SEMESTER II						
Course Code	Course Tittle	L	T	P	C	PRE
Theory						
Ch 1227	Organic Chemistry	3	0	0	3	
Hum 1227	Technical English	3	0	0	3	
Math 1227	Differential Equation and Transform Analysis	3	0	0	3	
ME 1227	Engineering Mechanics	4	0	0	4	
Ph 1227	Magnetism and Nuclear Physics	3	0	0	3	
Sessional						
Ch 1228	Sessional on Organic Chemistry	0	0	3/2	0.75	
Hum 1228	Sessional on Technical English	0	0	3/2	0.75	
ME 1220	Engineering Drawing Sessional-I	0	0	3	1.5	
Ph 1228	Sessional on Magnetism and Nuclear Physics	0	0	3	1.5	
	Total					20.5

Distribution of Marks

i. Theory Courses:

Class participation, attendance and assignments	10 %
Class tests, Quizzes, Spot tests etc.	20%
Term Final Examination	70%
Total	100%

N.B. Students fail to attend 60% of the class will not allow to sit in the final exam in any circumstance.

ii. Independent laboratory/design/field work courses:

Class participation and attendance	10 %
Quizzes, Viva-Voce conducted in lab class	20%
Viva-Voce conducted centrally	20%
Performance and reports	50%
Total	100%

iii. Project/thesis (Continued for two terms):

a) *At the end of 4th year 1st Term*: 30% of the total marks to be evaluated as follows:

Presentation and (Viva-Voce conducted by a Viva-Voce committee)	10%
Supervisor	20%
Total	30%

b) *At the end of 4th year 2nd Term*: 70% of the total marks to be evaluated as follows:

Presentation and Viva-Voce (conducted by a Viva-Voce committee)	20%
Supervisor	40%
External examiner (any other teacher of the department/ a member of examination committee	10%
Total	70%

Materials Science and Engineering
Khulna University of Engineering and Technology
Khulna-9203, Bangladesh

1st Year, Term-2

Ch 1227 Organic Chemistry

Credits: 3

Referred textbooks:

- "Organic Chemistry" by I. L. Finar
- "A Guide book to Mechanism in Organic Chemistry" by Peter Sykes
- "Organic Chemistry" by Clayden, Greeves, Warren and Wothers
- "Organic Chemistry" by McMurry
- "Organic Chemistry" by David R. Klein
- “Organic Chemistry” by Morrison and Boyd

Course description:

Organic chemistry is evolving as an essential part of materials science. Firstly, organic chemistry provides materials with complex functionality. Secondly, the bridge between materials science and biology/medicine is made by organic chemistry, by building an interface between biological systems and an electronic or optical system requires close attention to the molecular level of that interface. Finally, it allows materials scientist to synthesis advanced nanomaterials, polymers, organic molecules, 3-D printing and sophisticated medical transplantation.

Topic covers:

Structure and Bonding: Atomic orbitals, Hybridization, Sigma and Pi-Bonding, Delocalization and Resonance, Molecular shape, Nomenclature of organic compounds (aliphatic and aromatic), Isomers, Electronegativity, bond order, Effect of bond order on bond length and bond strength.

Organic reactions and their mechanism: Nucleophilic and Electrophilic substitution reactions and their kinetics, steric hindrance and stereochemistry, Structure of carbon cations, Role of solvent in SN1 and SN2 reactions, E1 and E2 reactions.

Aromatic Compounds: Nomenclature of aromatic compounds, Benzene and aromacity, Unusual stability of benzene, Modern theories of the structure of benzene, Aromatic compounds (Phenol, aniline, pyrrole).

Polymers: Macromolecules & polymers, Classification of polymers, Molecular Weight, Degree of polymerization, Tactility, Thermoplastic and Thermosetting, Chain-Growth Polymers, Types and mechanism of polymerization, Addition polymerization (Free Radical, cationic and anionic), Condensation and Copolymerization, Coordination polymerization, Conducting polymers.

Biomolecules: Structure and reaction of cellulose, Structure of amino acids, peptide linkage, structure of proteins.

Spectroscopic Techniques: Fundamentals of spectroscopy, UV-vis spectroscopy, FTIR spectroscopy.

Module learning outcomes:

After successful completion of the subject, students should learn about

1. Know and recall the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism.
2. Different types of bonding in organic molecules and organic chemistry, e.g. covalent bond, sigma and pi bond, hydrogen bond, van der wales force etc.;
3. Name the functional groups and different class of organic compounds;
4. Recognize the basic practical skills for the synthesis and analysis of organic compounds;
5. Hybridization concepts and bond angle in hybrid molecules;

6. Identification of polymeric materials and their classification.
7. Gain the clear about the functional groups and their reaction mechanism based on the functional group characteristics.
8. Use the concepts nucleophile and electrophile in order to explain the reactivity and the role of reactants in a chemical reaction;
9. Explain and visualize the stereochemical (and eventual regiochemical) outcome for some common and important organic reactions as SN2, E2, SN1, E1, addition of electrophiles to alkenes and some additions of nucleophiles to a number of representative carbonyl compounds;
10. Insight into the knowledge of biomaterials relating to organic chemicals and compounds.
11. Comprehensive demonstration of Mass Spectrometry, Infrared Spectroscopy, and Ultraviolet Spectroscopy.

Hum 1227 Technical English

Credits: **3**

Referred textbooks:

- ''Oxford Handbook of Commercial Correspondence'' by A. Ashley
- ''A Practical English Grammar'' by J. Thomson & A. V. Martinet
- ''Complete Course in English'' by Robert J. Dixson
- ''Essentials of Business Communications'' by Rajendra Pal & J. S. Korlahalli
- ''Technical Writing by John'' M. Lennon
- ''Writing Scientific English'' by J. Swales

Course description:

Learning English as a second language is always fascinating. Most of the Engineering books, journal articles are usually written in English. Thus, learning this language is not only stimulating but also rewarding to gain specific knowledge in engineering subjects. This undergraduate course will deal with English phonetics, Vocabulary, English grammar, construction of sentences, some grammatical problems, Comprehension, Paragraph writing, Amplification, Report writing, Commercial correspondence and tenders, Short stories written by some well-known classic writers.

Topic covers:

General Discussion: Introduction, Mastering Various Approaches to Learning English.

Grammatical Problem: Construction of Words and Sentences, Grammatical Problems, Sentence variety and style, Transformation of sentences; Common errors; Conditionals, Grammar and Usages, Vocabulary and Diction, Clauses, Prefixes & suffixes, Synonyms and Antonyms.

English phonetics: The Phonetics systems and correct English Pronunciation.

Writing Skill: Principles of Effective Writing, Organization in writing, Planning and Development, Composition, Precis writing, Paragraph writing, Amplification, Free Composition.

General Strategies for the Writing Process: Generating Ideas, Identifying Audiences and Purposes, Constructing Arguments, Stating Problems, Drafting and Finalizing.

Approaches to Communication: Communication Today, Business Communication, Organization and organizational Behavior, Developing Intra-personal Interpersonal Relationship, Introducing Dialogue; Specific Applications of Tenders and Quotations, Resumes and Job Letters, Do letter, Memo letter, Official note, Complain letter, Newspaper letter, Journal Articles.

Module learning outcomes:

After completion of the course, Students will demonstrate competency with the following skills:

1. Identify the differences in style between every day and formal English and adapt his/her written and spoken language accordingly;
2. Understand advanced-level English oral presentations of some length;

3. Follow an argumentation given in specialized language provided that the topic is more or less familiar;
4. Understand relatively long texts from specialized areas;
5. Take active part in discussions and be able to explain and defend his/her opinions on well-known topics;
6. Use correct, varied and appropriate language, give an individually prepared oral presentation on a specialized subject;
7. Write reports, e-mails and letters, and essays of a specialized nature;
8. Revise their writing by adhering to the rules of standard English, including grammar, punctuation, and capitalization;
9. Demonstrate the ability to write orderly and coherent paragraphs based on organization
10. Able to use critical thinking by reading, analyzing and writing about their outside sources.

Math 1227 Differential Equations and Transform Analysis

Credit hours: **3**

Referred textbooks:

- ''A First Course in Differential Equations, 10th edition'' by Dennis G. Zill
- ''Mathematical Techniques'' by D. W. Jordan and P. Smith
- ''Advanced Engineering Mathematics'' by E. Kreyszig
- ''Partial Differential Equations - Theory and Technique'' by G. F. Carrier and C. E. Pearson
- ''An Introduction to Laplace Transform and Fourier Series'' by Dyke and Philip P.G.

Course description: The main objectives of this course include showing the students how differential equations appear in real life and physical phenomena, and teach them the main three methods, namely analytic, geometric and numerical methods, for studying differential equations, Laplace transform.

Topic covers:

Differential Equations: Formation of differential equations, order and degree of differential equation; Solution of differential equations of first order first degree by various methods; Application of first order differential equation, Solution of general linear equations of second and higher orders with constant coefficients, Solution of Euler's homogeneous linear equations.

Special Functions: Solution in series by Forbenious method; Solution of Bessel's differential equation; Solution of Legendre differential equation; Bessel's function and its properties; Modified Bessel's function, Ber and bei functions, Legendre polynomials and its properties, Legendre function of second kind.

Fourier Series: Euler Fourier series representation of functions; Conditions for existence of Fourier series; Fourier series with different periods; Fourier series for odd and even functions; Half range sine and cosine series; Complex form of Fourier Series; Parseval's identity; Practical Harmonic Analysis.

Laplace Transform: Definition and existence of Laplace transform; Properties of Laplace transform; Laplace transform of elementary functions; Inverse Laplace transform and its properties; Convolution; Applications: Solution of ordinary differential equation using Laplace transform.

Module learning outcomes:

After successful completion of this course, students should have developed a clear understanding of differential equations, Fourier series, and Laplace transform. The tentative outcomes of the course are:

1) Find general solutions to first-order, second-order, and higher-order homogeneous and nonhomogeneous differential equations by manual and technology-based methods;
2) Identify and apply initial and boundary values to find particular solutions to first-order, second-order, and higher order homogeneous and non-homogeneous differential equations;

3) Select and apply appropriate methods to solve differential equations; these methods will include, but are not limited to, undetermined coefficients, variation of parameters, Laplace and inverse Laplace transforms;
4) Select and apply series techniques to solve differential equations;
5) Find the Laplace transform of a function by definition and by use of a table, and the inverse Laplace transform of a function;
6) Write piecewise functions using the unit step function;
7) Find transforms using the first and second translation theorems, and find the convolution of two functions and the transform of a convolution;
8) Solve linear differential equations with constant coefficients and unit step input functions using the Laplace transform;
9) Familiarize with Fourier series and their applications and be notionally aware of their convergence;
10) Know how to derive the heat, wave and Laplace's equations in several independent variables and to solve them.

ME 1227 Engineering Mechanics

Credit: 4

Referred textbooks:

The following books are recommended for this course and class lectures will be delivered according to the outline of these books.

- ''Engineering Mechanics: Statics'' by R.C. Hibbeler.
- "Vector Mechanics for Engineers: Statics" by Ferdinand P. Beer & E. Russell Johnston, Jr.
- ''Engineering Mechanics: Dynamics'' by R.C. Hibbeler.

Course description:

This course uses the Laws of Mechanics to predict forces in and motions of machines and structures. The course is the key prerequisite course to sequences of courses dealing with mechanics of machines, stress analysis and design of mechanical systems. Application of the fundamental principles of Newtonian mechanics to the statics and dynamics of particles and the equilibrium of trusses, frames, beams and other rigid bodies. Dynamics of moving particles, including friction, torque, impulse, and momentum.

Topic covers:

Statics

Introduction: Basic concepts of mechanics, Composition and Resolution of forces.

Equilibrium of particles: Condition for the equilibrium of particle, Free-body diagram, Coplanar Force systems.

Force System Resultants: Moment of a force, Principle of moments, Moment of a force about a specified axis, Moment of a Couple, Reduction of a force to couple system.

Equilibrium of a Rigid Body: Types of support, Free-Body diagrams, Conditions of rigid body equilibrium, Moments and Couples, Constrains and Statistical determinacy.

Dynamics

Kinematics of particles: Motion of particle, rectilinear and curvilinear motion; motion of several particles, rectangular components of velocity and acceleration; Motion relative to frame in translation; tangential, normal, radial and transverse components.

Kinetics of particles: Newton's second law of motion, linear and angular momentum, radial and transverse components of motion, motion under central force, two body problem.

Work and energy: Principle of work and energy and its application; Power and efficiency; Potential energy, conservative forces; Conservation of energy and its application; Principle of impulse and momentum; Direct and oblique central impact.

Rigid body: Introductory concepts of kinematics of rigid body

Mechanics of Machinery: Inertia and kinetic energy of rotation and reciprocating parts; Turning moment diagram, fluctuation of energy and speed; Fly wheel; Balancing of stationary, rotating and reciprocating masses, balancing of in-line engines and V-engines, principle of direct and reverse cranks in balancing problems, Balancing machines; Law of gearing forms of tooth and types of gear; Gear trains and their arrangements; Types of governors and their control.

Module Learning Outcomes:
Upon successful completion of this course, the student will be able to:
1. Construct free-body diagram and apply the basic principles of static equilibrium of rigid bodies.
2. Investigate forces and reactions for frames and beams.
3. Determine the resultant force, equivalent force/couple systems, and distributed loads.
4. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
5. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
6. Apply Newton's laws of motion to particles and rigid bodies.
7. Use the energy and momentum methods for particles, systems of particles and rigid bodies.
8. Use methodical approaches to solve statics and dynamics problem.
9. Comprehensive theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
10. In-depth understanding of specialist bodies of knowledge within the engineering discipline
11. Application of established engineering methods to complex engineering problem solving
12. Application of systematic engineering synthesis and design processes.

Ph 1227 Magnetism and Nuclear Physics

Credit hours: 3
Suggested textbook:

- ''Fundamentals in Nuclear Physics'' by Jean-Louis Basdevant, James Rich, Michel Spiro
- ''Fundamentals of Physics: Electricity and Magnetism'' by Halliday, Resnick, and Walker
- "Nuclear Physics" by S.N. Ghoshal
- "Atomic and Nuclear Physics" by N. Subrahmanyam and Brij Lal
- "Electricity and Magnetism'' by Edward M. Purcell and David J. Morin
- "Introduction to Magnetic Materials" by B.D. Cullity
- "Introduction to Magnetism and Magnetic Materials 2nd edition" by David C. Jiles
- "The Physical Principles of Magnetism" by Allan H. Morrish

Course description:
The objective of this course is to provide primary and extended knowledge of the principles of magnetism, electro-magnetism and nuclear physics. These properties of matter are closely controlled by the crystal structure of the materials. Therefore, the study of Ph 1227will enhance their understanding to the structure properties relationship to the materials.
Topic covers:

Magnetism: Dipoles, Dipole Moment, Dipole in an Electric Field, The magnetic effect of an Electric Current, Magnetic Flux, permeability and reluctance, Magnetic field strength, Magnetic potential, Flux density, Magnetization curve, Susceptibility, Magnetic induction, Laws of magnetic circuits: Ohm's law, Ampere's circuital law, Hysteresis and Eddy current losses, The Biot-Savart Law, Magnetic Field Near a Long, Straight, Electromagnetic induction.

Dielectrics and Ferroelectrics: Maxwell Equations, Polarization, Macroscopic Electric Field Local Electric Field at an Atom, Dielectric Constant and Polarizability, Ferroelectric Crystals, Ferroelectric Domains, Piezoelectricity, Pyroelectricity, Classification of magnetic materials.

Properties of Magnetic Materials: Diamagnetism, Paramagnetism, Quantum Theory of Paramagnetism, Ferromagnetism, Ferromagnetic Order, Ferrimagnetic Order, Antiferromagnetism, Antiferromagnetic Order.

Elasticity of Matter: Different modulus of elasticity and their relationship, Elastic, Fatigue, Poison's ratio, Work done in deforming a body, Twisting by a cylinder, Maxwell kneedle, Bending moment, Cantilever.

Nuclear Physics: Introduction to nuclear physics, Basic concepts of nuclear physics, Radioactivity, Radioactive decay, Measurement of Decay rates, Calculation of decay rates, Half-life, Nuclear Fission, Chain Reactions, Nuclear Fusion, Radiation dosimetry, Mechanism of nuclear reactor, Disposal of radioactive isotope, Materials for building reactors, Application of radiation to medical treatment and in industry.

Module learning outcomes:
Upon completion of this course students should have a basic understanding of electricity, magnetism, and nuclear physics. Expected learning outcomes include but are not limited to the following:

1) Understand concepts which require a solid knowledge of electrical and magnetic forces and formulate solutions to physical problems;
2) Clear concepts of electric fields and electric potential to and apply these to relevant problems;
3) Knowledge of basic atomic and nuclear physics, and identify their relevance to the macroscopic properties of matter and current technologies;
4) Analyze the motion of a particle of specified charge and mass under the influence of an electrostatic force;
5) State the general relationship between field and potential, and define and apply the concept of a conservative electric field;
6) Deduce the direction of a magnetic field from information about the forces experienced by charged particles moving through that field;
7) Calculate the flux of a uniform magnetic field through a loop of arbitrary orientation;
8) Use conservation of mass number and charge to complete nuclear reactions;
9) Determine the mass number and charge of a nucleus after it has undergone specified decay processes;
10) Analyze production and decay reactions for fundamental particles, applying conservation principles to determine the type of reaction taking place;
11) Understand nuclear fission, so they can describe a typical neutron induced fission and explain why a chain reaction is possible.

Ch 1228 Sessional on Organic Chemistry

Credit hour: **0.75**
Course description: Experiments based on the course Ch 1227, Organic Chemistry.

ME 1220 Engineering Drawing Sessional-I

Credit hour: **1.5**
Course description: Engineering drawing types, Orthographic drawing, starting from simple objects to complicated objects, Isometric view of the objects, Section drawing, auxiliary views.

Ph 1228 Sessional on Magnetism and Nuclear Physics

Credit hour: 1.5
Course description:
Experiments based on the theory course of Ph 1227.

Hum 1228 Sessional on Technical English

Credit hour: 0.75

Topic covers:

Developing Reading Skill: Strategies of Reading-Skimming, Scanning Prediction, Inference; Analyzing and Interpreting Variety of Texts; Practicing Comprehension from Literary and Non Literary Texts.

Developing Writing Skill: Sentences, Sentence Variety, Generating Sentences; Clarity and Correctness of Sentences; Linking Sentences to Form Paragraphs. Writing Paragraph, Essays, Reports, Formal and Informal Letters.

Listening Skill and Note Taking: Listening to Recorded Texts and Class Lectures and Learning to Take Useful Notes Based on Listening.

Developing Speaking Skill: Oral Skills Including Communicative Expressions for Personal Identification, Life at Home, Giving Advice and Opinion, Instructions and Directions, Requests, Complaints, Apologies, Describing Peoples and places, Narrating events.