Engineering	75	3	3
MSE3231	Corrosion Engineering	75	3	3
MSE3241	Electrochemical Engineering	75	3	3
MSE3251	Optics and Optical Properties of Materials	50	2	2
MSE3212	Electrochemical and Corrosion **Laboratory**	50	2	4
MSE3222	Computer Aided Engineering Drawing & Designing **Laboratory**	50	2	4
MSE3210	Viva-Voce	50	2	-
	Total	**500**	**20**	22

Fourth Year First Semester Examination, 2027

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE4111	Microscopic Methods in Materials Characterisation	75	3	3
MSE4121	Plastic and Rubber Technology	75	3	3
MSE4131	Magnetic and Dielectric Materials	75	3	3
MSE4141	Waste Management, Industrial Safety and Environmental Issues	75	3	3
MSE4151	Surface Science and Engineering	50	2	2
MSE4112	Metallurgical **Laboratory**	50	2	4
MSE4122	Polymer Processing **Laboratory**	50	2	4
MSE4132	Electronic Materials **Laboratory**	50	2	4
	Total	**500**	**20**	26

Fourth Year Second Semester Examination, 2027

Course Code	Course Title	Marks	Credits	Contact Hours/Week
MSE4211	Nano- and Biomaterials	75	3	3
MSE4221	Spectroscopic Analysis of Materials	75	3	3
MSE4231	Welding and Joining Technology	50	2	2
MSE4241	Engineering Materials	50	2	2
MSE4251	Fiber Technology	50	2	2
MSE4212	Welding and Joining **Laboratory**	50	2	4
MSE4222	Industrial Training/ Project/Study tour / Field work	50	2	-
MSE4232	Research Project	50	2	-
MSE4210	Viva-Voce	50	2	-
	Total	**500**	**20**	16

Course Outline

First Year First Semester Examination, 2024

Course Code: MSE1111 **Course Title:** Introduction to Materials Science and Engineering
Course Credit: 3 **Course Teacher(s):** **1.** Dr. Mohammad Abdullah Al Mamun
2. Md. Shahnawaz Parvez

Course Description:

This course designed to familiarize the students with the fundamental concepts of materials science and engineering, which will be used as background knowledge for the understanding of 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.

Course Objective (Intended Learning Objectives, ILOs):

1. Familiarize the students about the importance of materials science in modern civilization.
2. Students will classify metals, ceramics, polymers, and electronic materials in context of atomic structure and interatomic bonding.
3. The course will build up the students' ability to make the relation among processing, structure, and physical properties of materials

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:

1. Classify the materials
2. Understand the basic properties that characterize the behavior of materials
3. The course will build up the students' ability to make the relation among processing, structure, and physical properties of materials

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Understanding of Materials:** Basic concepts of materials science and engineering, development of materials, classification of materials and their characteristics, uses of materials, advanced materials, modern materials' needs, scope and applications of materials science and engineering.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Types of Solid Materials:** Metal, polymer, ceramics, composites, semiconductor, crystalline & amorphous solids, Superconductor, Characteristics of Materials.		
CLO-1,2	**3. Materials Selection and Design:** Introduction, the importance of materials selection, factors affecting the selection of		

	materials, relation of materials selection to design, product analysis, activities of product development.		
CLO-2,2	**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 & non-steady-state diffusions, factors that influence diffusion, other diffusion path.		
CLO-3	**6.** Properties of Materials: Electrical & electronic properties, Thermal &thermoelectric properties, Mechanical Properties, Optical properties, Magnetic properties.		

Recommended book(s):

	Authors' name	**Title**
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: MSE1121 **Course Title:** Crystallography-I
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description:
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.

Course Objective (Intended Learning Objectives, ILOs):
1. Describe different types of bonds that are exists in solid materials.
2. Define lattice, crystal system, lattice plane and direction
3. Explain different types of defects in crystals.

Course Learning Outcome (CLO):
After successfully completion the course the students should be able to:
1. Calculate packing factor, density, interplanar spacing, using the geometrical parameters of crystal system.
2. Clarify which type of defect has severe impact on material properties.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Solid Materials:** Types of crystalline solids: ionic, covalent, molecular and metallic crystals. Cohesive energy of ionic crystals, lattice energy, Born-Haber cycle, isomorphism, polymorphism, enantiotropy and monotropy.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Crystals and Crystal Structures:** The 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, AB-type compounds, silica, alumina, complex oxides, silicates, crystallinity in polymers.		
CLO-1	**3. Describing Lattice Planes and Directions in Crystals:** 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, the addition rule; indexing in the trigonal and hexagonal systems; transforming miller indices and zone axis symbols.		
CLO-2	**4. Imperfections in Crystals:** Effects on Crystal due to Presence of Imperfection, Causes of Imperfections in Crystals, Different Types of Crystal Defects, Point defect, Line defect, Plane defects, Volume defect.		

Recommended Books:

Authors' name	**Title**
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: MATH1111 **Course Title:** Algebra, Trigonometry and Vector Analysis
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: This course is introducing 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.

Course Objective (Intended Learning Objectives, ILOs):

1. Introduce the fundamentals of algebra to solve mathematical equations.
2. Familiarize the students to understand trigonometric functions and calculating their value.
3. Present 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):

After successfully completion the course the students should be able to:

1. Understand sets, relation and function to solve the systems of linear equation.
2. Use trigonometric functions of complex argument to model a variety of real-world problem solving applications.
3. Perform basic vector operations both graphically and algebraically – addition, subtraction and scalar multiplication.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1.** Algebra of sets, De Morgan's rule, relation & function. Determinants: Properties and Cramer's rule.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Theory of Equations:** Theorem, and relation between roots and coefficients, Solution of cubic equations.		
CLO-1	**3.** De Moiver' theorem. Deduction from De Moiver's theorem.		
CLO-2	**4.** Functions of complex arguments. Gregory's series. Summation of series. Hyperbolic functions.		
CLO-3	**5.** Vector Addition, Multiplication & Differentiation.		
CLO-3	6. Definitions of line, surface and volume integral. Gradient of scalar function, Divergence and curl of vector function. Physical significance of gradient, divergence and curl. Integral forms of gradient, divergence and curl, Divergence Theorem, Stoke's theorem, Green's theorem and Gauss's theorem.		

Suggested Reading Lists/Essential Readings

Author's Name	:	**Title**
1.Higher Algebra	:	H. S. Hall and S. R. Knight
2. Higher Trigonometry	:	B. C. Das and B. N. Mukherjee

3. Vector Analysis : M. R. Spiezel
4.Theory of Equations : Barnside and Panton

Course Code: PHY1111 **Course Title:** Mechanics, General Properties of Matter, Waves and Sound
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: It is one of the fundamental course of physics related to the study of physics from the ground up, learning the basic principles of physical laws, their application to the behavior of objects, and the use of the scientific method in driving advances in this knowledge. In this course the students are introduced with the laws of rotational and oscillatory motions and the elastic behavior of maters and fluid dynamics of liquid are discussed. The students will also acquire knowledge on mechanical behavior of waves and forms of sound waves to know the applications in aspect of physics.

Course Objective (Intended Learning Objectives, ILOs):
1. To deliver knowledge on the fundamental laws of rotational and oscillatory motions.
2. To deliver idea about surface tension and viscous state of fluids.
3. To give knowledge on elasticity of solids.
4. To provide overall concept on mechanical and sound waves and their sources.

Course Learning Outcome (CLO):
After successfully completion, the course the students should be able to:
1. Acquires a thorough understanding of the principle of rotational and oscillatory motions of physical objects.
2. Understands the elastic properties of matter and the limits of elastic behavior.
3. (a) Gains an appreciation of surface phenomena and the concept of energy involved in the creation of new surfaces.
   (b) Understand the surface tension and viscosity of fluid.
   (c) Analyze waves and oscillations.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Rotational Motions:** Rotational variable; rotation with constant angular acceleration; relation between linear and angular kinematics, torque on a particle; angular momentum of a particle; kinetic energy of rotation and moment of inertia; conservation of angular momentum.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Oscillatory Motions:** Hooke's law and vibration; simple harmonic motion; combination of harmonic motions;		
CLO-3	**3. Surface Tension:** Surface tension as a molecular phenomenon; surface tension and surface energy; capillary rise or fall of liquids; pressure on a curved membrane due to surface tension.		

CLO-2	**4. Elasticity:** Moduli of elasticity, Poisson's ratios; relations between elastic constants and their determination.		
CLO-3	**5. Fluid Dynamics:** Fluids, density, and pressure, fluids at rest, measuring pressure, Pascal's principle, Archimedes' principle, the equation of continuity, Bernoulli's equation, Viscosity and coefficient of viscosity.		
CLO-3	**6. Waves in Elastic Media:** Types of waves, transverse and longitudinal waves, the speed of a travelling wave, energy and power of a wave traveling along a string, interference of waves, standing waves and resonance.		
CLO-3	**7. Sound Waves:** Speed of sound, travelling sound wave, interference, intensity and sound level, beats, Doppler effects.		

Suggested Reading Lists/Essential Readings

Author's Name	:	**Title**
1. Mechanics and Properties of Matter	:	Ahmed & Nath
2. General Properties of Matter	:	Emran et al
3. Physics (Part-I & II)	:	Halliday & Resnick
4. Elements of Properties of Matter	:	Mathur
5. General Properties of Matter	:	Newman & Searle
6. Mechanics	:	Symon
7. Text Book of Sound	:	Emran
8. Text Book of Sound	:	Wood
9. Waves	:	Coulson

Course Code: CHEM1111 **Course Title:** Physical and Inorganic Chemistry
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):
1. Grow the students' ability to understand physio-chemical properties of materials.
2. Provide students the fundamental chemical principles of materials formation.

Course Learning Outcome (CLO):
After successfully completion the course the students should be able to:
1. Understand the elementary laws electrochemistry and apply them in various electrochemical cells.
2. Determine the rate of chemical changes of materials formation or materials interaction.
3. Demonstrate the role of surfaces during fluid- materials interaction.
4. Explain the atomic structure based on quantum mechanics and understand the periodic properties of the atoms.
5. Explain and predict the structure and bonding in molecules.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Electrochemistry (10 Lectures):** Conductors, Electrolytes and Electrolysis; Faradays Laws of Electrolysis and their significance. Ohm's law and electrolytic conductance; Theories for electrolytic conductance (Arrhenius& Debye-Hükel). 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).	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Chemical Equilibrium and Kinetics (10 lectures):** Equilibrium and Equilibrium constants, Kc, Kp, Kx. Rate of reaction and rate constants; Le Chatelier principle and its application. Order and molecularity of a reaction; integrated rate expressions & half-lives of zeroeth, first and second order reactions. Determination of order & 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. Surface Chemistry and Colloids (10 lectures):** Adsorption and sorption; Characteristics of physical and chemical adsorptions. Fruendlich, Langmuir and Gibb's Adsorption isotherms; The BET equation. 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	**4. Atomic structure and Periodic Table (10 lectures):** Modern concept of atomic structure and Periodic Table; related principles and Laws. Constitution and Periodic properties of elements (ionization potential, electronegativity, electron affinity, atomic and ionic radii). Grouping of elements, their properties and uses. Isotopes and radioactivity.		
CLO-5	**5. Electronic Theory of Valence and Chemical Bonding (8 lectures):** Different types of bonds (ionic, covalent, co-ordinate, hydrogen and metallic) Classification of solids on the basis of bonding and their properties. Atomic orbitals and their hybridization; valence bond and Molecular orbital theories.		
CLO-5	**6. Chemistry of Transition Elements, Lanthanides and Actinides (7 lectures):** Definitions, electronic configurations, preparations (nuclear transformations), general properties and uses.		

Recommended Books:

Authors' name	**Title**
1. R. D. Madan	Modern Inorganic Chemistry
2. M. M. Haque and 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 and 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: ENG1111 **Course Title:** Technical and Communicative English
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (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):

After successfully completion the course, students should be able to:

1. Use English effectively for academic purposes across the curriculum.
2. Communicate effectively and appropriately in real life situations.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Grammatical Principle:** Sentences, Tenses, Clauses, Connectors, Understanding long Sentences, Conditional Sentences, Transformation of Sentences, and Phrases: Noun phrases Adverbial phrases, Prepositional phrases, Verb phrases, Modifier, Head word, Appositives, Determiners.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	2. Making words with adding suffix and prefix, Phrase and idioms, Modal Verbs, Gerund, Infinitive, Bear infinitives, Causative verbs, Words of Negation.		
CLO-1,2	**3. Spoken English:** Greetings, Dialogues, Responding to a Particular Situation, Extempore speech.		
CLO-1,2	**4. Reading:** Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.		
CLO-1,2	**5. Technical Writing:** Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.		
CLO-1,2	**6. Professional communication:** Business letter, job application, memos, quotations, tender notice.		

Books Recommended:

Authors' name	Title
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: MSE1112 **Course Title:** Qualitative and Quantitative Analysis of Materials Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This lab. course is designed to demonstrate knowledge of analytical vocabulary, standard solutions, volumetric glassware, and dilution calculations and various gravimetric and volumetric titrations. This course will enhance the students' skill of basic quantitative and qualitative analytical techniques and help them to identify appropriate methods of sampling and sample preparation prior to analysis.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. Acid-base titration, Oxidation-reduction titration, Precipitation titration, Complex metric titration and Gravimetric titration. 2. Estimation of calcium and magnesium from different compounds 3. Estimation of zinc and copper form analysis of brass. 4. Analysis of Portland cement, insoluble silicate, limestone, water and some other industrial products.	Lecture Exercise/Tutorial/ Quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Recommended Books:

Authors' name — **Title**
1. A.I. Vogel — A Text-book of Quantitative Inorganic Analysis

Course Code: CHEM1112 **Course Title:** Physical Chemistry Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later.

Course Description:

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. Determination of cell constant of a conductivity cell. 2. Conductometric titration. 3. Potentiometric titration. 4. Conductometric determination of degree of dissociation. 5. Construction of some electrodes and measurement of their standard potentials. 6. Determination of heat of capacity, heat of solution, heat of neutralization, equilibrium constant and energy of activation. 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 adsorptive power of an absorbent and verification Langmuir Isotherm.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Recommended Books:

Authors' name	Title
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
J.N. Gurtu	Advanced Experimental Chemistry

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Course Code: MSE1211 **Course Title:** Crystallography - II
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description:
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 chapters 3 and 5 by the topics of lattice, basis, unit cell, crystal system, Atomic packing factor, lattice plane, lattice directions, and crystalline structure of metal, ceramics and polymer. Stereographic projection is included in chapter 3. Chapter 4 covers the topics of point group, space group and reciprocal lattice. Finally, the defects that are generally found in crystal are introduced in the last chapter.

Course Objective (Intended Learning Objectives, ILOs):
1. Define lattice, crystal system, point group, space group and reciprocal lattice.
2. Be familiar with the stereographic projection in crystallography.
3. To get fundamental knowledge about the crystal growth.

Course Learning Outcome (CLO):
After successfully completion the course the students should be able to:
1. Demonstrate the construction stereographic projection and the symmetry of crystal.
2. To get insight about the crystal growth techniques.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Crystal Symmetry:** Point group and space group, centres and inversion axes of symmetry, crystal symmetry and properties, symmetry elements.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Representation and Study of Crystals in Projection:** Introduction, representation in two dimensions, stereographic projection and its construction, stereographic projection in small circle, stereographic net, use of stereographic projection in crystallography, gnomonic projection. five-plane lattice. Bravais lattices and crystal systems		
CLO-2	**3. Reciprocal Lattices:** Reciprocal lattice vectors, reciprocal lattice unit cells, geometrical relationships, reciprocal lattice cell for cubic crystal.		
	4. Growth of Crystal from Melt and Vapour: Introduction, Preparation of single crystals by Czochralski, Bridgeman and Stockbarger, flux methods; Epitaxial growth and vapour phase transport of single crystal, Electron		

	beam deposition and MBE growth, Sputtering and Spray-pyrolysis methods.		
CLO-2	**4. X-rays and X-ray diffraction:** Introduction, origins and characteristics of X-rays, X-ray diffraction and Bragg's law, Moseley's law, Laue equations, Methods of diffraction- powder methods, single crystal method, x-ray diffraction experiment, Structure of crystals from X-ray diffraction		

Recommended Books:

Authors' name	**Title**
5. F. Donald Bloss	Crystallography and Crystal Chemistry
6. C. Hammond	Introduction to Crystallography
7. R. West	Solid State Chemistry
8. L. V. Azaroff	Introduction to solids
9. D. McKie & C. Mckie	Crystalline Solids
10. A. Windle	A First Course in Crystallography
11. N.F. Kennon	The Structure in Crystals
12. F.C. Phillips	An Introduction to Crystallography
13. C. Kittle	Introduction to Solid State Physics

Course Code: PHY1221 **Course Title:** Electricity and Magnetism
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (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):

After successfully completion the course the students should be able to:

1. Know the theory of capacitance, and its application using dielectrics and Gauss law and the electron theory of conductors.
2. Know the use of Coulomb's law and Gauss' law for the electrostatic force and the relationship between electrostatic field and electrostatic potential.
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.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Capacitors:** Parallel plate capacitors; dielectrics and Gauss's Law; susceptibility, permeability, and dielectric constant; energy stored in an electric field.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Electrostatics:** Electric dipole; electric field due to a dipole; dipole on external electric field; Gauss's Law and its applications.		
CLO-3	**3. Electric Current:** Electron theory of conductivity; conductor, semiconductors and insulators; superconductors, current and current density.		
CLO-3	**4. Electromagnetic Induction:** Faraday's experiment; Faraday's law; Ampere's law, motional e.m.f.; self and mutual inductance galvanometers-moving coil, ballistic and deadbeat types.		

CLO-3	**5. Thermoelectricity:** Thermal e.m.f; Seebeck, Peltier and Thomson Effects; laws of addition of thermal e.m.f., thermoelectric power.		
CLO-3	**6. DC and AC Circuits:** D.C. circuits with LR, RC, and LCR in series; A.C. circuits with LR, RC, LC, and LCR in series.		

Recommended Books:

Authors' name	**Title**
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: MATH1211 **Course Title:** Differential and Integral calculus
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):
1. Familiarize the students with introductory calculus
2. provide necessary background of differential and integral calculus.

Course Learning Outcome (CLO):
After successfully completion the course the students should be able to:
1. Understand the concept of function, limit and continuity and solve the limiting value problem.
2. Use different method to solve ordinary and partial differentiation.
3. Calculate the integral of definite and indefinite forms.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Functions:** Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate form.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 75%
CLO-2	2. **Ordinary Differentiation:** Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.		
CLO-2	3. **a. Expansions of functions:** Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae. b. Maximum and minimum of functions of one variable.		
CLO-2	4. **a. Partial Differentiation:** Euler's theorem, Tangents and normal. b. Asymptotes.		
CLO-3	5. **Indefinite Integrals:** Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.		
CLO-3	6. **Definite Integrals:** Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.		
CLO-3	7. **Multiple Integrals:** Determination of lengths, Areas and Volumes.		

Books Recommended:

Authors' name	Title
1. B.C. Das and B.N.Mukherjee	Differential Calculus
2. B.C.Das and B.N. Mukherjee	Integral Calculus
3. F.Ayres	Calculus
4. Edwards	Differential Calculus

5. Williamson — Integral Calculus
6. Muhammad and Bhattacherjee — Differential Calculus
7. Muhammad and Bhattacherjee — Integral Calculus

Course Code: CHEM1211 **Course Title:** Organic Chemistry
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):
1. The students should able to develop basic skills for the multi-step synthesis of organic compounds and mechanism for a chemical reaction.
2. This course will help to understand the structure and reactivity of organic molecules, with examples illustrating the role of organic chemistry in industry.
3. They can apply chemical principles in the laboratory setting

Course Learning Outcome (CLO):
On completion of the course, the student should be able to:
1. Gather and recall the fundamental principles of organic chemistry that include purification, elemental analysis and bonding
2. Extend knowledge on nomenclature, preparation, properties, types of reactions and important uses of aliphatic hydrocarbons.
3. Understand the basic concept of biochemistry and stereochemistry of organic molecules.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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, hybridization of orbital (sp, sp^2 and sp^3)	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 & ketones, carboxylie acids & 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 book(s):

Authors' name	**Title**
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:	Sterechemistry 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: ECON1211 **Course Title:** Industrial Economics
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: The content of this course include 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.

Course Objective (Intended Learning Objectives, ILOs):

1. The goal of this course is to provide the student with advanced concepts of engineering economic analysis and its role in engineering decision making.
2. It is designed to make the students 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):

After successfully completion the course the students should be able to:

1. Acquire knowledge on the economic analysis, feasibility and evaluation of enterprises and projects.
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.
3. Realize the theoretical and conceptual basis of upon which engineering projects analysis is built.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 and Theory of the Firm:** 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.		
CLO-1&2	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 of Bangladesh:** The revenue at the capital budget; Income, expenditure of the government; direct and indirect taxes.		
CLO-1&2	9. **Development Planning in Bangladesh:** Need for planning in Bangladesh; Various five year plans in Bangladesh; Development strategies in the five year plans of Bangladesh.		

Books Recommended:

Authors' name	**Title**
1. Semuelson and Nordhous	Economics
2. Byrons and Stone	Economics
3. Dewett, K. K.	Modern Economic Theory
4. Ahuja, H. L.	Advanced Economic Theory
5. Government of Bangladesh	Various Five Year Plans

Course Code: MSE1212 **Course Title:** Crystallography Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This course designed to develop strong fundamentals of crystal structure. Students will be able to identify different crystal system and calculate the density of the crystal. The will gain the knowledge to find out lattice parameter and defect phase from the XRD pattern of a particular material.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. Concept of Unit and dimensions. 2. Familiar with different crystal systems. 3. Identification of different crystal structures. 4. Calculation of compactness of different structures. 5. Determination of different phases of materials from diffraction intensity profile. 6. Determination of lattice parameter.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Course Code: MSE1222 **Course Title:** Engineering Drawing Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Course Code: ME1232 **Course Title:** Mechanical Engineering Workshop
Course Credit: 2
Course Teacher(s): Announce to be later

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

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. Familiar with engineering tools. 2. Study of grinding, milling and drill machine. 3. Cutting, filing and polishing of solid materials 4. Study of lathe machine and Preparation of Nut, bolt and different solid bodies.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Second Year First Semester Examination, 2025

Course Code: MSE2111 **Course Title:** Phase Diagram and Microstructure of Materials
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

1. To provide a guideline about the various crystal growth techniques with their common features.
2. The purpose of this curricular unit is to use phase equilibrium diagrams 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):
After successfully completion the course the students should be able to:

1. Acquire theoretical knowledge on numerous crystal growth techniques and importance's of phase diagrams in the field of materials science and engineering.
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.
3. Know the applications of phase diagrams and able to analyze their crystal structure.
4. Know the metallographic features of metals and alloys with their microstructure.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO -1	1. **Phase Diagrams:** Phase and phase equilibria, Gibbs phase rule, binary isomorphous system - interpretation of phase diagram, determination of compositions & phase amounts, binary eutectic systems equilibrium diagrams having intermediate phases, congruent phase transformations.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO- 2 & 3	2. **Binary Phase Diagrams of Alloy Systems**: Iron-iron carbide phase diagram, development of microstructure in iron-carbon alloys, hypo-eutectoid alloys, hypereutectoid alloys, non-equilibrium cooling, and the influence of other alloying elements.		

CLO-2 & 3	**3. Microstructure of Materials:** Development of microstructure in isomorphous and eutectic alloys, equilibrium diagrams having intermediate phases.		
CLO-2 & 3	**4. Metallography:** Function of metallurgical microscope, Preparation of specimens for microstructure study, Microstructure of metal and alloys, Sulphur print, phosphorous print.		
CLO-4	**5.** Study the phases and microstructure of non-ferrous metal and their alloys. Cu, Al, Ni, and their alloys.		

Books Recommended:

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

Course Code: MSE2121 **Course Title:** Construction Materials
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: First part of this course is basic building stones, building stones materials, and second part 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.

Course Objective (Intended Learning Objectives, ILOs): This course intended to be an introduction to the main construction materials currently used in industry and the building materials.

Course Learning Outcome (CLO):
After successfully completion, the course the students should be able to:
1. Explain the fundamentals of construction materials, their classifications and applications
2. Identify the quality of construction materials of using suitable component as a construction.
3. Illustrate principle and using of the different clay product as construction materials.
4. Select the suitable preservation technique for preserving construction materials.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Bricks, Tiles, Terra cotta and Other clay products:** 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	2. **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	3. **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	4. **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	**5. 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		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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: MSE2131 **Course Title:** Electronic Properties of Materials
Course Credit: 3
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

At the end of this course students should be able to:

1. Explain the behavior of electron as particle or wave.
2. Introduce energy band theory of semiconductor.
3. Know fundamental properties of semiconductor materials.
4.Gain knowledge about carrier transport mechanism

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. develops understanding of the fundamentals of energy band theory.
2. Can utilize the knowledge of drift and diffusion mechanism in particular device application as for example of photodetector.
3. can apply the knowledge in solving a wide range of problems originating in part in semiconductor research.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Energy Level and Spectra:** Introduction; Atomic model, The single electron system; Electron states in atoms; Energy spectra in atoms, Correspondence principle, atomic excitation, origin of adsorption and emission spectra, wave, particle and its duality.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	2. **Energy Bands in solids:** Introduction, Energy bands in metals, semiconductors and insulators, Schrödinger equation, The Bloch theorem, The Kronig Penney model, Effect of temperature &Pressure on energy band gap.		
	3. **Electrons in a crystal:** Fermi level & Fermi surface, Fermi-Dirac Distribution, Density of states, Population density; complete density of states function within a band, consequences of the band model.		
CLO-2	4. **Properties of semiconductor:** Intrinsic and Extrinsic Semiconductors, Carrier Transport Phenomena, Hall Effect,		

	Compound Semiconductors, Semiconductor Devices.		
CLO-1	**5. Electrical Properties in Metals and Alloys, Polymers, Ceramics Dielectrics and Amorphous Materials:** Conductivity-Classical and Quantum Mechanical Considerations, Thermoelectric Phenomena, Conducting Polymers, Dielectric Properties, Ferroelectricity, Piezoelectricity, Electrostriction, Pyroelectricity and Amorphous Materials.		

Recommended book(s):

Authors' Name	**Title**
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: MATH2111 **Course Title:** Matrices and Differential Equations
Course Credit:3
Course Teacher: Announce to be later

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

Course Objective (Intended Learning Objectives, ILOs):

The objective of this course is to understand the formation, solution and application of differential equation.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:

1. To understand the concept of different matrices, their transformation and properties
2. To calculate eigenvalue and eigenvector of a system using matrices
3. To analyze and apply the different order differential equation and find the solution of the equation

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Algebra of Matrices:** Adjoint, Inverse and rank of matrix-definition, Properties and evaluation.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
	2. **Elementary Transformations:** Echelon: Canonical and normal forms, Solution of system of linear equations, Consistency and solution of homogeneous and nonhomogeneous systems by matrix method, and reduction to equivalent system.		
CLO-2	3. **Characteristic Equation**: Eigenvalues, Eigenvectors and Caley-Hamilton theorem, similar matrices and diagonalization.		
CLO-3	4. **Solutions** of first order and first degree and first-order and higher degree equations with variable coefficients.		
CLO-3	5. **Solution of Higher-Order** linear differential equations.		
CLO-3	6. **Differential Equations**: Series solution of linear differential equation, Series solution of second order equation with variable coefficients, 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 book(s):

Authors' name	Title
1. M. L. Khanna	Matrices
2. S. L. Ross	Introduction of Ordinary Differential Equations
3. F. Ayres	Theory and problems of Matrices
4. Moduffe	Theory of Matrices
5. F. Ayres	Differential Equations
6. B. D. Sharma	Differential Equations
7. L. Pipes	App. Mathe. For Engineers and Physicist
8. I. S. Sokolnikoff & R.M.Redheffer	Math. For Physics and Modern Physics

Course Code: PHY2111 **Course Title:** Basic Electronics and Instrumentations
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: This is an introductory course that covers electricity and electronics fundamentals, math principles and applications, numbering systems and codes, taking standard measurements, electronic components, circuits and applications. It provides students with an understanding of computer electronics and methods of analyzing circuits, the use of circuit models to solve electrical problems, and the applications of circuit techniques to semiconductor and discrete components. Students will cover topics in circuits, producing electricity, semiconductors and integrated circuits, wiring, testing, the information age, and electricity and electronics at work. It also covers average value calculation and measurement of different waveforms to achieve their effective values, phase measurements, rise and fall time measurement of pulse wave forms using an oscilloscope.

Course Objective (Intended Learning Objectives, ILOs):

1. To understand operation of semiconductor diodes including DC analysis and AC models of semiconductor devices.
2. (a) To apply concepts for the design of Regulators and Amplifiers and transistor-amplifiers in different configurations.
   (b)To understand the operation and design of transformer coupled various types of power amplifier circuits.
3. To understand the principle of feedback signal and effects of negative and positive feedback on amplifier circuits.
4. To introduce the students with digital numbering system and designing of logic gates using algebraic laws.
5. To understand the operation of oscilloscope to determine the frequency of oscillation and spectra of measured data.

Course Learning Outcome (CLO):

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

1. Understand the current voltage characteristics of semiconductor devices, and analyze dc circuits and relate ac models of semiconductors with their physical operation.
2. (a) Able to design Bipolar junction 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.
3. Design the different oscillator circuits for various frequencies and analysis of data from spectroscopic measurements as well.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Semiconductor Diodes:** n-and p-type semiconductors, p-n junction diodes and their volt-ampere characteristics, Zener diode, half-and full wave rectifiers, voltage regulation using Zener diodes.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Bipolar Junction Transistors**: PNP and NPN Transistors: Construction and Operations, DC characteristics of CE, CB and CC configurations and transistor amplifiers in different configuration.		
CLO-2	**3. Feedback and Oscillators:** Principles of feedback, positive and negative feedback, oscillators: RC, Hartely and Colpitt's oscillator.		
CLO-2	4. **a) Number Systems**: Decimal, Binary, Octal and Binary codes. **b) Logic Gates and Boolean algebra**: Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR and Ex-NOR operations and their truth tables; Laws of Boolean algebra, De-Morgan's theorems.		
CLO-2	5. **Flip-Flops**: RS, D, T and JK Flip-Flops.		
CLO-2 & 3	6. **Instrumentations**: Oscilloscope, pH-meter, GM and Scintillation counters; AVO meter.		

Recommended book(s):

Authors' Name	Title
1. Grob, B.	Basic Electronics
2. Gupta, SL and Kumar, V.	Handbook of Electronics
3. Boylestad, RL and Nashelsky, L.	Electronic Devices and Circuit Theory
4. Mehta, VK.	Principles of Electronics
5. Malvino, AP	Electronic Principles
6. Tocci, RJ.	Digital Systems

Course Code: ACCO2111 **Course Title:** Industrial Management & Accountancy
Course Credit:2
Course Teacher: Announce to be later

Course Description:

Course Objective (Intended Learning Objectives, ILOs):

Course Learning Outcome (CLO):

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. **Industry:** Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry; Business: Meaning & Objectives of Business, Types of Business: Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
	2. **Fundamentals of Management**: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Scientific Management and Core Management skills.		
	3. **Factory Location and Plant Layout**: Factors Determining Location of Factory, steps in Location, Factors Influencing Layout, Types of Layout, Problems of Layout.		
	4. **Work-Environment and Plant Utility**: Meaning, Importance, Factors Affecting Work Environment, Plant Utility, Lighting, Ventilation, Air-conditioning, Sanitation and Noise Control.		
	5. **Sole Proprietorships**: Features, Advantages, Disadvantages of Sole Proprietorship, Sustainability of Sole proprietorships.		
	6. **Man Power Planning & 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.		
	7. **Conflict & Union Management Perspective**: Meaning, Process of Conflict, Types of Conflict, Industrial Conflict Resolution Methods, Negotiation Skills, Growth of Trade Unions, Functions, Structure, Leadership		

	and Management in the Trade Union, Collective Bargaining.		
	8. Accountings: History, Scope and Nature of Accounting, Purpose of Accounting, Information and Uses.		
	9. Transaction: Meaning and Features, Accounting Equation, Meaning and Classification of Account, Double entry System, Rules for Determining Debit and Credit, Accounting cycle.		
	10. Journal, Ledger and Trial Balance: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems.		
	11. Work Sheet: Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.		
	12. 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.		
	13. Cost-Volume-Profit Relationship: Contribution Margin and Ratio, Break-even Analysis, CVP relationship in Graphical Form and Target Net Profit Analysis.		

Recommended book(s):

Authors' name	**Title**
1. M. C. Shukla	Business Organization and Management
2. Harold Koontz and Heinz Weihrich	Management
3. Krajewski and Ritzman	Operation Management
4. David A. Decenzo and Stephen P. Robbins	Human Resource Management
5. Afzal A. Rahman	Managing Conflict in Organization
6. HermansonEtar	Accounting Principles
7. Ray H. Garrison	Managerial Accounting

Course Code: MSE2112 **Course Title:** Metallography and Microstructure Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective:

Course content	Teaching-learning strategy	Assessment Strategy
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 rebar. 4. Determination of micro-hardness of different phases. 5. Study of microstructure of martensitic and annealed steel. 6. Microstructure of composite materials. Quantitative metallography: grain size, volume fraction, aspect ratio, particle size distribution, etc. 7. Quantitative metallography: grain size, volume fraction, aspect ratio, particle size distribution, etc.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Course Code: PHY2112 **Course Title:** General Physics Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective:

Course content	Teaching-learning strategy	Assessment Strategy
1. Determination of the viscosity of a liquid. 2. Determination of the surface tension. 3. Determination of the galvanic resistance (half deflection method). 4. Determination of the figure of merits. 5. Measurement of high resistance. 6. Measurement of low resistance by the method of fall of potential. 7. Determination of end-correction of a metre bridge wire. 8. Measurement of resistance per unit length of a metre bridge wire. 9. Determination of the specific resistance of a wire. 10. Calibration of a metre bridge wire. 11. To study the variation of reactance due to L and C with frequency. 12. Determination of resonance frequency in LCR circuit (series and parallel). 13. To study the characteristics of p-n junction diode	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readi]ngs

Second Year Second Semester Examination, 2025

Course Code: MSE2211 **Course Title:** Materials Thermodynamics and Kinetics
Course Credit:2
Course Teacher: Announce to be later

Course Description:
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.

Course Objective (Intended Learning Objectives, ILOs):
This course is intend to develop an understanding of the fundamental thermodynamic and kinetic processes in materials. Students will develop skill sets needed to evaluate the stability of materials under different external conditions.

Course Learning Outcome (CLO):
After successful completion of the course student will be able to:
1. To develop an understanding of the fundamental thermodynamics lows of materials.
2. Evaluate the suitability of using the materials under different external conditions.
3. Illustrate principle and evaluation of using heat transfer in different process, reversible and irreversible process and Carnot cycle.
4. To develop an understanding of the fundamental kinetic processes in materials.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Introduction:** Scope of thermodynamics; Thermodynamics systems and equilibrium; zeroth law; Thermodynamics process; Internal energy; Equations of state.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. First law of thermodynamics:** Statement of first law of thermodynamics; Thermodynamics cycles; Work in difference process; Isothermal and adiabatic equation; Concept of enthalpy.		
CLO-1&2	**3. Second and Third laws of thermodynamics:** Statement of second law; Carnot's cycle and Carnot's theorem; Heat engine; Concept of entropy; Changes of entropy in reversible and irreversible process; Entropy temperature diagram, Third law of thermodynamics.		
CLO-3	**4. Thermodynamics relation:** Thermodynamics potential functions; The Maxwell's relations; Joule –		

	Thomson effect; Chemical potential; Phase equation and phase rule; Phase transitions. Degree of Freedom Phase diagram of Water, One component system.		
CLO-4	**5. Kinetic theory of gas:** Introduction, Fundamental assumptions in the kinetic theory, kinetic gas equation, Total kinetic energy from kinetic gas equation, The root mean square velocity.		
CLO-4 & 5	**6. 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; Thermo dynamical Statistics.		

Recommended book(s):

Authors' name	**Title**
1. T. Hossain	Text book of heat
2. Brizlal	Heat and Thermodynamics
3. R. E. Smallman	Modern Physical metallurgy

Course Code: MSE2221 **Course Title:** Materials for Energy Conversion and Storage
Course Credit:2
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will help the students to understand the importance of the implementation of renewable energy sources.
2. Students will learn the fundamental electrochemical, optoelectronic and thermodynamic properties of materials used for energy conversion and storage devices.
3. The course will enhance the students' capability to design and select appropriate materials for a particular energy device.

Course Learning Outcome (CLO):

At the end of the course, students should be able to

1. Classify the source of energy
2. Design and enhance the performance of different types of cells for energy conversion and storage.
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.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Sources of Energy:** Introduction, Type of energy Sources, Conventional and Non-Conventional Energy, Energy storage and Conversion.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	2. **Electro-chemical Cells:** Leclanche cell - construction, shelf life, cell reactions & 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-ion batteries, lithium polymer batteries.		
CLO-2	3. **Fundamentals of Fuel Cells:** Direct and indirect energy conversion; fuel cells and related systems; air-depolarised 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, 3a	4. **Materials for Solar 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: Photovoltaic devices, principles of photovoltaic, design of photovoltaic systems, Storage batteries.		
CLO-3b	**5. Bioconversion and Biomass:** Introduction, Photosynthesis, Biogas Generation, Digester and their Designs, Materials for Biogas and Biomass and Their application.		
CLO-3b	6. **Pyrolysis of biomass:** Introduction, types of pyrolysis, pyrolysis product, pyrolysis kinetics, types of pyrolyzer, heat transfer in a pyrolyzer, pyrolyzer design, biochar.		

Recommended book(s):

Authors' name	**Title**
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. Prabir Basu	Biomass Gasification, Pyrolysis and Torrefaction

Course Code: EEE2211 **Course Title:** Electrical Engineering
Course Credit:3
Course Teacher: Announce to be later

Course Description: This course focuses to develop knowledge, basic concepts and building blocks of electrical circuits. It is a base in circuit theory. It is engineer's fundamental tool in electrical study. Students will understand fundamental laws, principles and phenomena in the area of electrical engineering. They will be enable to apply the acquired knowledge and skills to learn complex machine systems like transformer, generator and motor which will help them to their professional and practical life.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will help the students to understand the basic electrical circuit quantities and theoretical understanding of A.C and D.C circuits system.
2. Students will learn different analytical process to solve complex circuit A.C and D.C circuit and Machine system.
3. The course will enrich the students' capability to handle electrical circuit as well as A.C and D.C machine system in their daily life as well as in work place.

Course Learning Outcome (CLO):

1. Know basic characteristics of electrical quantities, circuit terminology and associated problems
2. Understand basic circuit laws, and circuit theorems for DC network to analyze complex circuits problems and their solution
3. Basic about AC theory and understand resonance phenomenon in circuits
4. Elementary to moderate knowledge of transformer, generator and motor machine systems.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Circuit Models**: Characteristics and applications of linear circuit elements; Ideal and non-ideal voltage and current source; Series, parallel and compound circuit analysis; Loading effects; Voltage sources in series and parallel, open and short circuit.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Circuit Theorem and Network Analysis**: Voltage and current divider rule; Kirchhoff's law; Superposition; Thevenin's, Norton's and Maximum power transfer theorem; Reciprocity theorem; Mesh and Nodal analysis; Delta-star transformation.		
CLO-3	**3. 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.		

CLO-4	**4. Transformer**: Working principle of transformer, elementary theory of an ideal transformer-E.M.F., equation of transformer-voltage transformation ratio, transformer with loses 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	**5. D.C Machines:** D.C generator; principle, types, performances and characteristics, D.C motor; principles, Types of motor, performances, speed control, starters and characteristics.		
CLO-4	**6. A.C Machines:** Classification of A.C motors, single phase induction motor principle, equivalent circuit of an induction motor, introduction of synchronous and special type of motor.		

Recommended book(s):

Authors' name	**Title**
1. D. R. Resnick and D. Halliday	Physics, Part-2
2. B. L. Theraza	Electrical technology (Volume-1&2)
3. Robert L. Boylestad	Introductory Circuit Analysis
4. R. P. Ward	Basic Electrical Engineering
5. Stephen J. Chapman	Electrical Machinery Fundamentals
6. George F. Corcoran	Alternating Current Circuits

Course Code: CSE2211 **Course Title:** Computer Fundamentals and Programming in C&C++
Course Credit:3
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will help the students to understand the basic structure and relation of different versions of computer system.
2. Students will learn different software, programming languages and networking system.
3. The course will enrich the students' capability to handle computer system effectively for their practical life.

Course Learning Outcome (CLO):

1. Knowledge about computer and its application
2. Understand and identify computer organization, architecture and associated units
3. Develop skills to use different types of software application
4. Learn the concepts of data communication and networking.
5. Knowledge about computer languages.
6. Analyze natural language 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.
7. Understand basic knowledge of C++ and apply the attained knowledge in C++ to analyze and solve problems in actual way.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Introduction:** Classification of Computer, working features of computer system, application.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Hardware:** Organization and architecture of a computer, CPU, memory units, I/O devices, peripheral devices, BIOS, bus architecture, storage devices.		
CLO-3 & 4	**3. Software and Internet Fundamental:** Classification, system software, application software, operating system concepts, word-word processing, spreadsheet database and presentation software, internet service, e-mail, e-commerce, different types of network, network topologies, communication media.		
CLO-5 & 6	**4. 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-4	**5. Operation and Expressions:** Classification of operators, statements, conditional statements, if and loops; for, while and do-while, decision making and branching, function arrays, pointer, file reading and writing operation in C.		
CLO-7	**6. Object Oriented programming:** Introduction, C++ terminology, encapsulation, class hierarchy, operator overloading, function overloading, C++ I/O function.		

Recommended book(s):

Authors' name	**Title**
1. Peter Norton's	Introduction to Computers
2. Taylor L. Booth	Introduction to computer Engineering Hardware and Software Design
3. E. Balagurusamy	Programming in ANSI C
4. MerbertSchildt	The complete Reference C & C++
5. Debasish Jana	C++ and object Oriented Programming Paradigm

Course Code: STAT2211 **Course Title:** Statistics for Engineers
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: Statistics for Engineers is one of the first year course in Bachelor of Materials Science and Engineering programme. The course offered in Semester 2 every year. This course introduces basic probability, continuous and discrete random variables, distribution functions and their applications, relationship between distributions, hypothesis testing, and simple linear regression and correlation.

Course Objective (Intended Learning Objectives, ILOs):
Understand and describe sample spaces and events for random experiments.

Course Learning Outcome (CLO):
After successfully completion, the course the students should be able to:

1. Interpret and calculate probabilities of events in discrete sample spaces, and conditional probabilities of events using Bayes' theorem.
2. Use probability as a tool to develop probability distribution that serve as models for any random variables.
3. Predict the value of any independent variable to the value of dependent variable using a linear regression analysis.
4. Perform a significant test of hypothesis concerning the values of population mean based on normal and t - distribution.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Analysis of statistical data:** Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	2. **Probability:** Concept of probability, Sample Space, Events union and Intersection of Events, Probability of events, Loss of probability, Conditional probabilities, Bose Einstein Statistics, Bay's Theorem, Chebysec's Inequality and Practical examples.		
CLO-2	3. **Random variables and probability Distribution:** Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions, Conditional Expectation and conditional variance, Moments and Cumulant generating functions, Characteristic function, Study of Binomial Poisson, Normal and Bivariate Normal distribution and Practical examples.		
CLO-3	4. **Linear Regression:** Correlation, Rank correlation. Partial and Multiple correlations Linear Regression for two Variables,		

	Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.		
CLO-4	**5. Test of Significance:** Basic ideas of Null hypothesis, Alternative hypothesis, Type-I error Type-II error level of significance Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, Two sample means and Variances. Test for 2×2 contingency tables, Independence test and practical examples.		

Recommended Books:

Authors' name	Title
1. P.G.Hoel.	Introductory Statistics
2. S.G. Gupta	Fundamentals of Statistics
3. A.J.B.Anderson	Interpreting Data
4. H. Cramer	The Elements of Probability Theory
5. D.V.Lindley	Introduction to Probability and Statistics
6. S.Lipschutz.	Probability
7. Mosteller, Rourke & Thomas	Probability with Statistical Applications
8. F.L.Wolf.	Elements of Probability and Statistics
9. T.H. Wonnacot&R.J.Wonnacot	Introductory Statistics
10. Yule &M.G.Kendall.	An Introduction to the Theory of Statistic

Course Code: LAW2211 **Course Name:** Law and Professional Ethics
Course Credit:2
Course Teacher: Announce to be later

Course Description:
Course Objective (Intended Learning Objectives, ILOs):
Course Learning Outcome (CLO):

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
	1. Law: Principle of law of contract, agency, partnership, sale of goods negotiable instruments, insurance-insolvency.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
	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.		
	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.		
	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.		
	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 book(s):

Authors' Name	Title
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. Emile Durkheim	Professional Ethics and Civics Morals
5. J. D. Mabboth	An Introduction to Ethics
6. Coopers	Outline of Industrial Law
7. A. Zulfiquar	A Text Book on the Bangladesh Labour Act-2006
8. P. Narayanan	Intellectual Property Law
9. A. R. Khan	Business Ethics

Course Code: CSE2212 **Course Title:** Computer Programming and Electrical Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective: This course concentrates on practical coverage of computer science area. It introduces general application software, tools and computer usage concepts as well as real life problem solving with the help of C/C++ programming language. Besides, this lab provides basic practical understanding about electrical circuits and machine system.

Course content	Teaching-learning strategy	Assessment Strategy
1. Computer programming and its applications to simple problems solution. 2. Writing and running programs for the solution of Engineering and Mathematical problems. 3. Solution of simple problems using C / C++ language. 4. Study series and parallel circuits to understand current voltage relationship in the circuit. 5. Verify thevenin's theorem for a complex linear circuit. 6. Design and construction of transformer.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Reference Books:

Author's Name	Title
1. E. Balagurusamy:	Programming in ANSI C
2. L. Theraza:	Electrical technology (Volume-1&2)

Course Code: CHEM2212 **Course Title:** General Chemistry Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective:

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.

Learning outcomes:

Upon successful completion of this course, students will understand safety, transfer and measurement of chemicals, using physical properties to identify compounds, chemical reactions. Students will gain an understanding of:

1. The planning and implementation of advanced organic reactions
2. Basic chemistry techniques, such as how to calculate percent yields, how to use measuring devices properly
3. Detection of elements in organic compounds
4. Identification of functional groups organic compounds
5. Determination and identification of different metal ions

Course content	Teaching-learning strategy	Assessment Strategy
1. Detection of elements in organic compounds. 2. Identification of functional groups organic compounds. 3. Identification of unknown organic compounds by their physical constants such as m.p. and b.p. 4. Preparation of different organic compounds. 5. Separation, purification and characterisation of organic compounds. 6. Determination and identification of different metal ions (Zn, Cu, Fe, Cr, Mn, Mg,Pb,Al, Mg etc). 7. Separation and estimation of iron and calcium, copper and zinc from their mixtures. 8. Analysis of water and some industrial products.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz/viva-voce and continuous assesment:20% Exam/Design work/Report: 70%

Suggested Reading Lists/Essential Readings

Third Year First semester Examination-2026

Course Code: MSE3111 **Course Title:** Polymeric Materials
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: The course gives a general introduction and concept to polymers. Focus is placed on the classification and systematic of synthetic polymers and biopolymers. This module is designed to provide students with an understanding of both the formation of polymers reaction and specialty polymers.

Intended Learning Objectives (ILOs):

1. The students can demonstrate fundamental materials knowledge including material microstructures, material thermodynamics, material mechanics, and phase transformations.
2. They should gain knowledge of contemporary issues on polymer materials and processing.
3. They will be able to apply critical thinking and problem solving skills in design and diagnosis of materials composition, processing, application, and failure in material scientific researches and industrial applications of materials.

Course Learning Outcome (CLO):

1. gather knowledge on the general introduction and concept of polymers
2. **a.** account for polymer reaction mechanisms during radical, ionic and condensation polymerization
   b. understand the basic information on specialty polymers
3. **a.** use methods for the characterization of polymer and thereby understand the structure and rheology.
   b. know polymer fabrication and analysis techniques.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/ Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2.a.	**2. Polymer Formation Reactions:** Addition polymerisation, condensation polymerisation, coordination polymerisation, ring opening polymerisation, copolymerisation, degree of polymerisation; 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 book(s):

	Authors' Name	Title
1.	V. R. Gowariker, N. V. Viswarathan& J. Sreedhar	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.	Premamoy Ghosh	Polymer Science and Technology of Plastics and Rubber

Course Code: MSE3121 **Course Title:** Glass and Ceramics
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: This course provides an overview of the glass specimens with their composition, structure, properties and relevant characterization techniques. It also deals various manufacturing process of glasses with their home and advanced applications. This course also discuss about 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.

Course Objective (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):

After completing this course the student should be able to:

1. Describe the glass theory, basic properties of glasses and how glass-ceramics are prepared and their applications in different sectors.
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.
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.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1&2	**1. Glass Technology: Glasses:** Definition, structure, composition and constitution, of glasses; Properties of glass: forming methods for glasses, chemical durability, stress release and annealing, glass-metal seals.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2 & 3	**2. Manufacturing and Characterization of Glass:** Raw materials and melting, primary forming operation, finishing operations, manufacturing tolerances and glass design, characterization: by IR, by NMR and by XRD.		
CLO-2 & 3	**3. Application of Glasses:** Glass containers, flat glass and glazing, laboratory glassware and thermometers, glasses in the chemical industry, sight and gage glasses, electric lamps and electron tubes, illumination.		
	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:** History, Definitions: 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. Al_2O_3-Cr_2O_3, MgO-Al_2O_3, ZrO_2-CaO and SiO_2-Al_2O_3 systems, phase composition versus temperature.		
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, characterization: by XRD, IR analysis and Impedance measurement.		
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:

Authors' Name	**Title**
1. E.B. Shand	Glass Engineering Handbook
2. William F. Smith	Foundation of Materials Science & Engineering.
3. William D. Callister	Materials Science & Engineering–An Introduction
4. J.C. Anderson, K.D. Leaver, D. Rawlings & J.M. Alexander	Materials Science
5. Robert B. Leighou	Chemistry of Engineering Materials
6. W.D. Kingery, H.K. Bowen & R. D. Whlmann	Introduction to Ceramics
7. P. William Lee	Ceramics

Course Code: MSE3131 **Course Title:** Composite Materials
Course Credit: 3
Course Teacher(s): Announce to be later
Course Description: 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 introduce.

Intended Learning Objectives (ILOs):
1. The course will help the students to understand the fundamental concepts of composite materials including the types, properties, fabrication and applications of the materials.
2. Students will also learn the design of composite materials and advanced field of nanocomposite.
3. The different bonding mechanism and interfacial chemical reaction of composite will be clearly understood.

Course Learning Outcome (CLO):
After successfully completion, the course the students should be able to:
1. Gain knowledge of general concept of composite materials including the types, properties, fabrication and applications of the materials.
2. Increase knowledge about the metal, polymer, ceramic and carbon matrix composite materials, and nano-composites materials.
3. Understand the design of composite materials, different bonding mechanism and interfacial chemical reaction.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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.		

Suggested Reading Lists/Essential Readings:

	Authors' name	Title
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: MSE3141 **Course Title:** Mechanical Behaviour of Materials

Course Credit: 3

Course Teacher(s): Announce to be later

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

Intended Learning Objectives (ILOs):

The objective of this course is to qualitatively and quantitatively assess the role of dislocations in plastic deformation, and to quantitatively predict creep, fatigue and fracture behavior in materials failure.

Course Learning Outcome (CLO):

On successful completion of this course, students should have the skills and knowledge to:

1. Explain and describe basic concepts and mechanisms of deformation in metallic structural materials
2. Understand the fundamental concepts of stress and strain and the relationship between them.
3. Identify and describe the basic creep, fracture and fatigue mechanisms and apply that knowledge to failure analysis

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/ Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 Properties of Engineering Materials:** Mechanical properties: Elasticity, Plasticity, Toughness, Resilience, Tensile Strength, Ductility, Malleability, Brittleness, Hardness; Stress Strain Relation; 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.		

Suggested Reading Lists/Essential Readings:

Authors' name	Title
1. R. E. Smallman	Modern Physical Metallurgy
2. G. K. Narula, K. S. Narula, V. K Gupta	Materials Science
3. O. P. Khanna	Materials Science and Metallurgy

Course Code: **MSE3151** **Course Title:**Production Metallurgy

Course Credit: 2

Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

1. The course will make the students familiarize with the main isolation and separation techniques of metal ores.
2. Students will also know the key equipment, unit operations and processes to extract metals from their parent ores.
3. The students will understand the theories behind the metal extraction.
4. They will know the techniques to produce important engineering alloys like iron and steel and some non-ferrous alloys.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. Choose optimum techniques to separate a metal from its ore by utilizing basic thermodynamic knowledge of metal separation
2. Select an appropriate way to refine a crude metal
3. a) Produce pig iron in blast furnace and manufacture steel through different techniques
3. b) Produce other engineering non-ferrous metals and alloys

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Unit Operations and Unit Processes:** Isolation and separation techniques, equipment, diagrams and applications. Different types of unit processes.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Sources of Metals and Ore Preparation:** Ore deposits, mining, 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	**3. 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	**4. 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, and recent developments in blast furnace practice.		
CLO-3.a	**5. Steel Making and Alloys of Steels:** Production of steel-cement and crucible steel, Bessemer process, open hearth process, duplex steel making process, plain carbon steels, low-alloy steels, high-alloy steel.		
CLO-3.b	**6. Modern Furnaces of Steel Making: Electric Arc Furnace (EAF):** Introduction, Working Principle of EAF, Construction of EAF, Charged Materials/Raw Materials, Advantages, Disadvantages; **Induction Furnace (IF):** Introduction, Working Principle of IF, Construction of IF, Operation, Use of IF, Charged Materials/Raw Materials, Advantages, Disadvantages; **Ladle Refining Furnace (LRF):** Introduction, Objective of Ladle Refining Furnace, Equipment design & Operation, Desulpherization, Deoxidation, Degasification, Temperature adjustment & Maintain, Homogenization, Removal of Impurities, Alloy adjustment, Inclusion Modification & Cleanliness.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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

Course Code: MSE3112 **Course Title:** Polymer Synthesis and Characterization Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective:

Course content	Teaching-learning strategy	Assessment Strategy
1. Preparation of polystyrene by a free radical polymerization process. 2. Preparation of solid epoxy resin. 3. Determination of epoxide equivalent of the given epoxy resin by the pyridinium chloride method. 4. Preparation of polysulphide rubber (Thiokol). 5. Determination of melting point, storing time and gel time of phenolic resins. 6. Determination of molecular weight of polymer by end group analysis and viscometry. 7. Estimation of number average molecular weight by hydroxyl end group analysis. 8. Identification of different rubbers and plastics. 9. Determination of tensile strength/breaking strength, elongation of synthetic natural fibres, fabrics and composite materials.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Author's Name	Title
1. A.I. Vogel	A Text Book of Quantitative Inorganic Analysis
2. G.D. Cheistain	Analytical Chemistry
3. F.J. Welcher (edited)	Standard Methods of Chemical Analysis
4. G. W. Ewing	Instrumental Methods of Chemical Analysis
5. P. Bahadur & N. V. Sastr	Principles of Polymer Science

Course Code: MSE3122 **Course Title:** Glass and Ceramic Processing Laboratory
Course Credit:2
Course Teacher(s): Announce to be later

Laboratory course Description/objective: 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.

Course content	Teaching-learning strategy	Assessment Strategy
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	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

	Author's Name	Title
1.	E.B. Shand	Glass Engineering Handbook
2.	W.D. Kingery, H.K. Bowen & R. D. Whlmann	Introduction to Ceramics

Course Code: MSE3132 **Course Title:** Mechanical Property Testing Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Laboratory course Description/objective:

Course content	Teaching-learning strategy	Assessment Strategy
1. Determination of tensile and 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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quizzes, viva-voce and continuous assessment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Third Year Second Semester Examination, 2026

Course Code: MSE3211 **Course Title:** Physical Metallurgy of Iron and Steels
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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 discuss in detail.

Course Objective (Intended Learning Objectives, ILOs):

1. The course will help the students to understand the fundamental concepts of steel, tool steel, stainless steel, and their different types of identification methods.
2. Students will also 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. The course will improve the student's capability of metallurgy of mechanical working process.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. Gain knowledge of steel, tool steels, and stainless steels with their allowing elements and identification methods.
2. Understand heat treatment processes used in the steel industry and know transformations with time-temperature-transformation diagrams.
3. Apply various mechanical working processes used in steel industry.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1.	**1. Steel and Tool Steels:** Introduction, Alloy steel, Effect of alloying elements, Nickel, Chromium Nickel-Chromium, Manganese, Molybdenum, Tungsten and Silicon steel, Tool steels; Classification of tool steel, Properties of different tool steel, Cast Iron: Type of cast iron, White cast iron, Malleable cast iron, Gray cast iron, Alloy cast iron.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1.	**2. Stainless Steel:** Introduction, Martesitic, Ferritic and Austenitic stainless steel, Ni and Cr equivalent, Schaeffler diagram of Stainless steel and Supperalloys.		
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, carburising, pack carburizing, gas carburizing, liquid carburizing, steel for carburizing, applications of carburizing, cyaniding, nitriding, carbonitriding, induction hardening and flame hardening.		
CLO-3	**6. Metallurgy of Mechanical Working:** Introduction, principle of hot and cold working, effects of hot and cold working on properties; others working processes: rolling, forging, extrusion, spinning, drawing, stamping, machining, welding and casting.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
1. R.E. Smallman:	Modern Physical Metallurgy
2. Sidney H. Avner:	Introduction to Physical Metallurgy
3. Robert B. Leighou:	Chemistry of Engineering Materials
4. Rajendra 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. Donald S. Clark and Wilber R. Varney:	Physical Metallurgy for Engineers
8. V. K. Manchanda and G. B. S. Narang:	Materials and Metallurgy

Course Code: MSE3221 **Course Title:** Materials Manufacturing Engineering
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: Materials become more valuable when they are make into products. The first part of this course focuses on the fundamental of metal casting, forming and shaping process of plastics, composite, ceramics and glass materials. Later chapters include fundamental of machining, micro-manufacturing and fabrication of microelectronics device, computer-aided manufacturing and computer-integrated manufacturing systems.

Course Objective (Intended Learning Objectives, ILOs):

1. The students will be able to know the basic of materials manufacturing process
2. The students will be able to know the metals casting processes together with typical applications, advantages, and limitation
3. The students will understand the materials-removal process and machining, and computer-integrated manufacturing system.

Course Learning Outcome (CLO):

After successfully completion, the course the students should be able to:
1. Understand the fundamentals of materials manufacturing.
2. Learn the metals casting and continuous casting machine.
3. Understand the materials removal process and fundamental of machining operations as cutting-tool materials and cutting fluids and fabrication of microelectronics devices.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. General Introduction:** Concept of Manufacturing, Product Design and Concurrent Engineering, Design for Manufacture, Assembly, Disassembly, and Service; Green Design and Manufacturing, Selection of Manufacturing Processes, Quality Assurance and Total Quality Management, Lean Production and Agile Manufacturing	Lecture Exercise/ Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz: 20% Exam: 70%
CLO-2	**2. Metal-Casting Processes and Equipment's:** Introduction, 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-2	**3. Continuous Casting Machine (CCM):** Introduction to continuous casting, Objective, 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, Application.		
CLO-3	**4. Material-Removal Processes and Machines:** Fundamentals of cutting, cutting-tool materials and cutting fluids, machining process for producing round shapes, machining process for producing various shapes, non-traditional machining processes.		
CLO-3	**5. Fabrication of Microelectronic Devices:** Introduction, semiconductor and silicon, crystal growing and wafer preparation, film deposition, oxidation, lithography, etching, diffusion and ion implantation, metallization and testing, bonding and packaging, reliability and yield, printed circuit board.		
CLO-3	**6. Computer-Integrated Manufacturing System:** Computer-Integrated Manufacturing System: Introduction, manufacturing systems, computer-integrated manufacturing, computer-aided design and engineering(CAD), computer-aided manufacturing(CAM), computer-aided process planning, 3D modelling, Printing and computer simulation of manufacturing process and systems, group technology, cellular manufacturing, flexible manufacturing systems, just-in-time production, artificial intelligence, factory of the future.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
1. Kalpakjian	Manufacturing Engineering and Technology
2. B. W. Niebel, A. B. Draper, R. A. Wysk	Modern Manufacturing Process Engineering
3. P. N. Rao	Manufacturing Technology
4. Rajiv Asthana, Ashok Kumar, Nerendra Dahotre	Materials Processing and Manufacturing Science
5. Peter Beeley	Foundry Technology
6. W. R. Irving	Continuous Casting of Steel

Course Code: **MSE3231** **Course Title:** Corrosion Engineering
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: At least to some extent most materials experience some kind of interaction with their diverse surrounding environment causing deterioration with time. Prior design, a materials engineer needs to know such type 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.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will help the students to understand the basic principle and theoretical background of different forms of corrosion.
2. Students will learn different preventive, protective and monitoring measures against corrosion.
3. The course will enrich the students' capability to protect machineries effectively from the risk of corrosion in industrial arena.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. Utilize their basic electrochemical knowledge to understand corrosion
2. Measure the rate of corrosion
3. a) Identify and detect the type of corrosion
3. b) Design a device or system to protect a structure from corrosion

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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. 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-3.a	**4. Corrosion Forms and Corrosion Under Special Conditions:** Galvanic corrosion, crevice corrosion, pitting, inter-granular corrosion, selective leaching, erosion corrosion, stress corrosion, corrosion fatigue, fretting corrosion, hydrogen damage, atmospheric corrosion and underground corrosion.		
CLO-3.b	**5. Corrosion Prevention:** Materials selection; alteration of environment, design, cathodic and anodic protection, inhibitors and passivators, metallic coatings, inorganic coatings, organic coatings.		
CLO-3.a,&b	**6. Corrosion in Industries:** High Temperature Corrosion, Corrosion in boiler plants, gas-turbine blades, chemical industries, petroleum, building and fertilizer industries.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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: MSE3241 **Course Title:** Electrochemical Engineering
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: 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 electro chemical phenomenon. Prior design, a materials engineer needs to know such type of interaction either to avoid or to minimize deterioration. First three chapters of this course will introduce different types of thermodynamical, electrode kinetics and electrochemical phenomenon of various electrochemical cells. The fundamental of electrodeposition, electrode and cell design for industrial uses, and electroplating of various metals and its alloys will be studied in chapter four, five and six respectively.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will be give some special electro chemical phenomenon of electrodes and electrochemical cells.
2. Students will learn about the thermodynamic and kinetics of electrode reaction.
3.The course will enrich theatrical knowledge about different electrodeposition process.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. Utilize their knowledge of natural science to understand the thermodynamics and kinetics of electrochemical cell.
2. Get advanced knowledge about the electrodeposition of metals and alloys.
3. Batch calculation and electroplating
4. Application of theoretical knowledge to about protect and beatify of several of materials especially metals.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Electrode Processes:** Electrochemical cells and reactions, faradaic and nonfaradaic processes, mass-transfer-controlled reactions, Nernstian reactions.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 behaviour, 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.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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 (edited)	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: MSE3251 **Course Title:** Optics and Optical Properties of Materials
Course Credit:2
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

In this engineering course, graduates will learn about the interactions of light with materials and the properties of optical materials.

Course Learning Outcome (CLO):

At the end of this course, the student should be able to:
1. This course intended to develop an understanding of the basic fundamental theory of optics of materials.
2. Identify the suitability of using the optical principle of materials under different conditions.
3. Understand the different forms of optical properties.
4. Learn about the classification of optical materials and; optical fibers.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Interference of light in a material:** Principles of interference, coherent source, phase and path differences, Fresnel's bi-prism, determination of thickness of thin films, interference in thin films, color of thin films and Newton's ring method,	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. 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, dispersive power of grating, resolving power.		
CLO-1&2	**3. Polarization of light:** Principles of polarization, polarization of transverse wave, plane of polarization, Polarization by reflection, Brewster's law, Nicholson prism analyzer,		
CLO-3	**4. Optical Properties:** Refractive index, Dispersion, Reflectance, Transmittance, Characteristic Penetration depth, Absorbance, Snell's law and total internal reflection, Luminescence, Phosphors, Optical anisotropy.		
CLO-4	**5. Optical Materials:** Classification of optical materials, Crystalline insulators		

	and semiconductors, Optical glasses, Metals, Doped glasses and insulators, Optical fibers,		

Recommended book(s):

Authors' Name	Title
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. Rolf E. Hummel:	Electronic Properties of Materials.

Course Code: MSE3212 **Course Title:** Electrochemical and Corrosion Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

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

Course content	Teaching-learning strategy	Assessment Strategy
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. 4. Determination of corrosion rates of carbon steels, galvanised steel, aluminium and nickel in various aggressive media. 5. Measurement of corrosion rates of base metals galvanically couples with different area ratios of the noble metals. 6. Microstructural study of some corroded specimen	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Author's Name	Title
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: MSE3222 **Course Title:** Computer Aided Engineering Drawing and Designing Laboratory

Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This course offers computer-aided design (CAD) and drawing. Students will get hands-on experiences about CAD software to create precision design and drawing of two-dimensional (2D) and three-dimensional (3-D) models.

Course content	Teaching-learning strategy	Assessment Strategy
1. Computer Aided Drawing (CAD): Use of interactive menu driven software for preparation of line drawing, graphic co-ordinate system; Commands for draw, erase, move, rotate, mirror, hatch, etc.; Blocks and layer, dimension drawing size, saving, editing and plotting 2. Drawing three dimensional objects. 3. Drawing three dimensional objects.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

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

Fourth Year First Semester Examination, 2027

Course Code: MSE4111 **Course Title:** Advanced Methods of Materials Characterization
Course Credit: 3
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

The course is introduced to help the students understanding of the basic principles and theoretical background of different materials characterization, their instruments and characterization techniques.

Course Learning Outcome (CLO):

1. Exploit their basic knowledge to understand the methods of surface study, Principle of various light microscope, surface treatment process followed by morphological analysis, Comparison of optical microscope with other conventional microscope.
2. Principle, Instrumentation, Applications, Advantages and Disadvantages, Sample preparation and their Modification of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM).
3. Explain different methods used to characterize materials and the basic operation of the equipment.
4. Basic operation of method and Practical aspect of the thermo gravimetric analysis of differential thermal analysis.
5. Characterizations of Magnetic Materials and Superconducting Device.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Metallurgical Microscopy**: Introduction to Optical 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 Microscope, Surface treatment process followed by Morphological Analysis.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Scanning Electron Microscopy (SEM):** Introduction, 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.		

CLO-2	**3. Transmission Electron Microscopy (TEM):** Introduction, 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, Sample Preparation and their Modification.		
CLO-3	**4. Atomic Force Microscopy (AFM):** Introduction, Principle of operation, Atomic force imaging, Biological molecules, Nanoscale surface forces, Non-Contact imaging.		
CLO-3	**5. Scanning Tunnelling Microscopy (STM):** Introduction, Principles of STM, Practical aspect of STM, Methods of automation, data analysis, sample preparation.		
CLO-4	**6. DTA and TGA:** Introduction to thermal analysis, differential thermal analysis: introduction, principles of method, Practical aspect of the method, data analysis, sample preparation, thermogravimetric analysis (TGA): Introduction, 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 book(s):

1. P.F. Kane Characterization of Solid Surfaces
2. Yang Leng Materials Characterization

Course Code: MSE4121 **Course Title:** Plastic and Rubber Technology
Course Credit:3
Course Teacher: Announce to be later

Course Description: This course clarify, inform and explain each aspect of plastic and rubber technology. This course are 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 dealing with plastic processing operation 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.

Course Objective (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):

After successfully completion the course the students should be able to:
1. Explain the concepts of plastics and rubber materials
2. (a) Preparations of raw materials for processing and manufacturing of plastics and rubber products
2. (b) To learn about finishing and machining of plastic and rubber products manufacturing
3. To understand about identification, testing and quality analysis of plastics and rubber materials.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Plastic Materials, Properties and Applications:** Introduction to plastic technology, Classification of plastic, Copolymer of ethylene, Polyethylene and Polypropylene, Polyethylene Terephthalate, Polyvinyl chloride (PVC), Polyamide (PA)/ Nylon, Polytetrafluoroethylene (PTFE), Polystyrene, Additives for plastic compounding, Ployurathanes, Polycarbonates, Epoxy resin, Phenolic resin, Cellulose plastic,	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
	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.		
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. Introduction to Rubbers:** Natural rubber, synthetic rubbers, thermoplastic elastomers (TPE), rubber compounding and processing technology, sulphurvulcanisation, non-sulphurvulcanisation, 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. Identification and 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 trasition, Rehology of polymers, polymer powder and coatings, X-ray Diffraction, Raman Spectroscopy and Microscopy of polymers.		

Recommended book(s):

Authors' name	Title
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.Premamoy Ghosh	Polymer Science and Technology of Plastic and Rubbers

Course Code: MSE4131 **Course Title:** Magnetic and Dielectric Materials
Course Credit:3
Course Teacher: Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

1. Introduce basic principles of dielectric and magnetic properties of solids
2. Familiarize students with magnetic disc data storage principles and technology
3. Discuss dielectrics in DC and AC fields.

Course Learning Outcome (CLO):

Upon completion of the course, the successful student:
1. Develops understanding of the fundamentals of polarizable solids, ferroelectricity, and magnetism.
2. Is able to relate this to the functioning of device that exploit these properties.
3. Understand how these properties may be used in device design.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1 & 2	**1. Diamagnetic & Paramagnetic Materials:** Introduction to Magnetic Materials, Magnetic Dipoles, Types of Magnetic Materials, Origin of Magnetism, Classical & Quantum Theory of Diamagnetism, Diamagnetic Substances, Classical & Quantum Theory of Paramagnetism, Paramagnetism for Free Electrons, Hunds Rules, Crystal Field Splitting, Curie law, Paramagnetic Substances.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 & 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 Behaviour.		
CLO-1	**4. Matter Polarization and Polarization Mechanism:** Dipole Moment and Electronic Polarization, Local Field and Clausius-Mossotti Equation, Ionic, Orientation and Interfacial Polarization.		
CLO-1 & 3	**5. Frequency Dependent Dielectric Constant and Dielectric 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. Capacitor Dielectric Materials and Piezoelectricity, Ferroelectricity, and Pyroelectricity:** Typical Capacitor Constructions, Dielectrics: Comparison, Piezoelectricity, Piezoelectricity: Quartz Oscillators and Filters, Ferroelectric, and Pyroelectric Crystals.		

Recommended book(s):

Authors' Name	**Title**
1.S. O. Kasap	Principles of Optical Materials and Devices
2.S. O Pillai	Solid State Physics
3. Dekkar, AJ	Solid State Physics
4. Kittle, C	Introduction to Solid State Physics
5. Omar, MA	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: MSE4141 Course Title: Waste Management, Industrial Safety and Environmental Issues
Course Credit:3
Course Teacher: Announce to be later

Course Description: This course explains the concepts and strategies related to industrial waste treatment, hazardous waste management and recycling of various wastes materials. The purpose behind this course is also to make the students familiar with the concepts of wastewater characterization, treatment and disposal. Also, focus on the sources, causes, and different effects of air, water and soil pollution. The aim is also to give deeper knowledge of industrial hazards, risk analysis and control of industrial hazards. Finally, explains the concepts and strategies related to environmental management, sustainable development and various environmental systems.

Course Objective (Intended Learning Objectives, ILOs):

1. The course will help the students to understand the fundamental concepts of industrial waste treatment, hazardous waste management and recycling of various wastes materials.
2. Students will also learn the wastewater characterization, treatment and disposal.
3. The sources, causes, and different effects of air, water, and soil pollution will be clearly understood.
4. The course will improve the student's capability of industrial hazards, risk analysis and control of industrial hazards.

Course Learning Outcome (CLO):

1. (a) Explain the concepts behind industrial wastes characterization, treatment and disposal and environmental issues.
1. (b) Identify the sources of solid and hazardous wastes and manage them.
2. Identify the methods for recycling, recovery and reuse of the materials considered to be waste.
3. (a) Understand sources, causes and effects of air and water pollution.
3. (b) Analyze different industrial hazards, risk analysis and control of industrial hazards.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1 (a)	**1. Wastes and Treatment Process:** Waste sources, types and characteristics, Principles of industrial waste treatment, General methods of treatment, Preliminary, primary, secondary and tertiary treatment of industrial wastes, Treatment of wastes or effluents with organic and inorganic impurities, Suspended solids removal, Ultimate disposal.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1(b)	**2. Hazardous Waste Management:** Origin and amounts of hazardous wastes, Types of hazardous wastes, Biomedical wastes, Hazardous wastes in the geosphere, hydrosphere, atmosphere and biosphere, Management of hazardous wastes, Off side hazardous waste disposal, Co-disposal; Security landfill, characteristics of solid waste, Methods of		

	solid waste treatment, Microbiology involved in solid waste disposal, Radioactive waste disposal, Converting radio waste into solid form and its management, Hazardous substances and health.		
CLO-2	**3. Recycling of Wastes:** Construction materials from waste; Utilization of agricultural wastes; Urban wastes and bagasse for electricity; Biomass into rural power; Recycling of metal, glass, concrete, plastic and rubber; Acacia, partied board and silica from rice husk; Jute wastes into paper and board plastic for heat and electricity generation; Paints from potatoes; Wealth from flyash; Converting garbage into fuel, fertilizers and power.		
CLO-1 (a)	**4. Current Industrial Environmental Status:** Concept of threshold limit values, sampling procedure, formulation of guidelines and discharge standards of various industries, permit systems for discharge/emissions, environmental management plan (EMP), objectives and components of EMP, matrix of EMP and its implementation, pollution control laws and acts, case studies with few chemical industries.		
CLO-3 (a)	**5. Air Pollution and remedies:** Definition, Sources of air pollution, Major air pollutant and their effects. Impacts of air pollution, Depletion of the ozone layer and its implications, Ozone depleting substances (ODS) and their substitutes, Montreal Protocol and its amendments, Greenhouse effect.		
CLO-3 (a)	**6. Water pollution and wastewater treatment:** Definition, Water resources, Hydrologic cycle, Sources of water pollution, Major water pollutant, their sources and effects; Wastewater treatment, Primary treatment, Secondary treatment, Tertiary treatment.		

CLO-3 (b)	**7. Industrial Hazards and Risk Analysis:** Types of industrial hazards, Fire hazards, Mechanical hazards, Electrical hazards, Chemical hazards, Pharmaceutical hazards, Radiation hazards, Dust explosion. Industrial pollutants in the environment, Industrial safety, Safety symbols, Importance of Industrial safety.		
CLO-3 (b)	**8. Control of Industrial Hazards:** Industrial plant layout, Ventilation and lighting, safe storage handling and transportation, Electrical systems, Personal protective devices, First Aid, Laboratory safety, Emergency procedure and mutual aid.		

Recommended book(s):

Authors' name	**Title**
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 and H. Kaur	Environmental Chemistry
5.T. Sawyer and 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 and Eddy	Wastewater Engineering

Course Code: MSE4151 **Course Title:** Surface Science and Engineering
Course Credit:2
Course Teacher: Announce to be later

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

Course Objective (Intended Learning Objectives, ILOs):

This course is 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):

1. Explain the fundamentals of surface engineering
2. Identify the surface modification of components using suitable surface-active agents.
3. Illustrate principle and evaluation of surface tribology such as friction, Wear and lubrication
4. Select the suitable coating technique for surface treatment.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	1. **Surface Phenomena:** Sorption, films of insoluble substances, adsorption by solids from solutions, electro kinetic potential.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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.		
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 book(s):

Authors' name	**Title**
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: MSE4112 **Course Title:** Metallurgical Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This lab. course is designed to demonstrate knowledge of metallurgical analyses of metal and alloy (cast iron, different types of steel and stainless steel, brass, bronze) by using Volumetric and spectrophotometric techniques. Analyses of available ores, slags and scraps.

Course content	Teaching-learning strategy	Assessment Strategy
1. Analysis of percentage of copper in Brass by spectrophotometric analysis. **2.** Estimation of percentage of manganese from steel by volumetric analysis. **3.** Determination of Lead in Brass by Gravimetric analysis. **4.** Estimation of percentage of calcium from eggshell by spectroscopic method. **5.** Volumetric, spectrophotometric, atomic absorption spectrophotometric and flame photometric techniques in metallurgical analyses. **6.** Analyses of commercially available cast iron, different types of steel and stainless steel, different types of bronze (gun-metal, phosphor bronze, Al bronze, Mn bronze), nickel silver, solder and silver alloy. **7.** Analyses of available ores, slags and scraps. **8.** Analyses of galvanized steel for zinc per unit surface area and determination of layer thickness.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Authors Name	**Title**
A.I. Vogel	A Text-book of Quantitative Inorganic Analysis by

Course Code: MSE4122 **Course Title:** Polymer Processing Laboratory

Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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.

Course content	Teaching-learning strategy	Assessment Strategy
1. Determination of physical and thermal properties of polymeric materials. **2.** Study of microstructure of polymeric materials. **3.** Preparation and processing of synthetic polymers. **4.** Casting of self-supporting polymer films. **5.** Synthesis of phenol-formaldehyde resins. **6.** Synthesis of vinyl polymers. **7.** Synthesis of nylon, polyesters, PP and PS. **8.** Analysis and estimation of cellulose, hemicellulose and lignin in a sample of jute fibre, wood and baggage.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Course Code: MSE4132 **Course Title:** Electronic Materials Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This course grows base parameters of the basic solid material types and their relationships to electrical, thermal, mechanical, and optical properties. In this course, students will gain hands-on experiences about semiconductors, magnetic and dielectric materials and their characteristics properties. Students will gain in depth practical knowledge to understand and develop the materials system with future trend.

Course content	Teaching-learning strategy	Assessment Strategy
1. Fabrication of semiconducting, and dielectric bulk, and thin film materials. 2. Study the capacitive properties of dielectric materials. 3. Study the temperature dependent conductivity of semiconducting thin film materials. 4. Study I-V characteristic of a p-n junction. 5. Study two and four probe measurement techniques for a high conducting thin film. 6. Study I-V characteristics of metal/ semiconductor junction to access built-in potential, and barrier height of the junction. 7. Study C-V characteristic of metal/semiconductor junction to access built-in potential, and charge carrier distribution in semiconductor.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

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Course Code: MSE4211 **Course Title:** Nano- and Biomaterials
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description:
This course actually deals of two different types of materials, one is nanomaterials and the other is biomaterials. These two classes of material are used in cutting edge research of materials science. This course will serve an introductory knowledge for these two special types of materials to the students.

Course Objective (Intended Learning Objectives, ILOs):

1. This course will help the students to critically evaluate the promise of nano-materials 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 surfaces of biomaterials
4. They can choose material for desired biological response.

Course Learning Outcome of Section A (CLO):

After successfully completion this section of the course the students should be able to:
1. Understand fundamental knowledge of nanomaterials and thereby recognize why and how physico-chemical properties of nanomaterials are different than their bulk counterpart
2. Fabricate nanostructures
3. a. Demonstrate an understanding of approaches to nanomaterials characterization.
3. b Figure out different applications of nanomaterials.

Course Learning Outcome of Section B (CLO):

After successfully completion, this section of the course the students should be able to:
1. Understand scientific vocabulary related to biomaterials other than layman language
2. Design, synthesis and fabrication strategy to generate new biomaterials to correct any functional disorder
3. Learn proteins and cells interactions with various biomaterials and thereby host responses to implants, including toxicity and health implications.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Nanomaterials:** Introduction, Carbon Fullerenes and Nanotubes, Micro and Mesoporous materials, Care-Shell Structures, Organic & Inorganic Hybrids, Intercalation compounds, Nano composites and Nano-grained materials.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2	**2. Nanostructures Fabricated by physical technique:** Lithography, Nanomanipulation and nanolithography, Soft lithography, Assembly of Nanopartices and Nanowires.		
CLO-3.a	**3. Characterization and properties of nanomaterials:** Structural characterization, Chemical Characterization, Physical Properties of nanomaterials.		
CLO-3.b	**4. Applications of Nanomaterials:** Introduction, Molecular electronics &		

	nanoelectronics, Nanobots, Biological applications of nanoparticles, Catalysis by Gold nanoparticles, Quantum well and Quantum dot devices, Nanomechanics, carbon nanotube emitters, photo electrochemical cells, photonic crystals and Plasmon waveguides.		
CLO-4	**5. 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	**6. 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 bioceramics, bio-inert, bio-reactive and bio-resorbable ceramics, degradation of materials in biological environment and its effect.		
CLO-6	**7. 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.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
1. Guozhong Cao:	Nanostructures and Nanomaterials synthesis, Properties & Applications
2. S.Bhat:	Introduction to Biomaterials

Course Code: MSE4221 **Course Title:** Spectroscopic Analysis of Materials
Course Credit: 3
Course Teacher(s): Announce to be later

Course Description: Materials characterization is a very important to tailor new and/or improve the properties of materials. Therefore, a materials engineer should have sound knowledge about different characterization technique. 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.

Objective (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):

After successfully completion the course the students should be able to:
1. Utilize their knowledge of natural science to understand basic principle of different spectroscopic method.
2. Identify the phase and internal structure of different types of materials.
3. Get information about the vibrational properties of materials.
4. Determine the chemical composition of different types of materials.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 75 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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, IRand NMR 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.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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, R. Peat, L.M. Peter, D. Pletcher & J. Robinson	Instrumental Methods in Electrochemistry

Course Code: MSE4231 **Course Title:** Welding and Joining Technology
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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.

Course Objective (Intended Learning Objectives, ILOs):

At the end of the course, students should have 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):

At the end of this course the student should be able to:
1. This course is intended to develop an understanding of the fundamental of welding and joining process.
2. Identify the evaluate of the suitability of using different welding and cutting process.
3. Illustrate principle and evaluation of using electricity and heat treatment considerations in different welding and cutting process.
4. This course is intended to develop an understanding of the fundamental of joining and bonding processes in materials.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Introduction:** 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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-1	**2. Gas Flame Processes in welding, cutting and Straightening:** Definition and classification of welding, Oxyfuel gas welding, definition and classification of cutting, 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 and cutting, power sources for arc welding, metallurgical and heat considerations in thermal cutting.		
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.		

Suggested Reading Lists/Essential Readings

Author's Name **Title**

1. E.Paul De Garmo, J.T. BlacRonald, A. Kohser — Materials and Processes in Manufacturing

Course Code: MSE4241 **Course Title:** Engineering Materials
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: 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, airframe, automobile structure, engines and power generation. This course will also familiarize the students with the properties of metal, ceramic, polymer and composite of engineering materials and methods to protect materials and alter their properties.

Course Objective (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):

Upon completion of this course the student will be able to:
1. Acquire knowledge on electrochemical, mechanical and physical properties of engineering materials to design engineering structures and devices.
2. Select appropriate materials for various engineering applications.
3. Identify characteristic properties of engineering materials made of alloys, metals, ceramics composites and polymers and how these can be changed.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Introduction to Engineering Materials:** The selection strategy, motivation for selection, deriving property limits and material indices, material index examples, materials selection case studies.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
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 Ship for Structures:** The ship girder, factors influencing materials selection for ship hulls, materials of construction.		
CLO-2 & 3	**4. Materials for Air Frame:** Principle 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, aluminium and its alloys, corrosion damage to automobiles, surface treatment of steel for car bodies, future trend in body construction and materials, Exhaust systems.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
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, J A Charles and J Furness	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: MSE4251 **Course Title:** Fibre Technology
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description:
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.

Course Objective (Intended Learning Objectives, ILOs):

1. The course will help the students to understand the fundamental concepts, structure, properties and applications of fibres.
2. Students will also learn the different production methods of natural, regenerated and synthetic fibers.
3. The course will improve the student's capability of more common technical fibers with their properties and applications.

Course Learning Outcome (CLO):

After successfully completion the course the students should be able to:
1. Gain knowledge of fundamental concept of different types of fibers, their structure and properties.
2. (a) Describe and recognize plants and animals which are able to provide fibers.
2. (b) Understand the different types of regenerated fiber that origin is natural materials.
3. Recognize different synthetic fibre, their fabrication, properties and end uses.

Learning Outcomes	Course content	Teaching-learning strategy	Assessment Strategy
CLO-1	**1. Structure and Properties of Fibres:** Fundamental concepts, classification, orientation and crystallinity of polymers, requirements of fibre-forming polymers, properties of fibres.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Tutorial/Quiz:20% Exam: 70%
CLO-2. (a)	**2. Cellulosic and Protein Fibres:** Cellulosic fibres: seed fibres- cotton, coir; bastfibres- jute, flax, hemp, ramine; leaf fibres- sisal, manilla, abaca; Other polysaccharide fibres- alginate fibres, chitin and chitosan fibres; protein fibres: wool fibres, silk fibres.		
CLO-2. (b)	**3. Regenerated Fibres:** Regenerated cellulose fibres, viscous, cuprammoniumrayons, regenerated protein fibres		
CLO-3	**4. Synthetic Fibres:** Processing of synthetic fibres, polyamide fibres, polyester fibres, acrylic and modacrylicfibres, polyolefin fibres, elastomeric fibres.		
CLO-3	**5. High performance fibres:** Introduction, aramid fibres, aromatic polyester fibres, polybenzimidazolefibres, fluoropolymer		

	fibres, carbon fibres, thermoset polymer fibres, ceramic fibers.		
CLO-3	**6. Other Speciality Fibres**: Nanofibers, electrically conducting fibres, optical fibres, luminescent fibres, biodegradable fibres.		

Suggested Reading Lists/Essential Readings

Author's Name	**Title**
1. R. W. Monchieff	Man–Made Fibres
2. Robert R mather and Roger 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 and L. D. Vilensky	Textile Science

Course Code: MSE4212 **Course Title:** Welding and Joining Laboratory
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description:

Course content	Teaching-learning strategy	Assessment Strategy
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.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

Course Code: MSE4222 **Course Title:** Computer Aided Engineering Drawing and Designing Laboratory

Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This course offers computer-aided design (CAD) and drawing. Students will get hands-on experiences about CAD software to create precision design and drawing of two-dimensional (2D) and three-dimensional (3-D) models.

Course content	Teaching-learning strategy	Assessment Strategy
4. Computer Aided Drawing (CAD): Use of interactive menu driven software for preparation of line drawing, graphic co-ordinate system; Commands for draw, erase, move, rotate, mirror, hatch, etc.; Blocks and layer, dimension drawing size, saving, editing and plotting 5. Drawing three dimensional objects. 6. Drawing three dimensional objects.	Lecture Exercise/Tutorial/ quiz Attendance	Full Marks: 50 Attendance:10% Quiz, viva-voce and continuous assesment:30% Exam/Design work/Report: 60%

Suggested Reading Lists/Essential Readings

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

Course Code: MSE 4222 **Course Title:** Industrial Training/ Project/Study tour / Field work
Course Credit: 2
Course Teacher(s): Announce to be later

Course Description: This project is introduced to make the students familiarize with the actual industrial environments and what they may need to do in an industry and also to make them realize how a material being produce in an industry.

Teaching-learning strategy	Assessment Strategy
Lecture/Industrial tour/training/attachment/ Exercise/Tutorial/ quiz Attendance	Full marks 50 Internal examiner/supervisor 30% External examiner (any teacher from the panel of examiners) 30% Presentation and oral examination 40%

Course Code: MSE4232 **Course Title:** Research Project (Laboratory)
Course Credit: 2
Full marks:50

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