



Vision and Mission of the Department:

Vision:

To develop highly creative human resources capable of creating sustainable processes in various industries, reducing environmental footprint and improving quality of life by applying the innovative science and technology in chemistry and related fields.

Mission:

To instill and disseminate the knowledge, passion, attitude, and skill set among the graduates towards science, technology, and engineering. To prepare the students for professional practice, and life-long learning by conducting research through innovation and advancement of the chemical technology and engineering.

Skill Mapping of the ACCE Program:

First Year: Students will have basic and fundamental knowledge of physical, inorganic, organic chemistry, chemical process technology, chemical engineering, environmental chemistry as well as physics, mathematics, computer and information technology. They will also be introduced with related laboratories and industrial plants visit.

Second Year : Students will have advanced knowledge of physical, inorganic, organic chemistry, chemical process technology, chemical

engineering, environmental chemistry as well as physics, mathematics and statistics. Industrial economics and entrepreneurship course will be included in this year. They will also be introduced with related hands-on experiments and chemical plants visit.

Third Year: Students will be able to show and demonstrate an advanced understanding of the various processes and engineering knowledge and skills that are required in the various industries. They will learn advanced chemical process technology and chemical engineering. New courses such as polymer technology, fuel technology, analytical chemistry, pharmaceuticals technology, metallurgy, food process technology will be part of the syllabus in this year. Students in the third year will start to develop a significant industrial attachment and problem-solving capacity.

Fourth Year: Students will go through in-depth knowledge on chemical and biochemical engineering, pharmaceutical process technology, petrochemicals, materials science, corrosion engineering, instrumental analysis as well as research methodology. The key feature of a student successfully finishing this year would require individual project completion and a month-long industrial training at Training Institute of Chemical Industries in Bangladesh.

Applied Chemistry and Chemical Engineering (ACCE)
University of Chittagong, Chittagong 4331, Bangladesh
Syllabus for B.Sc. (Honours)
(Four-year integrated course)
Session: 2021-2022 & 2022-2023

A. There will be a total of four examinations as follows:

1. First Year B. Sc. (Honours) Examination, 2022 & 2023
2. Second Year B. Sc. (Honours) Examination, 2023 & 2024
3. Third Year B. Sc. (Honours) Examination, 2024 & 2025
4. Fourth Year B. Sc. (Honours) Examination, 2025 & 2026

B. Year-wise courses, distribution of marks and credits are as follows:

1. First Year B. Sc. (Honours) Examination, 2022 & 2023

Course No.	Course Title	Marks	Credit
ACCE-101	Chemical Process Technology-I	75	3
ACCE-102	Chemical Engineering-I	50	2
ACCE-103	Environmental Chemistry-I	50	2
ACCE-104	Physical Chemistry-I	50	2
ACCE-105	Inorganic Chemistry-I	75	3
ACCE-106	Organic Chemistry-I	75	3
ACCE-107	Physics-I	75	3
ACCE-108	Mathematics-I	75	3
ACCE-109	Computer and Information Technology	75	3
ACCE-110	Lab-I Inorganic Qualitative Analysis	75	3
ACCE-111	Lab-II: Organic Qualitative Analysis	75	3
ACCE-112	Lab-III : Computer and Information Technology	50	2
ACCE-113	Sessional	75	3
ACCE-114	Viva-voce	75	3
Total:		950	38

** Special English Course: Eng.-001 (Non-credit Compulsory) - 100 Marks.

2. Second Year B. Sc. (Honours) Examination, 2023 & 2024

Course No.	Course Title	Marks	Credit
ACCE-201	Chemical Process Technology-II	50	2
ACCE-202	Chemical Engineering-II	50	2
ACCE-203	Environmental Chemistry-II	50	2
ACCE-204	Physical Chemistry-II	75	3
ACCE-205	Inorganic Chemistry-II	50	2
ACCE-206	Organic Chemistry-II	50	2
ACCE-207	Physics-II	75	3
ACCE-208	Mathematics-II	75	3
ACCE-209	Statistics for Applications	75	3
ACCE-210	Industrial Economics and Management	50	2
ACCE-211	Lab-IV: Inorganic Quantitative Analysis	75	3
ACCE-212	Lab-V : Physical Chemistry	75	3
ACCE-213	Lab-VI : Chemical Engineering-I	50	2
ACCE-213	Sessional	75	3
ACCE-214	Viva-voce	75	3
Total:		950	38

3. Third Year B. Sc. (Honours) Examination, 2024 & 2025

Course No.	Course Title	Marks	Credit
ACCE-301	Chemical Process Technology-III	75	3
ACCE-302	Chemical Engineering-III	75	3
ACCE-303	Fuel Technology	75	3
ACCE-304	Polymer Processing Technology	75	3
ACCE-305	Analytical Chemistry	75	3
ACCE-306	Pharmaceutical Process and Technology-I	75	3
ACCE-307	Metallurgical Engineering	75	3
ACCE-308	Food Processing Technology	75	3
ACCE-309	Lab-VII: Chemical Engineering-II	50	2
ACCE-310	Lab-VIII: Chemical Process Technology-I	50	2
ACCE-311	Lab-IX: Chemical Process Technology-II	50	2
ACCE-312	Lab-X: Environmental Technology-I	50	2
ACCE-313	Lab-XI: Scientific communication: Written, Oral and Visual.	50	2
ACCE-314	Sessional	75	3
ACCE-315	Viva-voce	75	3
Total:		1000	40

4. Fourth Year B. Sc. (Honours) Examination, 2025 & 2026

Course No.	Course Title	Marks	Credit
ACCE-401	Chemical Engineering-IV	75	3
ACCE-402	Pharmaceutical Process and Technology-II	75	3
ACCE-403	Petrochemical Technology	75	3
ACCE-404	Instrumental Analysis	75	3
ACCE-405	Research Methodology	75	3
ACCE-406	Materials Science and Engineering	75	3
ACCE-407	Biomedical Engineering	75	3
ACCE-408	Corrosion Engineering	75	3
ACCE-409	LabXII: Chemical Engineering-III	50	2
ACCE-410	Lab-XIII: Chemical Process Technology-III	75	3
ACCE-411	Lab-XIV: Pharmaceutical Process and Technology	50	2
ACCE-412	Lab-XV: Environmental Technology -II	50	2
ACCE-413	In-plant Training	75	3
ACCE-414	Project	50	2
ACCE-415	Sessional	75	3
ACCE-416	Viva-voce	75	3
Total:		1100	44

C. The duration of examinations for Theoretical and Practical Courses will be as follows:

Theoretical	Lab
2 hours for 25 marks	4 hours for 25 marks
3 hours for 50 marks	6 hours for 50 marks
4 hours for 75-100 marks	9 hours for 75 marks
	12 hours for 100 marks

D. Sessional marks will be distributed as follows:

(i) Class Attendance- 10

Marks will be added on the basis of average class percentage.

(ii) Tutorial/Class Test/Term Paper/Assignment/Class Performance- 40

Marks will be distributed in all the theoretical courses and at least two class test marks for each course will be added.

(iii) Study tour/Industrial tour/Fieldworks/Field tour- 25

All students will have to perform a study tour/ an industrial tour/fieldwork/Field tour. Participation is compulsory for all students and they will submit a report and sit for written examination/viva-voce/ a powerpoint presentation. The report and written examination/viva-voce/ presentation will be examined by the internal examiners.

Syllabus for First Year B.Sc. (Honours) Examination, 2022 & 2023

Course No.: ACCE-101 Chemical Process Technology-I

Credit: 3 Exam.-2022 & 2023	Marks: 75 Time: 4 Hours
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Rationale: This course provides students with the essential concepts, principles, and techniques of chemical processes. The course is designed with the manufacturing procedure, raw materials and technological development of some chemical processes and their perspectives in Bangladesh. The water treatment technology is also included in this course.

Objectives of the Course: To gain understanding and knowledge,- Unit operations and Unit processes of different process units.

Process symbols, flow diagrams, block diagrams, pipe and instrumentation diagrams of various chemical industries.

Present problems and upcoming prospects of chemical industries.

Intended Learning Outcomes (ILOs): At the end of the course, students will be able to-

Employ knowledge in process industries.

Build up a model or conceptual framework of the chemical process industry.

Know the duty of a chemical process technologist.

Know the function of different types of equipment used in different chemical process industries.

Course Content

1. Introduction to Chemical Process Technology: Chemical Process technology, fundamental considerations in the development of chemical process industries. Unit operations and unit processes, process symbol, flow diagram and flow sheets. The future prospect of different types of industries in Bangladesh.

2. Water Conditioning and Treatment: Sources of water and water quality. Water conditioning for municipal, industrial and boiler purposes. Wastewater treatment.

3. Sulphur and Sulphuric Acid: Sources of sulphur. Extraction of sulphur. Manufacture of sulphuric acid-by Chamber process and Contact process. Oleum, Sulfan. Sulphuric acid industry in Bangladesh.

4. Pulp and Paper Industries: Cellulose structure and natural sources. Manufacture of different types of pulp. Manufacture of paper from pulp. Additives used with pulp in papermaking. Utilization of by-products of pulp and paper industry. De-inking of waste paper. Pulp and paper industry in Bangladesh.

5. Glass Industry: Definition, composition, classification, physical and chemical properties of glass. Raw materials. Manufacturing steps. Glass making furnaces and their operations. Special glasses: fused silica glass, high silica glass, borosilicate glass, optical glass, safety glass, photochromic glass, glass composites. Glass industry in Bangladesh.

6. Cement Industry: Definition, Types of cement. Raw materials, composition, properties and uses of different types of cement. Manufacture of cement by different methods. Settling and hardening of cement . The testing of cement. Cement industry in Bangladesh.

7. Fats, Oils and Waxes: Sources and classification of oils and fats. Oils and fats from different sources: chemical composition and physical properties. Extraction, refining, bleaching, deodorization and hydrogenation of oils. Saponification value, Acid value, Iodine value, Reichert-Meissl value, Polenske value. Waxes.

8. Soap and Detergents: Soap: definition. Manufacturing of different types of soap. Recovery of glycerin from spent lye. The cleansing action of soap. Detergent: definition. Different types of detergents and their functions.

Books recommended:

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| 1. Chemical Process Industries | : R.N. Shreve |
| 2. Handbook of Industrial Chemistry | : Reigels |
| 3. Industrial Chemistry | : B.K. Sharma |
| 4. Industrial Chemistry (Part I & II) | : R. K. Das |
| 5. A Text Book of Chemical Technology | : G.N. Pandy |
| 6. Rogers Industrial Chemistry | : Furnas |
| 7. Industrial Chemistry including Chemical Engineering | : B.K. Sharma |
| 8. শিল্প রসায়ন | : নূরুল হক ভূঁইয়া |
| 9. Pulp and Paper | : Casey |
| 10. Unit Operations of Chemical Engineering | : W. L. McCabe,
J.C.
Smith and P.
Harriott |
| 11. Bailey's Industrial Oil and Fat Products | : Fereidoon Shahidi |

Course No.: ACCE-102 Chemical Engineering-I

Credit: 2
Exam.-2022 & 2023

Marks: 50
Time: 3 Hours

Rationale: This course covers the fundamentals of chemical engineering including engineering calculations, mass and energy balances, distillation, evaporation, fluid mechanics and crystallization.

Objectives of the Course: The course will help students to understand and knowledge in:

The concept of conversion of mass as the basis for determining mass flows in chemical processing systems involving chemical reactions and separation systems.

The fundamental concepts of mass transfer.

The study of fluid mechanics and crystallization.

Intended Learning Outcomes (ILOs) : Upon completion of this course the student is expected to-

Apply knowledge of fundamental engineering calculations.

Know the mass and energy balances and related problems.

Understand the principles of heat transfer to solve heat transfer problems.

Know the principles and performance of heat exchanger, distillation plant and evaporation equipment in detail.

Understand the fluid mechanics and crystallization system.

Course Content

- 1. Fundamentals of Chemical Engineering:** Units and dimensions, systems of dimensions and units, process and process variable-temperature, pressure, composition and flow rates, simple stoichiometric calculations, triangular diagram, graphical methods of addition and subtraction, basis of calculation, The chemical equation and stoichiometry, Regression and nonlinear axes , mathematical relationship between variables. Basics of mass and energy balance.

2. **Distillation:** Vapour liquid equilibrium, relative volatility, boiling point and equilibrium diagram of binary systems, types of distillation and rectification, types of rectifying columns, column and plate to-plate calculation, heat and material balances, reflux ratio and entrainment, steam distillation, effect of pressure in distillation.
3. **Evaporation:** Types of evaporators, construction and principle of action including heat and material balances and economy of single-effect, multiple-effect and thermo-compression evaporators, scale formation and its removal.
4. **Drying:** Types of dryer, the theory of drying solids- rate of drying curves, total, equilibrium and critical moisture contents, batch and continuous equipment for drying solids with special reference to milk, fruit juice, paper and pulp, biological and pharmaceutical products.

Books recommended:

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| 1. Introduction to Chemical Engineering | : W.L. Badger & J.T. Banchero |
| 2. Elementary Principles of Chemical Processes | : R.M. Felder & R.W. Rousseau |
| 3. Unit Operations of Chemical Engineering | : W.L. McCabe, J.C. Smith & P. Harriot |
| 4. Introduction to Chemical Engineering | : L.B. Andersen & L. Wenzel |
| 5. Handbook of Chemical Engineering | : Peery |
| 6. Introduction to Chemical Engineering | : S.K. Ghosal, S.K. Sanyal & S. Dutta |
| 7. Basic Principles and Calculations in Chemical Engineering | : D.V. Himmelblau |
| 8. Stoichiometry | : E. Williams & C. Johnson |
| 9. Mass Transfer Operations | : R.E. Treybal |
| 10. Chemical Engineering Thermodynamics | : B.F. Dodge |
| 11. Principles of Unit Operations | : A.S. Foust et al |
| 12. Heat Engineering | : V.P. Vasandan & D.S. Kumar |

13. Principles of Powder Technology : M. Rhodes
14. Hydraulics : Wisler & J.G. Woodburn

Course No.: ACCE-103
Environmental Chemistry-I

Credit: 2 Exam.-2022 & 2023	Marks: 50 Time: 3 Hours
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Rationale: The purpose of this course is to provide students with a basic understanding of the earth's environment, pollution of the earth and its environment. Students are expected to learn and understand different aspects of environmental chemistry. This course emphasizes the understanding of the different kinds of environmental pollution,

toxicology, control/mitigation of pollution waste disposal systems and green chemistry.

Objectives of the Course: The main aim of the course is to equip students with the knowledge of physical and chemical properties as well as about the chemical reactions essential for the emergence and existence of the cycling and accumulation of pollutants in the environment. The course addresses the chemistry of elements and compounds in the atmosphere, water and soil, and lays special emphasis on the processes that define the connections and the dependence between individual segments of the environment.

Intended Learning Outcomes (ILOs): Upon successful completion of the course, students will be able to-

Learn the basic principles of environmental chemistry.

Understand the interconnections between different sectors of the environment (soil, water, and atmosphere) and know the effect of human activities on the natural chemical processes.

Understand and explain contemporary environmental issues.

Course Content

1. The Environment: Definition, environmental segments. Earth's atmosphere and its composition. Atmospheric regions, the atmosphere of the outer regions. Chemical and photochemical reactions in the atmosphere. Scope of environmental chemistry. Environmental problems in Bangladesh.

2. Chemistry of Air Environment: Air pollution and its causes, adverse effects of air pollutants; oxides of carbon, nitrogen, sulphur, hydrocarbons, particulates, ozone layer depletion, types of automobile pollutants and their effects, cigarette smoking, radioactive fallout, greenhouse effect, chlorofluorocarbons and their effects, photosynthesis, acid rains and their effects, air quality standards.

3. Chemistry of Water Environment: Sources and chemistry of natural waters, aquatic environment. Freshwater resources and their uses. Water pollution and its causes. Sources and classification of water pollutants and their adverse effects, Eutrophication, water quality parameters and standards, trace elements in water, DO, BOD, COD, arsenic in environmental waters (causes, effects and remedies).

4. Soil Chemistry: Formation, elemental, chemical and physical composition of soil, sources and classification of soil contaminants, pesticides and their effects. Possible hazards from contaminated soil. Reclamation of contaminated soil.

5. Environmental Toxicology: Toxic chemicals in the environment, pollutants and contaminant, types of toxicity, toxic and micronutrients; classification of toxicology, tolerance limit and TLV, the impact of toxic chemicals on enzymes, genetic toxicology and chemical carcinogens, dose-response relationships of toxicants. Impact of toxic chemicals (As, Hg, Pb, Cd, Cr, CO, SO₂, pesticides, etc.).

Books recommended:

1. Environmental Chemistry : S.E. Manahan
2. Environmental Chemistry of Soil : M. McBride
3. A Guide to the Study of Environmental Pollution : William Andrews
4. A Text Book of Environmental Chemistry and Pollution Control : S.S. Dara

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| 5. Environmental Chemistry | : A.K. De |
| 6. Environmental Chemistry | : H. Kaur & B.K. Sharma |
| 7. Environmental Chemistry | : S.C. Bhatia |
| 8. Environmental Toxicology | : J.N. Duffins |
| 9. The Chemistry of our Environment | : R.A. Horne |
| 10. Air and Water Pollution | : A.S. Stoker |
| 11. Environmental Toxicology | : T.P. Mommsen and T.W. Moon |

Course No.: ACCE-104 Physical Chemistry-I

Credit: 2 Exam.-2022 & 2023	Marks: 50 Time: 3 Hours
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Rationale: Chemistry is the study of materials and substances, and the transformations they undergo through interactions and the transfer of energy. Physical Chemistry develops students' understanding of the chemical concepts and chemical change including chemical, electrical and thermal energy.

Objectives of the Course: The course will cover and act as a support to understand the fundamental topics of physical chemistry.

Intended Learning Outcomes (ILOs): Upon completion of this course students will be able to understand and explain basic concepts, laws and effects on state and properties of matter; distinguish between different states of matter, various solutions, define and explain basic concepts, laws and properties of thermodynamic systems and processes, describe properties, laws and equations of thermochemistry, understand and explain basic concepts, equation, effects and importance of chemical equilibria.

Course Content

1. **Gaseous State:** Fundamentals of physical chemistry, Postulates of the kinetic theory of gases, kinetic equation, mean free path, behavior of ideal and real gases, van der Waals equation, critical constants, the relation between critical constants and van der Waals constants. Equations of state. Principle of corresponding states.

Joule-Thomson effect and liquefaction of gases. Dalton's law of partial pressure.

2. Liquid State and Properties of Dilute Solutions: Physical properties and molecular structure, surface tension, interfacial tension, viscosity, molar refractivity and dipole moment. Vapour pressure and its measurement. Colligative properties: Raoult's law; Elevation of boiling point, Depression of freezing point, Osmotic pressure and their measurements. Ideal and non-ideal solutions.

3. Thermodynamics-I: Scope and limitations of thermodynamics. The system, surrounding, intensive and extensive properties, thermodynamic variables. Isothermal, adiabatic, isobaric, reversible, irreversible processes. The first law of thermodynamics. Isothermal reversible expansion of work. Thermochemistry: thermochemical equation, reaction enthalpies, thermochemical laws, Hess's law, Kirchoff's equation, bond energy.

4. Chemical Equilibrium: Law of mass action. The equilibrium constant, application of the law to homogeneous and heterogeneous equilibria, Le Chatelier's principle, the principle of the mobile equilibrium and its application to reactions of industrial importance. The van't Hoff equation.

Books recommended:

1. A Text Book of Physical Chemistry : S. Glasstone
2. Principles of Physical Chemistry : M.M. Hoque & M.A. Nawab
3. Essentials of Physical Chemistry : Bahl & Tuli
4. Elementary Physical Chemistry : Lewis & Glasstone
5. Physical Chemistry : P.C. Rakshit
6. Physical Chemistry : N. Kundu & S.K. Jain
7. Physical Chemistry : W.J. Moore
8. A Text Book of Physical Chemistry : K.K. Sharma *et al.*

Course No.: ACCE-105

Inorganic Chemistry-I

Credit: 3
Exam.-2022 & 2023

Marks:75
Time: 4 Hours

Rationale: The purpose of this course is to provide students with a basic understanding of the principles of inorganic chemistry. At its core, the study of inorganic chemistry deals with the modern concept of atomic structure, position of elements in a periodic table, their electronic configuration and characteristics. Moreover, this course has been designed to develop the analytical skill of the students to analyze and interpret inorganic compounds.

Objectives of the Course: The course will help the students to gain understanding and knowledge in-

The modern concepts of atomic structure including different principles related to inorganic chemistry.

Modern periodic table and its applications.

All types of chemical bonding and their uses.

Intended Learning Outcomes (ILOs): After studying this course, students will be able to-

Know the modern concept of atoms and molecules.

State and explain the different principles and equations of inorganic chemistry and write the electronic configuration of elements.

Explain the modern periodic law and the meaning of ionization energy, electronegativity and electron affinity.

Understand, determine and signify the diverse concept of acids and bases, their strength, charge and size.

Make students confident in solving numerical problems involving pH, decay of radioactive materials.

Course Content

- 1. Modern Concepts of Atomic Structure:** The development of modern atomic theory, The nuclear atom model, atomic spectra,

Bohr atom model, quantum number, atomic orbital and energy levels, electronic configuration, Aufbau principle, Hund's rule, Pauli exclusion principle, Heisenberg's uncertainty principle, de-Broglie equation, Schrodinger equation, Photoelectric effect, Compton effect.

2. Periodic Table: Classification of elements, the periodic law, modern periodic table. Periodic properties: Ionic radii, electronegativity, ionization potential, electron affinity. Effective nuclear charge and shielding effect. Usefulness and limitations. Prediction of properties of elements from electronic configurations.

3. Chemical Bonding-I: Origin of the chemical bond, development of the electronic theory of valency. Condition of formation, general characteristics and properties of ionic bond; lattice energy, stability of ionic compounds. Condition of formation, general characteristics and properties of covalent bond; ionic character of covalent bond. The coordinate covalent bond.

4. Acids and Bases: The different concepts of acids and bases. The strengths of acids and bases, charge and size relationships, ionic potential, oxidation states. Conjugate acid and base, Hard and soft acid-bases. pH and buffer solution.

5. Qualitative Inorganic Analysis: Theoretical basis of inorganic qualitative analysis, principles of group identification of ions. Application of the law of mass action, common ion effect and solubility product, principles in the precipitation reactions. Interfering acid radicals and principles of their separation.

6. Oxidation and reduction: Classical and Modern concepts. Oxidizing and reducing agents. Oxidation states and numbers. Equivalent weight. Redox reactions and potentials.

Books recommended:

1. Fundamental Concepts in Inorganic Chemistry : E.S.Gilreath
2. Introduction to Modern Inorganic Chemistry : S.Z. Haider

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| 3. Snatak Ajoybo Rashayon | : S. Ahmed & L. Hossain |
| 4. Inorganic Chemistry | : T. Moeller |
| 5. Modern Inorganic Chemistry | : R.D. Madan |
| 6. Chemical Bonding | : Companion |
| 7. Qualitative Inorganic Analysis | : A.I. Vogel |
| 8. Basic Concepts in Analytical Chemistry | : S.M. Khopkar |
| 9. Selected Topics in Inorganic Chemistry | : Malik, Madan, Tuli |

Course No.: ACCE-106 Organic Chemistry-I

Credit: 3

Exam.-2022 & 2023

Marks: 75

Time: 4 Hours

Rationale: The best understanding of the properties of matter comes from a study at the molecular level. Organic chemistry provides students with the basic principles that govern the chemical structure (and therefore the behavior and reactivity) of molecules.

Objectives of the Course: The course is designed for the students to impart and improve fundamental knowledge and aspects related to organic chemistry and chemistry of functional derivatives of aliphatic hydrocarbons. To know preparations, reactions and physical and chemical properties of aliphatic and aromatic compounds with their applications.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-
compare and contrast between organic and inorganic molecules;
understand and outline basic concept and effect on organic molecules;
determine and solve empirical and molecular formulae related problems.
Name, classify, prepare and apply, explain properties of alcohols, phenols, ethers, halides, aldehydes, ketones and carboxylic acids; summarize, predict and estimate their substitution products with related rules and principles.

Course Content

1. Introduction: Comparative study of inorganic and organic chemistry. Electronic structure of atoms, bonding in molecules, carbon molecular

orbitals in organic compounds. Formation and breaking of bonds. Inductive effect, resonance and conjugation effect, electrometric effect, hyperconjugation and steric effect.

2. Qualitative Analysis of Organic Compounds: Qualitative identification and quantitative determination of C, H, N, S and halogens in Organic compounds. Analysis for functional groups of organic compounds, determination of empirical and molecular formulae.

3. Aliphatic Hydrocarbons: Alkanes, alkenes and alkynes - Structure, nomenclature, conformation, preparations, physical properties, chemical properties: the Grignard reaction, the Wurtz reaction, Markovnikov's and anti-markovnikov's rule, reduction and oxidation of olefins, acidity of alkynes.

4. Alcohols, Phenols and Ethers: Nomenclature, physical properties, preparations and reactions. Test for alcohols, phenols and ethers.

5. Halides: Nomenclature and structure, preparations, chemical reactions and applications.

6. Aldehydes, Ketones and Carboxylic Acids: Nomenclature, general methods of preparations, reactions of aldehydes, ketones and carboxylic acids. Nucleophilic addition to carbonyl compounds.

Books recommended:

1. Organic Chemistry : R.T. Morison & R.N. Boyd
2. Organic Chemistry (Vol. I & II) : I.L. Finar
3. Advanced Organic Chemistry : B.S. Bahl & Arun Bahl
4. Organic Chemistry : S. Pine
5. Organic Chemistry : M. Ahmed & A. Jabber
6. Organic Reaction Mechanism : Peter Sykes

Course No.: ACCE-107
Physics-I

Credit: 3 Exam.-2022 & 2023	Marks: 75 Time: 4 Hours
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Rationale: This course covers the general properties of matter and the applications of physical concepts and laws to solve physical and chemical operations of the matter.

Objectives of the Course: The course will cover the problems that is required in the physicochemical analysis of matter. The course will help students to gain knowledge in fundamental aspects and laws of rigid and non rigid particle motion/dynamics, elasticity and sound.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Understand and explain basic concepts, laws and properties of particle motion and dynamics. Understand the theory and principles of gravitation, elasticity, waves and sound. Learn fundamental concepts in classical mechanics such as force, energy, work, momentum etc. as needed for further studies in industrial chemistry. Apply these principles together with logical and mathematical reasoning to situations of the chemical world.

Course Content

1. Particle Motion and Dynamics: Particle kinematics, motion in a plane: projectile motion, uniform circular motion, centripetal, tangential and correlations, frictional forces, linear and angular momenta of particles, work, energy and power.

2. Oscillations: Simple harmonic motion, damped harmonic motion, Forced oscillations and resonances, simple and compound pendulums.

3. Conservations of Energy and Momentum: Conservative and non-conservative forces, centre of mass, conservation of linear and angular momenta of particles, conservation of mass and energy.

4. Gravitation: The law of universal gravitation; acceleration due to gravity (g) and constant of universal gravitation (G), the gravitational field and potential energy, Satellite.

5. Elasticity: Elastic media, stress and strain, Hook's law, elastic modulus, relations between elastic constants and their determination.

6. Waves in Elastic Media: Mechanical waves, types of waves, superposition principle, wave velocity and intensity in wave motion, interference of waves, complex waves, standing waves and resonance.

7. Sound Waves: Audible, ultrasonic and infrasonic waves, Sound intensity and loudness, Noise, Effects of noise pollution, Beats, Doppler effect, Reverberation and Reverberation time, Sound absorption.

Books recommended:

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| 1. Physics (I and II) | : Halliday & Resnick |
| 2. University Physics | : H.D. Young & R.A.Freedman |
| 3. University Physics | : M. Zemansky & F. Sears |
| 4. Classical Mechanics | : H. Goldstein |
| 5. Elements of Properties of Matter | : D.S. Mathur |
| 6. A Text Book on Sound | : A.B.Wood |
| 7. Acoustics & Vibrational Physics | : R. W. B. Stephens and A. E. Bate |
| 8. পদার্থবিদ্যা ১ম খণ্ড | : আ.ব.ম. মাসুদ, মু. হামিদ হোসেন ও মো. গোলাম হোসেন |

Course No.: ACCE-108

Mathematics-I

Credit: 3

Exam.-2022 & 2023

Marks: 75

Time: 4 Hours

Rationale: Algebra, trigonometry and calculus are a powerful tool for problem-solving in science, engineering, technology, economics, architecture and many other fields .

Objectives of the Course: To impart knowledge on theory and solve problems related to basic algebra, trigonometry, differential and integral calculus. This course provides basic training on the methods and tools that are commonly used in industrial chemistry. This course can be regarded as a survival guide in industrial chemistry study.

Intended Learning Outcomes (ILOs): On successful completion of this course, students will be able to-

Explain, discuss and solve basic algebra.

Explain, discuss and solve integral calculus and related problems.

Explain, discuss and solve differential calculus and related problems.

Course Content

1. Basic Algebra: Summation of series, convergence and divergence. Theory of equations: Relation between roots and coefficients, Descarte's rule of signs, roots of symmetric functions, Matrices: Definition of matrix; Different types of matrices, Algebra of matrices, Adjoin and inverse of a matrix; Rank and Elementary transformations of matrices; Matrix polynomials; Caley-Hamilton theory with uses of rank and nullity; Normal and canonical forms; Eigen values and eigenvectors, solution of system of linear equation by matrix methods.

2. Trigonometry: De-Moivre's theorem and its applications, Gregory's series and Hyperbolic functions.

3. Differential and Integral Calculus: (i) Functions of a single variable and its domain and ranges. Graphical representation of standard functions, limit and continuity.

(ii) Definition of differentiation, techniques of finding derivatives of functions of single variable, maxima and minima of real valued functions, successive differentiation's, Leibnitz's theorem and its applications.

(iii) Integration of functions of a single variable. Techniques of integration by standard formula, method of substitution, integration by parts, integration of special functions, integration of trigonometric functions.

(iv) Definite integrals, properties of definite integrals, idea and uses of Beta and Gamma functions.

(v) Partial differentiation, Euler theorem, total differentiation, Jacobian transformation and its application.

Books recommended:

1. Higher Trigonometry : S. A. Satter
2. Higher Algebra : Bernard & Child
3. A Text Book on Higher Algebra : Shahidullah & Bhattacharjee
4. Differential and Integral Calculus : Mohammad & Bhattarjee
5. Differential Calculus : Das & Mukherjee
6. Integral Calculus : Das & Mukherjee
7. Calculus : F. Ayres
8. Differential Calculus : J. Edwards
9. Integral Calculus : Williamson
10. Matrices : F. Ayres

Course No.: ACCE-109
Computer and Information Technology

Credit: 3	Marks: 75
Exam.-2022 & 2023	Time: 4 Hours

Rationale: This course helps to provide students with the basic knowledge of computer systems such as hardware, software, computer maintenance and networks.

Objectives of the Course: To learn fundamental concepts of computer and information technology applications for ACCE.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Define and explain the fundamental terms of CIT.

Discuss, explain and apply MS word, MS Excel and MS powerpoint presentation.

Identify, formulate and solve computer-related problems.

Discuss, explain and apply the internet for e-mail, web search, web publishing etc.

Course Content

1. Concept of Computer and ICT: Introduction; Computer types; History and generation of Computer; characteristics, specifications, applications of computer; Basic information technology, information technology and systems, development of information systems, information assurance: security, privacy and ethics, ICT applications, intelligence system and E-business. Computer security: Objectives, various security issues.

2. Hardware and Software Components: Basic organization and functional units of computer–I/O devices, Central processing unit, Memory unit and Basics of microprocessor and its architecture. Types of Software; System Software; System utilities; Application software, Introduction to Operating System, function and types of operating system.

3. Office Application Software: Features and applications of Microsoft Word, Microsoft Excel, Microsoft PowerPoint and Microsoft ss. Database: Concept of database and database management system (DBMS).

4. Number Systems and Codes: Decimal, Binary, Octal, Hexadecimal number and their conversion systems, Binary arithmetic, BCD, ASCII codes and other codes, Integer and floating number representation.

5. Computer Maintenance: Power supply, Stability, Grounding, Handling, Protection, Troubleshooting: Computer viruses, Theft, Computer Security: Objectives, Various Security issues.

6. Computer Networks: Introduction to the computer network, Network structure, Network protocols, LAN, MAN, WAN and LAN topologies; Network tolls: modems, repeaters, hubs, bridges, switches, gateways, routers; intranet, extranet. Internet Address, Hyper Text Transfer Protocol (HTTP), File Transfer Protocol (FTP), Web Server, Mail Server, Proxy Server, Web browser. The internet: then and now, how the internet works, major features of the internet, online services, internet related features in

applications.

Books recommended:

1. Computer and Information Processing : William M. Fouri
2. Programming in ANSI C. : E Balagurusamy:
3. Introduction to Computers. : Peter Norton:
4. Introduction to Computer Vol-I. : N. Subramarian:
5. Programming with C. : Byron S. Gottfried
6. Data Communication and Networking : Behrouz A. Forouzan:
7. Computer Networks and Internets with Internet Applications : Douglas E. Comer:
8. Switching theory and digital electronics. : V. K. Jain
9. Digital circuit and logic design. : S. C. Lee
10. Data and Computer Communication. : W. Stallings and Macmillan:
11. Principle of Digital electronics. : Tocci. T.J
12. Introduction to Information Technology : Pearson Education, IITL Education Solutions Ltd.

Course No.: ACCE-110

Lab-I: Inorganic Qualitative Analysis

Credit: 3	Marks: 75
Exam.-2022 & 2023	Time: 9 Hours

Rationale: This course helps to provide students with the basic elements of systematic qualitative analysis of radicals. Good laboratory practice and lab safety are also covered by this course.

Objectives of the Course : The course will help students to understand the practical knowledge of lab safety and management, GLP and to learn and apply the systematic qualitative analysis of a mixture of acid and basic radicals using standard procedure and chemical tests.

Intended Learning Outcomes (ILOs) : At the end of the course, the students will be able to-

Know the good laboratory practice (GLP), safety and risk management of the laboratory.

Identify and analyse various acid and basic radicals from a radical mixture.

Explain the separation techniques and reactions involved therein.

Course Content

Part-A: Lab Safety and Management:

Introduction:

Understanding Chemical Safety and Chemical Security, Lab Safety and Management (definition, lab design, construction and decommissioning, responsibilities, Personal protective (PPE) and lab safety equipment's, General safety disciplines for lab.

Hazardous Chemicals:

Definition of hazardous chemicals, Dangers of Improper Storage of Hazardous Chemicals, How to handle hazardous chemicals, Major accidents (Churhatta Fire and Explosion, Fire and Explosion Benapol land port 2018, Tianjin Explosion, Beirut Explosion, Aug 2020, etc.) related to improper storage of chemicals.

Risk Assessment and Mitigation:

Risk Assessment, Chemical Disaster Management, Safe Technology, Minimizing Consequences, Transportation Risk and risk management, Mitigation Strategies, Good Practices for both Chemical Safety and Security.

Part-B: Inorganic Qualitative Analysis

Systematic qualitative analysis of samples containing up to four radicals of which there will no be more than three basic radicals and no more than two acid radicals.

Basic ions/radicals: Silver, lead, mercury, bismuth, copper, cadmium, tin, arsenic, antimony, iron, aluminum, chromium, manganese, zinc, cobalt, nickel, calcium, barium, strontium, magnesium, potassium, sodium and ammonium.

Acid ions/radicals: Carbonate, sulphite, sulphide, sulphate, nitrate, nitrite, chloride, bromide, iodide, phosphate and borate.

Books recommended:

1. A Text Book of Inorganic Qualitative Analysis : A.I. Vogel

Course No.: ACCE-111
Lab-II: Organic Chemistry Qualitative Analysis

Credit: 3
Exam.-2022 & 2023

Marks: 75
Time: 9 Hours

Rationale: Analysis and identification of unknown organic compound constitute a very important aspect of experimental organic chemistry. The types of functional group serve as the basis for naming organic compounds. This course helps to provide with the basic of systematic organic qualitative analysis of functional groups.

Objective of this Course: To perform and identify functional groups in organic compounds by chemical tests in the laboratory with related reactions.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-
Perform and identify various functional groups in organic samples.
Check the melting and boiling point of organic solid and liquid compound.

Course Content

Systematic Identification of Organic Compounds: Unsaturation, alcohols, aldehydes, ketones, acids, phenolic, amino, amido, imido and nitro compounds. Determination of physical constants such as melting point (m.p). and boiling point (b.p) of substances.

Books recommended:

1. A Text Book of Practical Organic Chemistry : A.I. Vogel
2. Systematic Organic Analysis : Curtin, Shriner & Fuson
3. Practical Organic Chemistry : Clarke
4. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে

Course No.: ACCE-112
Lab-III: Computer and Information Technology

Credit: 2
Exam.-2022 & 2023

Marks: 50
Time: 6 Hours

Rationale: This course helps to provide students with practical knowledge on the fundamental of computer and information technology.

Objectives of the Course: To apply computer and information technology for communication, chemical engineering drawing and analysis.

Intended Learning Outcomes (ILOs): Upon completion of this course students will be able to-
Outline and apply CIT for drawing tables, 2D and 3D chemical structures, prepare powerpoint presentation, perform document searching and related works.

Course Content

Computer hardware components with their properties, specifications and the processes of assembly.

Word Processing Programs (MS Word). Study and practice the Presentation Programs (MS Power Point); Spreadsheet Programs (MS Excel); Data Base Management System Programs (DBMS).

Equations, drawing 2D and 3D chemical structures using Chem Office Ultra and Chem Draw tools.

Books recommended:

- 1 Microsoft Office, : Mahbubur Rahman
. 97/2000 (Cistech Publication)
- 2 Internet and Web : A. Mansoor (Pragya
. Designing Made Easier Publication)
- 3 To Be Suggested by the
. Course Teacher

Special English Course: Eng.-001

Credit: 4

Exam.-2022 & 2023

Marks: 100

Time: 4 Hours

Rationale: The English language course is to enable students to improve both student's ability to communicate and student's linguistic competence in the chosen course. A balance of receptive (reading, listening) and productive (speaking, writing) skills will be developed through communicative classes and self-study.

Objectives of the Course: The ENG-001 is a non-credit course, students have to take the course as compulsory and sit for the final examination. However, students may get the benefit of extra points above 12.00 (cut point) scored in the course in their total points obtained from the courses (**Reference: Science Faculty Ordinance**). This course helps to learn modern terms applicable for applied chemistry education and communicate in English correctly. Moreover, this course aims at

enhancing to enhance the level of students' English Language proficiency which is needed throughout their life.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Write and communicate in modern English correctly.

Represent the Applied Chemistry and Chemical Engineering knowledge in English. Communicate in English effectively.

Course Content

1. Reading and comprehension of prose passages concerned with different areas like science, linguistics, etc., focusing on: (a) Vocabulary (word class, synonym, antonym, idioms and phrasal verbs, etc.), (b) Thematic structures (syntax), (c) Cohesion, (d) Content questions (referential, inferential, giving suitable title to the passage) and (e) Summary.

2. Structures: (a) Tense, Modals and Conditionals; Determiners and Modifiers; Prepositional phrases; Clauses. (b) Completion of sentences. (c) Joining sentences. (d) Transformation of sentences. (e) Framing questions. (f) Correction of sentences.

3. Writing free and guided composition (within 150-200 words):

- (a) Narrative, (b) Descriptive (c) Expository, and (d) Argumentative
4. Letter writing: (a) Personal letters, and (b) Formal letters (different kinds of official, business and public letters).
5. Passage translation: From Bangla into English and from English into Bangla.
6. Interpretation of charts, tables and diagrams in a concise and meaningful way.

Books recommended:

1. Grammar and Composition : Houghton and Mifflin
2. Living English Structure : A. Stannard Allen
3. Oxford Practice Grammar : John Eastwood
4. From Paragraph to Essay : Maurice Imhoff & Herman Hudson
5. Business Correspondence and Report Writing : R.C. Sharma and Krishna Mohan
6. Foundation English for Undergraduates : Q.M. Billah, G.S. Chowdhury & Monjurul Alam
7. Writing Scientific English : Swales Jolm
8. Practical English Uses : Swan Michael
9. Learning English – The Easy Way : Ahmed Sadruddin
10. The Advanced Learner’s Dictionary : A.S. Hornby

Books recommended:

1. Introduction to Chemical Engineering : W.L. Badger & J.T. Banchero
2. Elementary Principles of Chemical Processes : R.M. Felder & R.W. Rousseau
3. Unit Operations of Chemical Engineering : W.L. McCabe, J.C. Smith & P. Harriot
4. Introduction to Chemical Engineering : L.B. Andersen & L. Wenzel

5. Handbook of Chemical Engineering : Peery Robert H
6. Introduction to Chemical Engineering : S.K. Ghosal, S.K. Sanyal & S. Dutta
7. Mass Transfer Operations : R.E. Treybal
8. Chemical Engineering Thermodynamics : B.F. Dodge
9. Principles of Unit Operations : A.S. Foust et al
10. Separation Process Principles : Seader J.D. & Henley E.J
11. Multi-component Distillation C. D. Holland
12. Distillation. :M. Van Vincle
13. Design of Equilibrium Stage Processes :B.D. Smith
14. Chemical Reaction Engineering : Levenspiel Octave
15. Fluid Mechanics with Engineering Applications : Franzini Daugherty
16. Fluid Mechanics : F. M. White
17. Handbook of Chemical Engineering. Calculation : Chohey N.P
18. Conceptual Design of Chemical Process : Douglas
19. Plant Design and Economics for Chemical Engineering : Peters and Timerhaus
20. Systematic Method for Chemical Process Design : Beigler, L. T
21. Industrial Catalysis and Separations: Innovations for Process Intensification : K. V. Raghavan, B. M. Reddy
22. Industrial Catalysis: A Practical Approach : Jens Hagen
23. Handbook of Industrial Catalysts : Lloyd, Lawrie

Syllabus for Second Year B. Sc. (Honours) Examination, 2023 & 2024

Course No: ACCE-201 Chemical Process Technology-II

Credit: 2
Exam.-2023 & 2024

Marks: 50
Time: 3 Hours

Rationale:

This course is designed to enhance the knowledge of chemical process technology including Chloro Alkali, Sugar and Starch, Ceramics, Leather, Paints and Varnishes, Fermentation, Fertilizer Industry. It is also designed to discuss with the problems and future prospects of the above mentioned industry in Bangladesh.

Objectives of the Course:

This course will help the students to gain knowledge about-
Advanced technical skills in chemical industry.

Pollution from different industries and their reduction procedure.

Raw materials availability, reuse of the byproduct, increasing yield etc.

Intended Learning Outcomes (ILOs):

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

Explain the manufacturing process of different types of process products.

Understand how to handle the different types of process unit (equipments).

Illustrate the effects of various reaction variables of the manufacturing process.

Course Content

1. Chloro Alkali: Importance of caustic soda, soda ash, chlorine and bleaching powder. Manufacture of caustic soda, soda ash, chlorine and bleaching powder. The industry of alkali, chlorine and allied chemicals in Bangladesh.

2. Sugar and Starch: Composition of sugarcane. The manufacturing process of sugar from sugarcane. Refining of raw sugar. By-products of sugar industries and their utilization. Sugar industry in Bangladesh.

3. Ceramics: Definition, classification, subdivision. Raw materials. Manufacture of ceramics. Manufacture of ceramic whitewares. Enamel porcelain. Ceramic industry in Bangladesh.

4. Leather: Classification of hides and skins. Structure of animal skins. Pre-tanning process, tanning process- vegetable tanning and chrome tanning. Finishing of leather. Commercial aspects of leather. Pollution from the leather industry. Leather industry in Bangladesh.

5. Paints and Varnishes: Classification, constituents and manufacture of paints. Requirements of good paint. Distempers, emulsion paints and latex paints. Method of applying paints. Varnishes: raw materials and manufacture. Paint industry in Bangladesh.

6. Fermentation: Favorable conditions for fermentation. Enzymes and yeast. Manufacture of ethyl alcohol, industrial alcohol and absolute alcohol. Manufacture of vinegar. Alcohol industry in Bangladesh.

7. Fertilizers: Plant nutrients. Classification of fertilizer and their importance as plant nutrients. NPK fertilizers. Raw materials. Manufacture of ammonia, urea, superphosphates (SSP and TSP), and potash fertilizer. Problems and future prospects of fertilizer industries in Bangladesh.

Books recommended:

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| 1. Chemical Process Industries | : R.N. Shreve |
| 2. Handbook of Industrial Chemistry | : Reigels |
| 3. Industrial Chemistry | : B.K. Sharma |
| 4. Industrial Chemistry (Part I & II) | : R. K. Das |
| 5. A Text Book of Chemical Technology | : G.N. Pandey |
| 6. Rogers Industrial Chemistry | : Furnas |
| 7. Industrial Chemistry including Chemical Engineering | : B.K. Sharma |
| 8. Paint and Varnish Technology | : Fisher |
| 9. Principles of Sugar Technology | : P. Honig |
| 10. শিল্প রসায়ন | : নুরুল হক ভূঁইয়া |

Course No.: ACCE-202 Chemical Engineering-II

Credit: 2
Exam.-2023 & 2024

Marks: 50
Time: 3 Hours

Rationale: Chemical engineering calculation is the basic subject of chemical engineering, as a chemical engineer, we deal with conversion, separation and reaction. For the simple and complex calculation we have to do. In industry mass and energy balances are widely employed in engineering and environmental analysis. Heat transfer is a discipline of thermal engineering that concerns the generation, use, conversion and exchange of thermal energy between physical systems. Refrigeration and air conditioning are widely used in industry for different purposes. For this reason this course covers the fundamentals of chemical engineering including engineering calculations, mass and energy balances, heat transfer, refrigeration and air conditioning.

Objectives of the Course: The course will help students to understand and knowledge in:

The concept of conversion of mass as the basis for determining mass flows in chemical processing systems involving chemical reactions and separation systems.

The fundamental concepts of mass transfer.

The study of heat transfer, refrigeration and air conditioning.

Intended Learning Outcomes (ILOs) : Upon completion of this course the student is expected to-

Apply knowledge of fundamental engineering calculations.

Know the mass and energy balances and related problems.

Understand the principles of heat transfer to solve heat transfer problems.

Understand the basics of refrigeration and air conditioning.

Course Content

1. Chemical Engineering Calculation: Units and dimensions, systems of dimensions and units, process and process variable- temperature, pressure, composition and flow rates, simple stoichiometric calculations, triangular

diagram, graphical methods of addition and subtraction, basis of calculation, The chemical equation and stoichiometry, Regression and nonlinear axes , mathematical relationship between variables.

2. Mass Balances: Process classification, types of balances, steady state and unsteady state operations, principle and procedure of material balance, material balance calculation of unit operations without chemical reaction. Limiting and excess reactant, yield, conversion, recycle, bypass, purge. Mass balance involving combustion of solid, liquid and gases, mass balance in industrial reactions.

3. Energy Balances: Forms of energy, energy balance on closed and open systems at steady state, heating of gases- heat capacity, empirical equation, mean heat capacity, heat of mixing, heat of combustion, heat of formation, heat of reaction, calculation of enthalpy change, calculation of heat of reaction of industrial reactions and differential energy balance.

4. Heat Transfer: Heat transfer in solids, principle of heat flow in fluids, heat transfer to fluids with and without phase change, radiation heat transfer, heat transfer equipments and applications.

5. Refrigeration and Air Conditioning: Basic theory, compression and absorption refrigeration cycles. ammonia absorption machines. The low-pressure and high-pressure side of a refrigeration system. Refrigerants, Applications of refrigeration.

Books recommended:

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| 1. Introduction to Chemical Engineering | : W.L. Badger & J.T. Banchero |
| 2. Elementary Principles of Chemical Processes | : R.M. Felder & R.W. Rousseau |
| 3. Unit Operations of Chemical Engineering | : W.L. McCabe, J.C. Smith & P. Harriot |
| 4. Introduction to Chemical Engineering | : L.B. Andersen & L. Wenzel |
| 5. Handbook of Chemical Engineering | : Peery |
| 6. Introduction to Chemical Engineering | : S.K. Ghosal, S.K. Sanyal & S. Dutta |

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| 7. Basic Principles and Calculations in
Chemical Engineering | : D.V. Himmelblau |
| 8. Stoichiometry | : E. Williams & C.
Johnson |
| 9. Mass Transfer Operations | : R.E. Treybal |
| 10. Chemical Engineering
Thermodynamics | : B.F. Dodge |
| 11. Principles of Unit Operations | : A.S. Foust et al |
| 12. Heat Engineering | : V.P. Vasandan & D.S.
Kumar |
| 13. Principles of Powder Technology | : M. Rhodes |
| 14. Hydraulics | : Wisler & J.G. Woodburn |

Course No.: ACCE-203
Environmental Chemistry-II

Credit: 2

Exam.-2023 & 2024

Marks: 50

Time: 3 Hours

Rationale: The environment impacts our way of life in many ways. Adverse impacts to this environment affect the well-being of humans and other living organisms. Therefore, it is essential that students understand natural environmental systems, physical and social causes of environmental problems, and strategies to mitigate or manage these issues. This course discusses the concepts of local and global climate conditions of the environment.

Objectives of the Course: The objective of this course is to understand the causes and sources of different types of environmental pollution and their environmental impacts. To examine the various ways by which human activities have altered the natural environment.

Intended Learning Outcomes (ILOs): Having completed this course, it is expected that the students will be able to-

Understand and define terminology commonly used in environmental chemistry.

Summarize and describe global, regional climate change and their adverse effect on environmental processes and systems.

List common and adverse human impacts on biotic communities, air quality and suggest sustainable strategies to mitigate these impacts. Apply learned information to postulated environmental scenarios to predict potential outcomes.

Course Content

1. Atmospheric Chemistry: Importance of the atmosphere, measurement of air quality; particulate matter, gases, the evolution of atmosphere, inversions and air pollution, global climate and microclimate, carbon cycle. Aerosols- their direct and indirect effects, aerosol properties, sources and production mechanisms of atmospheric aerosols, direct and indirect forcing associated with aerosols.

2. Environmental Sampling and Monitoring Techniques: Factors affecting sampling schedules and locations, selection of materials and methods, measurement of source concentration, ambient concentration, monitoring techniques for air, water and soil samples.

3. Marine Pollution: Sources, causes and effects of marine pollution, toxic pollutants- antifouling paints, DDT, dioxins, PCBs, oil pollution, marine debris- fishing gears, plastics.

4. Climate Change: Definition of climate change, how climate change occurs, consequences of climate change, mitigation and recommendation, impacts of climate change on Bangladesh.

5. Environmental Radioactivity: Sources of radionuclides in the environment, the effect of radiation on environment, effects of ionizing radiation on living things, transmission of radioactive fall out in food chain of man. The risks and benefits of radiation. Danger from nuclear power plants. Preventive measures from radiation. Radioactivity atlas with special reference to Bangladesh.

Books recommended:

1. Environmental Chemistry : S.E. Manahan
2. Environmental Chemistry of Soil : M. McBride
3. A Guide to the Study of Environmental : William
Pollution : Andrews
4. A Text Book of Environmental : S.S. Dara
Chemistry and Pollution Control
5. Environmental Chemistry : A.K. De
6. Environmental Chemistry : H. Kaur & B.K.
Sharma

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| 7. Environmental Chemistry | : S.C. Bhatia |
| 8. Environmental Toxicology | : J.N. Duffins |
| 9. The Chemistry of our Environment | : R.A. Horne |
| 10. Air and Water Pollution | : A.S. Stoker |
| 11. Environmental Chemistry | : G. Eglinton |
| 12. Introduction to Atmospheric Chemistry | : Peter V. Hobbs |
| 13. Water Pollution | : V. P. Kudeshia |
| 14. Visualizing environment and forest
considering climate change using GIS | : Mohmmmed Al
Amin |
| 15. Applications of Environmental Aquatic
Chemistry | : Eugene R.
Weiner |

Course No.: ACCE-204
Physical Chemistry-II

Credit: 3

Exam.-2023 & 2024

Marks: 75

Time: 4 Hours

Rationale: Physical Chemistry develops students' understanding of the chemical concepts and chemical change including chemical, electrical and thermal energy.

Objectives of the Course: The course will act as a support to understand the fundamental topics of physical chemistry.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to understand the importance of phase equilibria; definition and basic concepts, laws and properties of thermodynamic systems and processes, their properties, laws and equations of electrochemistry, definition, classification, their properties, laws of surface chemistry and colloids.

Course Content

1. Phase Equilibria: Phase rule and its derivation, metastable systems, sublimation, polymorphism, one-component systems. Binary liquid systems, the distillation of liquid mixtures. Partially miscible liquids.

2. Chemical Kinetics and Catalysis: Order of a reaction, reactions of first, second and third order, reactions of fractional and zero-order, determination of the order of reaction, simultaneous reaction, chain reactions. Theories of reaction rates: Simple collision theory, absolute

reaction rate theory. Characteristics of catalysts, types of catalysis, theories of catalysis, industrial catalysts and additives.

3. Thermodynamics-II: Second law of thermodynamics, Carnot theorem, Entropy and free energy. Dependence of free energy function on temperature and pressure, Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Applications of the second law in colligative properties, Third law of thermodynamics.

4. Electrochemistry: Conductor, Conductance of electrolytes, Equivalent conductance at infinite dilution for strong and weak electrolytes.

Electrolysis: Theory of Electrolytic dissociation. Arrhenius theory of ionization, Debye-Huckel law, the salvation of ions, Migration of ions. Transport number and its determination. Kohlrausch's law, Reversible and Irreversible Electrochemical Processes; Standard Electrode Potentials; Redox Potentials; Nernst's Equation for Electrode Potential.

5. Surface and Colloid Chemistry: Adsorption at gas-solid interface, physical and chemical adsorption, Langmuir and BET theory and surface area determinations, Gibb's adsorption isotherm. General methods of preparation, purification, classification and general properties and stability of colloids. Colloidal electrolytes, Ionic micelles. Gel and emulsion.

Books recommended:

1. A Text Book of Physical Chemistry : S. Glasstone
2. Principles of Physical Chemistry : M.M. Huque & M.A. Nawab
3. Essentials of Physical Chemistry : Bahl & Tuli
4. Elementary Physical Chemistry : Lewis & Glasstone
5. Physical Chemistry : P.C. Rakshit
6. Physical Chemistry : N. Kundu & S.K. Jain
7. Physical Chemistry : W.J. Moore
8. A Text Book of Physical Chemistry : K.K. Sharma *et al.*
9. Physical Chemistry : P. W. Atkins
10. Physical Chemistry : K. L. Kapoor

Course No.: ACCE-205
Inorganic Chemistry-II

Credit: 2
Exam.-2023 & 2024

Marks: 50
Time: 3 Hours

Rationale:

The purpose of this course is to provide students with a deep understanding of inorganic chemistry. At its core, the study of inorganic chemistry deals with the details of chemical bonding, bonding stereoisomerisms and applications of coordination complexes, quantitative inorganic analysis and spectrophotometric analysis. Moreover, students of this course are expected to learn the characteristics of transition, inner transition materials and organometallic compounds.

Objectives of the Course: The course will help the students to gain understanding and knowledge in:

Chemical bonding and chemical bonding theories such as VBT, CFT and MOT.

Theory and practices of colorimetric and spectrophotometric analysis.

The theoretical basis of inorganic quantitative analysis.

Analytical application of coordination compounds.

Chemistry of transition, inner transition and organometallic compounds.

Intended Learning Outcomes (ILOs): After studying this course, students should be able to-

Explain the chemical bonding theories.

Explain the hybridization of bonding orbitals, classify, compare and interpret theories of covalent bonds in term of VBT, CFT and MOT methods.

Acquire knowledge in nomenclature, general characteristics, and stability of organometallic compounds and general applications of organometallic compounds.

Solve numerical problems.

Course Content

1. Chemical Bonding-II: Shapes of molecules, general properties of the metallic bond, dipole moments, the hydrogen bond, Van der Waals forces.

Variable valences, comparison of different bond types, hybridization of bond orbitals. Bond energy, bond length, bond angle, atomic and ionic sizes, and covalent radii. Elementary idea on VBT, CFT and MOT.

2. Coordination Compounds: Definition and types. Warner's theory. Types of ligands. Nomenclature. Electronic interpretations and bonding stereoisomerisms of 4 and 6 co-ordinate complexes, inner complexes. Analytical uses of coordination complexes.

3. Quantitative Inorganic Analysis: Principles involved in volumetric analysis, acid-base and redox titration. Theories of acid-base and redox indicators.

4. Organometallic Compounds: Definition, classification of organic ligands and organometallic compounds and their nomenclature, general characteristics, stability of organometallic compounds, general uses.

5. Nuclear Chemistry: Radioactivity, patterns of nuclear stability, nuclear transmutations, rates of radioactive decay, detection of radioactivity, energy changes in nuclear reactions, nuclear fission, nuclear fusion, isotopes, isobar, isomers, methods of separation of isotopes, applications of radioisotopes.

Books recommended:

1. Fundamental Concepts in Inorganic Chemistry : E.S.Gilreath
2. Introduction to Modern Inorganic Chemistry : S.Z. Haider
3. Snatak Ajoybo Rashayon : S. Ahmed & L. Hossain
4. Inorganic Chemistry : T. Moeller
5. Modern Inorganic Chemistry : R.D. Madan
6. Chemical Bonding : Companion
7. A Text Book of Quantitative Inorganic Analysis : A.I. Vogel
8. Basic Concepts in Analytical Chemistry : S.M. Khopkar
9. Selected Topics in Inorganic Chemistry : Malik, Madan, Tuli

10. Co-ordination Chemistry : Basalo & Johnson
11. Valency and Molecular Structure : Cartmell and Fowels

Course No.: ACCE-206
Organic Chemistry-II

Credit: 2
Exam.-2023 & 2024

Marks: 50
Time: 3 Hours

Rationale: This course will make students aware of the basics and fundamentals of synthetic organic chemistry which is very useful in the synthesis of various intermediates and final compounds. The study of organic chemistry will ensure a foundation in the structure and properties of the chemistry of carbon compounds and their importance in medicinal chemistry, biochemistry, environmental chemistry and consumer product chemistry.

Objectives of this Course: To study aromatic hydrocarbons with their preparations and reactions. To study synthesis, physical, chemical properties and applications of various important alicyclic and heterocyclic compounds. To impart theoretical knowledge on stereochemistry (geometrical, optical and conformational) with special application to biomolecules. To impart consciousness and learn the chemistry of biologically active organic molecules such as carbohydrates in advanced level.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Identify, classify, prepare, apply and explain sources, properties and reactions of various aromatic, alicyclic and heterocyclic compounds. Synthesize and explain properties, reaction and uses of amines. Illustrate the basic concept of rigidity, chirality and configuration. Determine and support configuration of geometrical isomers. Explain,

distinguish and characterize carbohydrates; deduce and measure their reactions.

Course Content

1. Aromatic Hydrocarbons: Structure, nomenclature, preparations, electrophilic aromatic substitution: Friedel-Craft's alkylation and acylation, direction and ease of aromatic substitution, resonance and inductive effects.

2. Aliphatic and Aromatic Amines: Nomenclature, preparation, reactions of amines, Hofmann degradation of amides. Aromatic diazonium salts: structure, preparation and introduction of functional group in the aromatic system, coupling reaction.

3. Alicyclic and Heterocyclic Compounds: Structure, preparation, reactions and general properties and uses of cycloalkanes, pyridine, pyrrole, furan, and thiophene.

4. Stereochemistry: Geometric and optical isomerism, Concept of enantiomers, diastereomers, epimers, Racemic mixture and its modification, Relative and Absolute configuration, Determination of *R,S* configuration. Conformation.

5. Chemistry of Carbohydrates: Definition and classification of carbohydrates, nomenclature, open chain and ring structure of glucose, mutarotation.

Books recommended:

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| 1. | Organic Chemistry | : R.T. Morison & R.N. Boyd |
| 2. | Organic Chemistry (Vol. I & II) | : I.L. Finar |
| 3. | Advanced Organic Chemistry | : B.S. Bahl & Arun Bahl |
| 4. | Organic Chemistry | : S. Pine |
| 5. | Organic Chemistry | : M. Ahmed & A. Jabber |
| 6. | Organic Reaction Mechanism | : Peter Sykes |
| 7. | Heterocyclic Chemistry | : J. A. Joule & G. F. Smit |
| 8. | Advanced Organic Chemistry | : Jerry March |
| 9. | Ionic organic reactions | : Alexander |
| 10. | Advanced Organic Chemistry | : Gilman |
| 11. | To be suggested by the course teacher. | |

Course No.: ACCE-207
Physics-II

Credit: 3
Exam.-2023 & 2024

Marks: 75
Time: 4 Hours

Rationale: This course covers the fundamental aspects, laws, properties and applications of optics, electricity and magnetism.

Objectives of the Course: Upon completion of this course students will be able to-

Appraise the physical accuracy of electrical effects such as ohmic heating and electrocution.

Describe how magnetism is produced and list examples where its effects are observed.

Identify the connection between electricity and magnetism.

Create physically believable special effects such as an electromagnetic pulse.

Intended Learning Outcomes (ILOS): Upon completion of this course students will be able to-

Understand, define and predict basic concept of interference, diffraction and polarization, solve related problems.

Outline, support and apply laws and properties related to electricity and electron emission.

Discuss, explain and predict general properties of magnetism deduce and apply related laws.

Know instrumentation of multimeter (volt/ohm meter VOM), oscilloscope, CRT and glucometer.

Course Content

1. Optics: Light and color- Definitions, Characteristics, Visible-Invisible light spectra, Perceiving color and color phenomenon in nature; Polarization: Optical activity and Polarimeter.

2. Electricity: Electrostatics: Coulomb's law, Electric field, Electric potential and electric dipole; Current: AC and DC, Ohm's law; Kirchoff's law; Circuit: LR, CR and LCR circuits.

3. Electronics: Electron emission: Thermionic emission and photoelectric emission; Semiconductor and Transistor: n-type and p-type semiconductors, pn junction and biasing, LED npn and pnp transistors, Principle of rectification and amplification.

4. Magnetism: Electromagnetic fields and induction: Magnetic force on a charge, Motion of a charge in a uniform electric and magnetic fields, Galvanometer, Biot-Savart law and Ampere's circuital law.

5. Instrumentation: Multimeter (volt/ohm meter VOM), Oscilloscope, CRT and Glucometer.

Books recommended:

1. Fundamentals of Optics : F. Jenkins & H. White
2. Physics (I and II) : Halliday & Resnick
3. Concepts of Electricity & Magnetism : A.K. Rafiqullah, A.K. Roy & M.S. Roy
4. Electricity & Magnetism with Electronics : K.K. Tewari
5. Fundamentals of Electromagnetics : M.A. Wazed Miah
6. Electronic Measurements : K.A. Bakshi, A.V. Bakshi and U.A. Bakshi
8. Handbook of Electronics : S.L. Gupta and V. Kumar
10. Principles of Electronics : V.K. Mehta

Course No.: ACCE-208
Mathematics-II

Credit: 3 Exam.-2023 & 2024	Marks: 75 Time: 4 Hours
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Rationale: This course covers the foundation of mathematics covering geometry and differential equations.

Objectives of the Course: Students will explore the basic ideas, methods and skills through solving problems related to geometry and differential equations.

Intended Learning Outcomes (ILOS):

Explain, discuss and solve geometry and problems related to this area.

Explain, discuss and solve differential equations and related problems.

Describe the connections of geometry and differential equations with drawings.

Describe the interrelations between mathematical equations and chemical problems.

Formulate and operate chemistry and chemical engineering related problems both qualitatively and quantitatively.

Course Content

1. Geometry: Geometry of two and three dimensions: pair of straight lines, 2nd-degree equations. Cartesian and Polar coordinates in three dimension. Equations of planes, lines, sphere, cylinder and cone.

2. Differential Equations: Ordinary differential equations, ordinary differential equations of the first order and first degree. Variables separable, homogeneous equations, Linear equation, exact differential equations, simple cases of differential equations of first order and of degree higher than one linear differential equations with constant co-efficient, methods of undetermined coefficients, variation parameters, Cauchy-Euler differentiation equations, higher-order linear differential equations, initial value problem (IVP), boundary value problem (BVP), Solution of ODE using Laplace Transform.

Books recommended:

1. A Textbook on co-ordinate geometry with vector analysis : Rahman and P.K. Bhattacharjee
2. An elementary treatise on co-ordinate geometry of three dimensions : Robert J. T. Bell
3. Introduction to ordinary Differential Equations : S.L.Roos
3. Differential Equations : F. Ayres
4. Differential Equations : B.D. Sharma
5. Advanced Engineering Mathematics : Erwin Kreyszig, 3rd edition; Wiley Eastern Company limited.

Course No.: ACCE-209 Statistics for Applications

Credit: 3
Exam.-2023 & 2024

Marks: 75
Time: 4 Hours

Rationale: This course covers the fundamentals of statistics. It provides an opportunity for students to acquire a basic knowledge of the different area of statistics. It also provides basic training on the methods and tools of statistics that are commonly used in analytical chemistry and engineering calculations

Objectives of the Course: To have a basic understanding of data analysis and statistical concepts, in order of think critically about the quantitative information. This course outlines the use of the statistics encountered in analytical chemistry, and understand the basic tools that student will use to approach statistical analysis in chemical engineering calculations.

Intended Learning Outcomes (ILOs): On successful completion of this course, the student should be able to-
Explain and apply statistical tools and their theories to identify and solve chemical process and engineering calculations.

Produce and interpret graphical summaries of both qualitative and quantitative data. Produce and interpret numerical summary statistics. Infer properties of a population from a sample by applying basic statistical inferential techniques, including confidence intervals, hypothesis testing and analysis of variance.

Course Content

1. Basic Concept of Statistics: Variables and attributes, collection and representation of statistical data, frequency distribution and graphical representation.

2. Interpretation of Data: Measures of central tendency: mean, median, mode. Dispersion: absolute and relative measures, variance, mean

deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

3. Probability: Basic concept of probability, random variables, probability functions and density functions. Distribution functions, Binomial distribution, Poisson distribution, Normal distribution.

4. Test of Hypothesis: Preliminary ideas of the test of hypothesis, statistical hypothesis, null hypothesis, Alternative hypothesis, Type-I error, Type-II error, level of significance, P-value, Test based on usual normal, t, F, χ^2 (Chi-square) Statistic.

5. Correlation and Regression: Correlation and regression, linear correlation, measures of correlation, coefficient of correlation, rank correlation, regression lines, method of least squares, Association of attributes.

6. Industrial Statistics: Concepts of industrial statistics, causes of variation, process control, principles of control chart, specification and tolerance limits, mean chart, range chart, p-charts, c-charts, advantages of quality control.

7. Analysis of Variance: The purpose of analysis of variance, computation of analysis of variance, one-way classification. Variation within treatments and variation between treatments, a mathematical model for the analysis of variance, two-way classification, variations for two-way experiments, analysis of variance for two-way experiments.

8. Design of Experiment: CRD, RBD, Factorial experiments.

Books recommended:

1. Theory and Problems of Statistics : Murry R. Spiegel
2. Fundamentals of Mathematical Statistics : S.C. Gupta, V.K. Kapoor
3. Essentials of Statistics for Scientists and Technologists : C. Mack
4. Applied Statistics for Engineers (Chem. Eng. Series) : William Volk
5. Statistical Methods in Research and Production : Owen L. Davies
6. Elementary Statistics : Paul G. Hoel
7. Introductory Statistics : T.H. Wonnacott, R.J., Wonnacott

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| 8. Basic Statistical Methods for Engineers and Scientists | : A.M. Neville, J.B., Kennedy |
| 9. Statistical Methods for Scientists | : Bethea |
| 10. Design and Analysis of Experiments | : Das M. M. and Giri N. C. |
| 11. Applied Mathematics in Chemical Engineering | : Harold S. Mickley, Thomas K Sherwood & Charles E. Reed |
| 12. Fundamentals of Applied Statistics | : S.S. Gupta & V.K. Kapoor |

Course No.: ACCE-210
Industrial Economics and Management

Credit: 2	Marks: 50
Exam.-2023 & 2024	Time: 3 Hours

Rationale: This course covers the fundamental aspects of industrial Economics and Management to build a model or conceptual framework of chemical process industry.

Objectives of the Course: The course aims at providing with basic knowledge of industrial economics and management. It intends to

highlight the concepts of industrial economics, demand and supply analysis of a given product, production and cost analysis. This course

attempts to focus on investment, market structure and probability analysis of the given project or business. In the case of management, the objective of the course is to provide the concept of management, principles and process of management, management history, decision-making process, organizational management functions in details.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-
Define, discuss and explain terms of industrial economics and management.

Design a pilot plant by giving special attention to economics and management.

Course Content

1. Industrial Economics:

a) Introduction: Nature and Significance of Economics, Micro and Macro Economics, Industrial economics, Scope of Industrial economics, the importance of industrial economics.

b) Demand and Supply: Concept of Demand, Concept of Supply, Theory of Consumer's Behavior Utility Analysis, Consumer Surplus, Elasticity of Demand

c) Production and Cost: Meaning of production, factors of production – land, labor, capital, Factors determining the efficiency of labor, capital formation. Short-run and long run cost, variable costs, average cost, marginal costs, and total cost curve.

d) Investment: Meaning of investment, types of investment, factors affecting investment, Marginal efficiency of capital.

e) Market Structure: The concept, classification of markets, pure competition, monopoly, oligopoly, pricing decision in a different market.

f) Depreciation: Physical functional depreciation, methods of determining depreciation, service value, salvage value, the present value of equipment.

g) Profitability Analysis: Project, project evaluation, evaluating project profitability, depreciation, break-even analysis, Determining p-table return, Replacement policy, methods of profitability evaluation for replacement.

2. Management Principles

a) Introduction: Manager, management, functions of a manager, management rules, levels, significance of management.

b) Approaches to Management: classical approach, quantitative approach, behavioral approach, contemporary approach.

c) Planning: Meaning, purpose, types, process, MBO, contemporary issues of planning.

d) Organizational Structure: Organizing, organizational structure, departmentalization, formal and informal organization, organizational design.

e) **Motivating Employees:** Motivation, early theories of motivation, contemporary theories of motivation.

Books recommended:

1. Modern Economic theory : K. K. Dewett and Adarsh chand
2. Management : Stephen P. Robbins and Mary Coulter
3. Principle of Economics : Lipsey and K. A. Chrysal
4. Principles of Economics : W. J. Baumol and A. S. Blinder
5. Management : R. W. Griffin
6. Management: A global perspective : Weihrich and Koontz

Course No.: ACCE-211
Lab-IV: Inorganic Quantitative Analysis

Credit: 3 Exam.-2023 & 2024	Marks: 75 Time: 9 Hours
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Rationale: This course covers the inorganic quantitative analysis techniques.

Objectives of the Course: To learn and apply inorganic quantitative analysis techniques such as volumetric analysis, precipitation titrations, gravimetric and colorimetric analyses.

Intended Learning Outcomes (ILOS): Upon the completion of this course students will be able to-
Outline, apply and discriminate important inorganic quantitative analyses techniques.

Course Content

1. Acid base titrations.
2. Oxidation-reduction titrations e.g. with KMnO_4 solution, with $\text{K}_2\text{Cr}_2\text{O}_7$ solution and with iodine solution.
3. Determination of copper iodometrically.

4. Precipitation titrations: Determination of Ag and Cl by Volhard's methods.
5. Gravimetric determination: Sulphate as BaSO₄, Copper as Cu₂(CNS)₂ and Nickel as Ni-Dimethylglyoximate.
6. Quantitative chemical separation and determination of mixtures: (a) Cu and Zn, (b) Fe and Mn, (c) Cr and Fe, (d) SO₄ and a metal, (e) Cu and Ni.

Books recommended:

1. A Text Book of Inorganic Chemistry : A.I. Vogel
Quantitative Analysis
2. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে

Course No.: ACCE-212
Lab-V: Physical Chemistry

Credit: 3

Exam.-2023 & 2024

Marks: 75

Time: 9 Hours

Rationale: Practical work is viewed as an important method for teaching and learning in chemistry. Practical work of physical chemistry is integral to ensure the opportunity to solve problems.

Objectives of the Course: The course will cover and act as a support to understand the practical knowledge of physical chemistry topics.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to determine and measure molar mass, partition coefficient, and heat of neutralization, phase diagrams, solubility product, and heat of dilution, conductometric and pH-metric titrations.

Course Content

1. Determination of molar mass of compounds by Victor Meyer's method, by Cryoscopic method: Rast's micro-method and by ebullioscopic method.
2. Partition Coefficient of I₂ between water and CCl₄.
3. ΔH_N of a strong acid by a strong base.
4. Phase diagrams of two component systems: low melting organic solids, miscible liquids: phenol-water.
5. Determination of the solubility product.

6. Heat of dilution of $\text{H}_2\text{SO}_4/\text{NaOH}$ by calorimetric method.
7. Conductometric and pH-metric titrations.
8. Determination of viscosity of solutions at different compositions.

Books recommended:

1. Findlay's Practical Physical Chemistry : B.P. Levitt
(9th Edn.)
2. Practical Physical Chemistry : B. Viswanathan &
P.S.
Raghavan
3. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে

Course No.: ACCE-213
Lab-VI: Chemical Engineering I

Credit: 2 Exam.-2023 & 2024	Marks: 50 Time: 6 Hours
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Rationale: Enabling the students to learn the methods and practices followed in the design of process equipment's and to draw the designed equipment to scale.

Objectives of the Course: The course will help students to familiarize with the: Design of heat and mass transfer equipment, drawing of different equipment, pumps, compressors, dryers, boilers, heat exchangers. Drawing of major types of vessels, enclosures and supports. Design and drawing of physical separation equipment. Symbols for piping and instrumentation and flow sheet symbols for unit operations. Layout, design and elevation drawings of heat exchangers.

Intended Learning Outcomes (ILOs): Upon the completion of the course, students will be able to- Design heat and mass transfer equipment. Identify the design needs for process equipment based on operating conditions of chemical plant operation. Design cooling and heating systems of chemical reactors and use software tools for the analysis of process equipment.

Course Content

1. Detailed design and drawing of enclosures and supports
2. Detailed design and drawing of different equipments- pumps, compressors, dryers, boilers, heat exchangers
3. Detailed design and drawing of agitated vessel and basket centrifuge.
4. Detailed design and drawing of gravity thickener.
5. Detailed design and drawing of cyclone separator.
6. Detailed design and drawing of the crystallizer.
7. Detailed design and drawing of cooling towers.
8. Introduction to computer-aided design of equipment

Books Recommended:

1. *Chemical Engineering*, Volume 6, : Sinnott. R.K, Coulson &
3rd Edn Butterworth Heinemann, Richardson's
New Delhi, 1999
2. Perry's, "*Chemical Engineers* : Perry. R.H., et al.
Handbook," 7th Edn.

Syllabus for Third Year B. Sc. (Honours) Examination, 2024 & 2025

Course No.: ACCE-301 Chemical Process Technology-III

Credit: 3 Exam.-2024 & 2025	Marks: 75 Time: 4 Hours
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Rationale: This course is primarily designed for a chemical engineer. Early stage of a professional career, a person primarily working in a chemical plant, engaged in the manufacture of various chemical products. It is, therefore, necessary to provide adequate information to the students about new materials, the chemistry involved in manufacturing process of some important chemical products such as cosmetics, perfume, agro-chemicals, woods chemicals and lubricants.

Objective of this Course: Understanding about fundamentals of design and implementation of a chemical project. To impart knowledge in understanding different basic concepts, sources, classification, composition and application of industrial technology and chemical process used in cosmetics, perfumes, agro-chemical and wood chemicals. To understand the importance of lubrication and how the lubricant protect the equipments. To understand the chemistry of adhesives.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Design, plant site selection, utility services, supply systems, disposal and implementation of a chemical project. Know the safe environment and minimize contamination.

Define, classify, compare, identify, and formulate, different cosmetics and perfumes.

Formulate and manufacture different important agrochemicals.

Course Content

1. Design and Implementation of a Chemical Project: Methods of carrying out a design project. Process development, Design information from literature, Techno-economic feasibility study, Selection of plant site, technology, utility services, instrumentation, storage and supply systems, waste disposal, health and safety aspects, maintenance, construction and operation.

2. Cosmetics and Perfumes: Cosmetics: Introduction and classification, essential oils and their importance in cosmetic industries, Skin and cosmetics, skin creams and lotion, face powder, talcum powder, lipsticks, sunscreen preparation; Hair care products and conditioners, shampoo, hair sprays and colourants. Cosmetics for Eye, Nail and Teeth; preservatives and antioxidants. B. Perfumes: Introduction and classification, raw materials of perfumes (Natural and Synthetic), Fantasy perfumes and their formulation (Aldehyde, Chypre types, Oriental and Green perfumes): Preparation and uses.

3. Agro-chemical Industries: Raw materials, method of manufacture and uses of insecticides, fungicides and Herbicides. Organophosphorus pesticides: Malathion, Monocrotophos, dimethoate, chloropyrifos. Carbamates: Carboryl, Baygon, Ziram, Zineb, Maneb. Pyrethroids: Natural pyrethrins: Isolation and structures, Synthetic Pyrethroids: Allethrin, Cypermethrin. Insect Peromones and Repellcnts: pheromones, general introduction and application in integrated. Plant growth stimulators.

4. Wood Chemicals: Hardwood distillation, naval stores, gum oleoresins, terpentines, sulphate pulp rosin, tall oil, lignin, lignosulfates, hydrolysis of wood, wood extractives and conversion processes, wood distillation. Tissue manufacture.

5. Lubricants: Definition, properties of lubricants, classification of lubrication, substances used as lubricants, greases, test for lubricants.

6. Adhesives: Animal glue, starch adhesives, synthetic adhesives, cellulose and silicate adhesives.

7. Industrial Gases: Manufacture and uses of hydrogen, oxygen, nitrogen and carbon dioxide.

Books recommended:

1. Chemical Process Industries : R.N. Shreve
2. Handbook of Industrial Chemistry : Reigels
3. Industrial Chemistry : B.K. Sharma
4. Industrial Chemistry (Part I & II) : R. K. Das
5. A Text Book of Chemical Technology : G.N. Pandy
6. Rogers Industrial Chemistry : Furnas
7. Industrial Chemistry including Chemical Engineering : B.K. Sharma
8. Polypropylene structure, blends and composites : Karjer –Koksis
9. Plant design and economics for chemical engineers : Max Peters and Timmerhaus
10. Elementary principles of chemical processes : Pelder& Rousseau
11. A text book of Engineering chemistry : M M Uppal
12. Chemistry of Pesticides : N.N.Melnikow
13. Chemicals for crop protection and pest management : M.B. Green, G. S. Hartley W.
14. Pesticides : R. Cremlyn
15. Particulate filled polymer composites : R Rothon

Course No.: ACCE-302
Chemical Engineering-III

Credit: 3 Exam.-2024 & 2025	Marks: 75 Time: 4 Hours
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Rationale: This course covers the mass transfer, fluid mechanics, crystallization, chemical reactor design, transportation of fluids and plant design and scale-up .

Objectives of the Course: The course will help students to understand and knowledge in:

The fundamental concepts of mass transfer.

The study of fluid mechanics, transportation of fluids, crystallization, chemical reactors design, plant design and scale up.

Intended Learning Outcomes (ILOs) : Upon completion of this course the student is expected to-

Know the mass transfer related problems.

Understand the fluid mechanics and crystallization system.

Understand the principles of fluid mechanics and transportation of fluids.

Design chemical reactors, reactor types, reactor design and reactions therein.

Course Content

1. Mass Transfer: General principle of diffusional processes, diffusion , multicomponent diffusion, Fick's law of diffusion, molecular and eddy diffusion, transfer of material between phases, mass transfer operation-filtration, gas absorption, leaching, liquid-liquid extraction, interphase mass transfer theory, Penetration theory, Surface renewal theory and Boundary layer theory.

2. Fluid Mechanics: Types of fluid, general properties of fluid, viscosity, fluid statics and its application, pressure concept, hydrostatic equilibria, manometers, fluid flow phenomena, mechanism of fluid flow, Reynolds number, Flow at low and high Reynold's number, basic equations for fluid flow. Newtonian and non-newtonian fluid, Laminar flow, turbulent flow, Navier-Stokes equation, Agitation, Cyclone.

3. Crystallization: Crystal form and crystal habit, classification of crystallizers, theory of crystallization, calculation of yield, nucleation, rate of crystal growth, caking of crystals and its prevention.

4. Chemical Reactor Design: Classification of reactors, ideal reactors, space-time and space velocity, residence time, distribution of fluid in vessels, dispersion model. Homogeneous reactions, interpretation of kinetic data, kinetic models for homogeneous reactions, testing kinetic model.

5. Transportation of Fluids: Pumps, pump head, power requirement, suction lift and cavitation, types of pumps, pump efficiency, pump priming.

Fans, blowers: types and operation. Positive displacement pump. Rotary pump, axial flow pump, NPSH (Net positive suction head).

6. Plant Design and Scale-up: Plant location, plant layout, flow diagram, plant operation, utilities, structural design. Importance of pilot plant study and models, the principle of similarity, dimensional analysis, similarity criteria, extrapolation, scale-up of heat transfer and mixing equipment, packed towers and chemical reactors.

Books recommended:

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| 1. Introduction to Chemical Engineering | : W.L. Badger & J.T. Banchero |
| 2. Elementary Principles of Chemical Processes | : R.M. Felder & R.W. Rousseau |
| 3. Unit Operations of Chemical Engineering | : W.L. McCabe, J.C. Smith & P. Harriot |
| 4. Introduction to Chemical Engineering | : L.B. Andersen & L. Wenzel |
| 5. Handbook of Chemical Engineering | : Peery |
| 6. Introduction to Chemical Engineering | : S.K. Ghosal, S.K. Sanyal & S. Dutta |
| 7. Basic Principles and Calculations in Chemical Engineering | : D.V. Himmelblau |
| 8. Stoichiometry | : E. Williams & C. Johnson |
| 9. Mass Transfer Operations | : R.E. Treybal |
| 10. Chemical Engineering Thermodynamics | : B.F. Dodge |
| 11. Principles of Unit Operations | : A.S. Foust et al |
| 12. Heat Engineering | : V.P. Vasandan & D.S. Kumar |
| 13. Principles of Powder Technology | : M. Rhodes |
| 14. Hydraulics | : Wisler & J.G. Woodburn |

Course No.: ACCE-303

Fuel Technology

Credit: 3
Exam.-2024 & 2025

Marks: 75
Time: 4 Hours

Rationale: Fuel was the original choice in early fast reactors and that will be more sustainable in future. Currently, technologists are developing and adapting fuel technology. This provides society with energy technology choices to meet ever-growing needs in areas such as fuel processing and use.

Objectives of the Course: The course will cover and act as a support to understand the fuel technology topics, to identify.

Intended Learning Outcomes (ILOs): Upon completion of this course students will be able to-

Define and explain basic concepts and properties of fuel. Know the chemistry and technology involved in petroleum and coal. Understand natural gas and modern and artificial fuel.

1. Basic Concepts of Fuel: Definition, essential requirements and classification of fuel. Primary and secondary fuels- solid, liquid and gaseous fuels; advantages and disadvantages of solid, liquid and gaseous fuels; classification of gaseous fuel. Composition and calorific value of fuels. Determination of calorific value- direct and indirect methods. Role of fixed carbon, nitrogen, sulphur, oxygen and ash content on the calorific value of fuels.

2. Geological Aspects and Exploration of Petroleum: Prospects of petroleum on the basis of geological analysis; preconditions for petroleum-source rock, reservoir rock, Trap.; History of petroleum and gas survey in Bangladesh; survey methods- geological, geophysical,

geochemical, recovery factor; petroleum and gas fields in different parts of the world; prospects of petroleum in Bangladesh; petroleum exploration and production.

3. Chemistry and Technology of Petroleum and its Products:

Origin, occurrence, composition and classification of crude oils, the chemistry of petroleum- effect of nonhydrocarbons on the product quality. Petroleum refining processes- distillation of petroleum, cracking of petroleum- thermal cracking, catalytic cracking, pyrolysis, refining products- fuel oil, diesel, kerosene, gasoline, antiknock motor fuels, liquefied petroleum gas (LPG), aviation gasoline, lubricating oils, bitumens, asphalts. Octane and cetane number of liquid fuels, detonation of fuels, antiknock compounds on knock inhibitors, methods of obtaining high octane fuel by alkylation, polymerization, hydroforming, reforming, aromatization and isomerization; chemical treatment to improve the properties of petroleum products, deasphalting, additives for petroleum fractions, petroleum waxes and their separation techniques from lubricating oils, pour point.

4. Natural Gas: Origin and occurrence of natural gas, chemical composition of natural gas obtained in Bangladesh, dry and wet natural gases, impurities of natural gas, purification of natural gas, compressed natural gas (CNG), reserve of natural gas in Bangladesh, prospect of natural gas in Bangladesh. Natural gas fields in different parts of the world.

5. Coal: Origin, formation and composition of coal; chemical definition of coal, classification of coal chemicals; analysis and properties of coal-proximate and ultimate analysis of coal. Effects of different constituents on the rank of coal, coal in industrial purpose- coking and non-coking coals, preparation and storage of coal. Prospect of coal in Bangladesh. Carbonization of coal- low and high temperature carbonization, changes at different temperature in carbonization process- semi, soft and hard cokes. Coal chemicals- recovery of coal chemicals, coal tar distillation, purification of aromatic compounds (benzene, toluene, xylene, anthracene etc.) from coal tar, coke oven gas, hydrogenation of coal.

6. Modern and Artificial Fuels: Definition and types of modern fuels; source of modern fuels- nuclear, solar, wind and water current sources; synthetic fuels- water gas, semi-water gas, producer gas and oils gas.

Books recommended:

1. The Petroleum Chemical Industry : Goldstein
2. Petrochemical Industries : Hrdu and Williams
3. Chemistry of Petroleum Derivatives : Flix
4. Chemical Refining of Petroleum : Kalichevsky

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| 5. | Chemical Process Industries | : R.N. Shreve |
| 6. | Introduction to Petrochemicals | : Sukumar Maiti |
| 7. | Chemistry and Technology of Basic Organic and Petrochemical Synthesis (Vol. 1 & 2) | : N.N. Lebedev |
| 8. | American Petroleum Refining | : H.S. Bell |
| 9. | Modern Petroleum Refining Process | : B.K. Bhaskara Rao |
| 10. | The World of Petroleum | : B.G. Deshpande |
| 11. | Petroleum Refining Engineering | : W.L. Nelson |
| 12. | Petroleum Refining and Economics | : J.H. Gray & G.E. Handwerk |
| 13. | Coal | : Moor |
| 14. | Coal | : W. Francia |
| 15. | Chemistry of Coal Utilization | : Lawry |
| 16. | Natural Gas and Natural Gasoline | : Huntington |
| 17. | Bangladeshe Tel Shambabona O Haripur Tel Bitorka | : Badrul Imam |

Course No.: ACCE-304
Polymer Processing Technology

Credit: 3

Exam.-2024 & 2025

Marks: 75

Time: 4 Hours

Rationale: To study on macromolecules has great importance. Macromolecules, these are the synthetic materials used for plastics, fibers and elastomers, with a few naturally occurring polymers, such as, rubber, wool and cellulose included. Today these substances are truly indispensable to mankind, being essential to clothing, shelter, transportation, and communication, as well as to the conveniences of modern living. Taken together, study on the polymer technology is very much rationale.

Objectives of the Course: The course will help students to gain knowledge in:

The basic concepts of synthetic and naturally occurring polymers.

Different polymerization/copolymerization techniques and their molecular weight concepts.

Size and shape of the high molecular weight compounds.

To give brief ideas on plastic industry and the production of common polymers.

Preparation, properties and reactions of different types of inorganic polymers.

Intended Learning Outcomes (ILOs): After studying this course, students will be able to:

Know the basic concept of polymer and the key design features of a polymer.

Understand the mechanism and kinetics of different polymerization/copolymerization methods.

Apply the knowledge of polymer formation to synthesize a new polymer.

Acquire knowledge on the sources, isolation and properties of inorganic polymers.

Course Content

1. Basic Concepts of Polymers: Classification, natural and synthetic polymers, organic and inorganic polymers, distinction between simple molecules and polymers, linear, branched and cross linked polymers, chemical and geometrical structure of polymer molecules, Crystallinity in polymers, glass transition temperature (T_g), uses of high polymers.

2. Polymerization: Types of polymerization- step reaction (condensation), radical chain (addition) and ionic chain polymerizations, mechanism and kinetic of polymerizations: initiator and initiation, propagation and termination, polymerization techniques, miscellaneous polymerization reactions.

3. Copolymerization: Copolymerization, free radical copolymerization, ionic copolymerization, copolycondensation, monomer reactivity ratios

and its determination, types of copolymerization, block and graft copolymers, Q-e scheme and dendrites.

4. Size and Shape of Macromolecules: Molecular weight of polymers- average molecular weight, number average and weight average molecular weight, degree of polymerization, polydispersity index, methods for

determining of molecular weight of high polymers,
significance of molecular weight and molecular weight distribution curves.

5. Polymer-metal Complexes as Catalysts: Polymer-metal complexes: synthesis and classification, reaction of peripheral functional groups in metal complexes with polymers, catalytic activities of polymer-metal complexes, application of polymer-metal complexes as catalysts, polymer-metal complexes as heterogeneous biologically active catalysts, macromolecular effects on catalytic activities of polymer-metal complexes.

6. Plastic Materials and Processing Technology: Classification of plastics, thermoplastic plastic and thermosetting plastics, properties and uses of plastics, raw materials for plastics, manufacture phenol-formaldehyde resins (Bakelite), melamine-formaldehyde resins, polyethylene, polypropylene, polyvinyl chloride and polystyrene. Plastics, elastomers and fibres, compounding, processing techniques- molding, extrusion, thermoforming, foaming, reinforcing, fibre spinning and others, multipolymer systems and composites, plasticizers and other additives.

7. Inorganic Polymers: Inorganic polymers, homopolymers and heteropolymers, polysulfur nitride, polysiloxanes, polysilanes, polyphosphazenes, carborane polymers, organometallic polymers.

Books recommended:

1. Principles of Polymerization : G. Odian
2. Polymer Science : Gowariker,
Viswanathan
& Sreedhur
3. The Chemistry of High Polymers : C.E.H. Bawn
4. Chemical Microstructure of Polymer Chain : J.L. Koenig
5. Textile Chemistry (Vol. 1, 2 & 3) : R.H. Peters
6. Wood Chemistry Fundamentals and Applications : E. Sjostrom
7. Wood Structure and Composition : M. Lewin and I.S. Goldstein
8. Polymer Science & Technology of Plastics and Rubber : P. Ghosh
9. Text Book of Polymer Science : F.W. Billmeyer
10. Principles of Polymer Chemistry : P. Flory
11. Introduction to Polymer Chemistry : G.S. Misra

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| 12. Dyeing of Cellulose Fibres and Related Processes | : Cockett & Hilton |
| 13. Chemical Technology of Fibrous Materials | : F. Sadov, Korchagim and Matetsky |
| 14. Dyeing and Chemical Technology of Textile Fibres | : E.R. Trotman |
| 15. Polymer Chemistry: an Introduction | : M.P. Stevens |
| 16. Polymer Chemistry | : Malcolm P. Stevens |
| 17. Essentials of Polymer Sciences and | : Paul C. Painter |
| 18. Engineering The Chemistry of Polymers | : John W. Nicholson |

Course No.: ACCE-305
Analytical Chemistry

Credit: 3	Marks: 75
Exam.-2024 & 2025	Time: 4 Hours

Rationale: This course is designed to develop the analytical skill of the students to analyze and interpret data in the practical applications. Students will be introduced to basic chemical measurements with sophisticated/modern instruments where basic laboratory skills will be developed.

Objectives of the Course: This course gives an introduction to analytical chemistry and an overview of important analytical methods and their range of application within detection of inorganic and organic compounds. The course also includes important steps and procedures in analytical chemistry and evaluation/interpretation of results. The course gives an overview of important use of selected classical, electrochemical

and instrumental chemical qualitative and quantitative analytical methods and a short introduction to their basic theory.

Intended Learning Outcomes (ILOs): After studying this course, students will be able to-
Perform calculations in analytical chemistry.

Calculate titration errors for method evaluation.

Perform statistical evaluation of results from classical and instrumental chemical experiments.

Explain the theoretical principles and important applications of classical analytical methods.

Course Content

1. Analytical Sampling: Solid, liquid and gaseous samples, sampling procedure and sample population, operations of drying and preparing a solution of the analyses.

2. Errors in Chemical Analysis: Significant figures, mean and median, precision and accuracy, classification of errors, determinate and indeterminate errors, random and systematic errors in analysis, minimization of errors, standard deviation, confidence intervals and limits, Statistical treatment of analytical data.

3. Titrimetric Analysis: Titrimetric analysis, classification of reactions in titrimetric analysis, standard solutions, preparation of primary standard solutions, principles of titrations, titration curves, detection of the end point, indicators.

4. Gravimetric Analysis: Introduction to gravimetric analysis, precipitation methods, unit operations in gravimetric analysis, impurities in precipitates, gravimetric calculation.

5. Complexometry: Principles and types of EDTA titration, formation constant of EDTA complexes, effect of pH upon complex formation, metal ion indicators and their functions, masking and demasking, applications of complexometric titration.

6. Polarography: Theoretical principles, residual, migration, diffusion and limiting currents, polarographic maxima and their suppression, half wave potential, applications of polarography.

7. Chromatography: Principles of chromatographic analysis: techniques and applications of column, ion-exchange, paper, thin layer chromatography (TLC) and gas liquid chromatography (GLC), High performance liquid chromatography (HPLC): normal phase, reversed phase, ion exchanges and ion pairing techniques of HPLC, application of HPLC in analysis of drugs and industrial products.

8. Solvent Extraction Method: General discussion, factors favoring solvent extraction, distribution coefficient, distribution ratio, percent extracted separation techniques, successive extraction, separation of mixtures by extraction, efficiency of metal chelates; analytical separations.

Books recommended:

1. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
2. A Text Book of Practical Organic Chemistry : A.I. Vogel
3. A Text Book of Inorganic Qualitative Analysis : A.I. Vogel
4. Fundamentals of Analytical Chemistry : D.A. Skoog, D.M. West & F.J. Holler
5. Environmental Sampling and Analysis for Metals : M. Csuros & C. Csuros
6. Basic Concepts in Analytical Chemistry : S.M. Khopkar
7. Analytical Chemistry : G.D. Christian
8. Analytical Chemistry : R.M. Verma
9. Quantitative Analytical Chemistry : H.A. Flaschka, A.J. Barnard & P.E. Sturrock

Course No.: ACCE-306
Pharmaceutical Process and Technology-I

Credit: 3 Exam.-2024 & 2025	Marks: 75 Time: 4 Hours
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Rationale: This course deals with the production of pharmaceutical dosage forms, bioavailability and stability of produced dosage forms, preparation, development and testing of modified release systems, determination of the properties of excipients and formulation of these excipients with active ingredients in the most convenient

Way. Finally it will deal the development of sterilization techniques and testing of assuring standard quality of solid dosage forms.

Objectives of the Course: The goal of this course is to enlighten the students with the knowledge of-
Solid dosage forms, stability, controlled dosage forms used in pharmaceutical technology.

Physico-chemical properties of active ingredients in drug formulations.

Processing and manufacturing of drugs.

Different methods of sterilization in pharmaceuticals.

Intended Learning Outcomes (ILOs): Upon completion of this course, students will be able to –

Know about the processing of pharmaceutical raw materials, the standard quality of ingredients and products.

Gain detailed knowledge of identification, chemistry, manufacturing and stability of drugs.

Course Content

1. Basic Concepts: (i) The Pharmacopoeias, Drugs-nomenclature, Generic and branded drugs, Source of drugs, Lipiniski's rule, INN drug, Factors affecting drug absorption, Diffusion of drug across membrane, Site of absorption, Bioavailability, Distribution of drugs, Drug metabolism.

(ii) Unit operation and unit process in pharmaceutical industry, Procurement, Specification, storage and dispensing of pharmaceutical raw materials, API and excipients with examples and functions, Product development, Documentation and validation, Responsibilities of QC and QA departments, Good Laboratory Practice (GLP), GMP, cGMP, Total Quality Management (TQM), Standard Operating Procedure (SOP), In Process Control (IPC) of Pharmaceuticals Manufacturing, Techniques used in Pharmaceutical manufacturing. Reference standard and working standard and Calibration of instruments

2. Tablets: Weights and measures, formulation and compounding of tablets by different methods, slugging capping of tablets, disintegration test for compressed tablets, essential qualities of a good tablet, advantages and disadvantages of tablets as medical dosage form.

3. Capsules: Definition and administration, hard and soft capsules, dispensing of capsules, prescriptions for hard capsules, enteric coated capsules, machineries used for making different types of capsules, quality control of capsules.

4. Enzymes and Proteins: Definition, Classification and properties of amino acids, primary, secondary, tertiary and quaternary structures of proteins, enzymatic degradation of proteins, qualitative and quantitative estimation of amino acids in proteins, sequence of polypeptides and proteins. Definition, classification, nomenclature and structural features of enzymes, specificity and mechanism of enzymatic action, optimum condition for enzymatic action; inhibition of enzymatic reaction, factors affecting enzymatic activity.

5. Aerosols: Definition and principles. Preparation of aerosols. Pharmaceutical application. Aerosols for typical use. Sterile filling. Equipments and quality control.

6. Sterilization: Microbial assays, sterility test and pyrogen testing.

Books recommended

1. Medicinal Chemistry : A. Burger
2. A Text Book of Pharmaceutical Chemistry : Driver
3. A Text Book of Inorganic Pharmaceutical Chemistry : Rogers
4. Modern Methods of Plant Analysis : Pacch and Tracy
5. Plant Alkaloids : Henry
6. May's Chemistry of Synthetic Drugs : R. Fleck
7. General Biochemistry : Fruton and Simmonds
8. Antibiotics : Flowry
9. Organic Chemistry (Vol. I & II) : I.L. Finar
10. Chemistry and Physiology of Vitamins : Rosenbudrg
11. The Vitamins : Dyke
12. Husa's Pharmaceutical Dispensing : E.W. Martin
13. Principles of Biochemistry : White, Handler & Smith
14. Tablet Making : A.E. Fribance
15. Process Engineering Economics : A.I. Little
16. Hormones : Pincus
17. Remington's Pharmaceutical Sciences : Remington
18. Chopra's Indigenous Drugs of India : Chopra et al

Course No.: ACCE-307 Metallurgical Engineering

Credit: 3
Exam.-2024 & 2025

Marks: 75
Time: 4 Hours

Rationale: Metallurgy is the part of material science and material engineering that studies the physical and chemical behavior of metallic elements, extraction techniques of metals, their intermetallic compounds and their alloys.

Objectives of the Course: The course will cover and act as a support to understand the basic concept of pyro-, hydro- and powder metallurgy, metals extraction process. Moreover, studies on physical and chemical

behavior of metals, elements, their intermetallic compounds and their alloys.

Intended Learning Outcomes (ILOs): Upon the completion of this course students will be able to-

Understand fundamental concepts, characteristics, refining, extraction, transportation, construction and phase diagrams of metals.

Help students to identify hazardous substances in metallurgical production and sources of environmental pollution.

Course Content

1. Metals, Ores and Pyro-metallurgy: occurrence and ore preparation. Physical methods of ore dressing: comminution, sorting classifications, concentration, gravity concentration, froth flotation methods. Pyro-metallurgical techniques: calcining, roasting, Sintering, smelting, Reduction of ores with carbon and metals, physical chemistry of thermal reduction process, slags, fluxes and Ellingham diagram.

2. Phase Diagrams: Definition and basic concepts, solubility limit, binary isomorphs system, development of microstructures in isomorphs alloys, binary eutectic system, development of microstructures in eutectic alloys, iron-iron carbide phase diagram, and development of microstructure iron-iron carbide alloys.

3. Iron and Steel: Construction and operation of the blast furnace with chemical reactions in the furnace. Fuel economy and uses of by-products. Cast iron, wrought iron and steel. Bessemer, open-hearth and electrical process of steel making, effect of impurities (S, P, Si, Mn etc.) on steel. Heat treatment of steel: annealing, normalizing, hardening, tempering and gas carburizing. Iron and steel industry in Bangladesh.

4. Hydrometallurgy: Principle of solvent extraction, leaching and their application in extraction of metals.

5. Extraction: Principles and general methods of Pyro-metallurgical extraction of copper, lead, zinc and hydrometallurgical extraction of aluminum and uranium.

6. Powder Metallurgy: Principle, application, advantages and limitations.Characteristics and production of metal powders. Compacting, hot pressing and sintering.

Books recommended:

1. Theory of Metallurgical Processes : A. Volsky and E. Sergievskaya
2. Extractive Metallurgy : J. Newton
3. Principles of Extractive Metallurgy : A. Ghosh and H. H. Ray
4. Extractive Metallurgy : Fathi Habash
5. Process Selection in Extractive Metallurgy : P.C. Hayes
6. A Text Book of Metallurgy : A. R. Baily
7. Physical Metallurgy : V. Gaghavan
8. Physical Chemistry of Iron and Steel Manufacture : C. Bodsworth
9. Manufacturing Process and Materials for Engineers : L.E. Doyle and C.A. Keyser
10. Chemistry of Engineering Materials : Robert B. Leighou
11. A Text Book of Material Sciences and Metallurgy : O.P. Khanna
12. Physical Metallurgy and Engineers : D.S. Clark and W.R. Varney
13. An Introduction to Science of Corrosion and its Inhibition : S. N. Banerjee
14. Corrosion Engineering : S. N. Banerjee
15. Corrosion Engineering : G. Fontana
16. Introduction to Corrosion Engineering and its Prevention : Uligue

Course No.: ACCE-308

Food Processing Technology

Credit: 3
Exam.-2024 & 2025

Marks: 75
Time: 4 Hours

Rationale: This course covers the general concepts, production, processing and preservation of food in detail. This course also explores the effects of various materials, microorganisms on food products.

Objectives of Course: Students will be able to develop knowledge and understand about basic of food industry and their nutritive value, food production, processing, preservation and consumption of food. Students will be able to analyses food by applying theoretical concepts.

Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to- Know the basics principle relating to food, nutrition and the relationship of food to human health.

Gain knowledge and familiarity with the ways of food processing and food preservation.

Conduct chemical and biological food tests and adjust the quality of food in factories.

Apply the principles and knowledge related to nutrition and food manufacturing.

Critically think to grasp the reality and the problems of the food industry and participate in resolving them.

Course Content

1. Introduction: General aspects of food industry, world food needs and Bangladesh situation, constituents of food, quality and nutritive aspects, food additives, standards, deteriorative factors and their control, preliminary processing methods, conversion and preservation operations.

2. Food Preservation: Preservation by heat and cold, dehydration and concentration, frying, irradiation, microwave heating, sterilization, and pasteurization, fermentation and pickling.

3. Food Packaging: Introduction, types of containers, food packaging materials and forms, Safety of food packaging.

4. Food Safety, Risks and Hazards: Food related hazard, microbiological consideration in food safety, effects of processing and storage on microbial safety.

5. Food Products and Processing: Production of Jam, Jelly and Fruit Juice. Processing of soft and alcoholic beverages, dairy products, poultry and fish products, treatment and disposal food processing wastes.

6. Food Analysis: Moisture, ash, crude protein, fat, fiber, carbohydrates, calcium, potassium, sodium and phosphate. Food adulteration; common adulterants in food, contamination of foodstuffs, microscopic examination of foods for adulterants. Pesticides analysis in food products. Extraction and purification of a sample; HPLC, GC for organophosphates, TLC for identification of chlorinated pesticides in food products.

7. Pollution from Food and Beverage Processing Industries: Historical background of food and beverage processing industries in Bangladesh, characteristics of liquid effluents of food and beverage processing industries, pollution control in food and beverage processing industries.

Books recommended:

1. Fundamentals of Food Processing Operations : Heid J.L. and Joslyn M.A.
2. Food Science : Potter N. N.
3. Elements of Food Engineering : Waston, Ernest. L., Harpaer, Cline J.
4. Elementary Food Science : Ronsivalli, L. J. Vieira, E. R.
5. Food and Food Production Encyclopedia : Considine D.M., Considine G.D.
6. Biotechnology and Food Ingredients : Goldberg I. Williams, R.

Course No.: ACCE-309
Lab-VII: Chemical Engineering-II

Credit: 2
Exam.-2024 & 2025

Marks: 50
Time: 6 Hours

Rationale: This course advances students' learning and experience in experimental aspects of a number of areas of chemical engineering. Both fundamental aspects, such as kinetics and reaction engineering, process control, heat and mass transfer and fluid flow as well as more applied topics will be covered. The course will not only serve to reinforce fundamental principles of chemical engineering, but also to the application of the technology.

Objectives of the Course: The course emphasises and reinforces topics and principles introduced in lectures through experiential learning in the laboratory and with practical work in general. In successfully completing the course students will develop the ability to critique experimental data and techniques.

Intended Learning Outcomes (ILOs): On successful completion of the course students will be able to:

Demonstrate an understanding of the fundamental principles underlying chemical engineering through practical experimentation.

Show an understanding of the issues related to experimental aspects of chemical engineering

Exhibit expertise relevant to the practice of engineering

Bring a problem-solving mindset to any challenge in the workplace

Demonstrate some understanding of the professional obligations related to the discipline of engineering, with a special emphasis of the development of safe working practices during laboratory exercises

Course Content

1. An analysis of simple liquid mixing
2. Determination of viscosity Index of Motor oils
3. Continuous and Fractional distillation of binary mixtures
4. Simple distillation
5. Estimation of chromium in the given stainless steel sample.
6. The particle size distribution of a mixture of particles by sieve analysis.

Books Recommended:

1. *Chemical Engineering*, Volume 6, 3rd Edn Butterworth Heinemann, New Delhi, 1999 : Sinnott. R.K, Coulson & Richardson's
2. Perry's, "*Chemical Engineers Handbook*," 7th Edn. : Perry. R.H., et al.
4. Applied Chemistry Theory and Practice : Vermani and Narula
5. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
6. Practical Organic Chemistry : Clarke

Course No.: ACCE-310 Lab-VIII: Chemical Process Technology-I

Credit: 2

Exam.-2024 & 2025

Marks: 50

Time: 6 Hours

Rationale: This course is designed to give students ideas about the analysis of few industrial products practically. This course will be conducted simultaneously with its theoretical knowledge. It is the medium that graduates can learn from theoretical knowledge and implement it practically to avoid analytical error in their professional carrier.

Objectives of the Course: The objectives of the course are to achieve the technical skill to analyze industrial products that may be applicable to various industries e.g. Textile, Petrochemicals, Heavy Chemical Industries, Water refinery, Sugar Industry, Food Industry etc.

Intended Learning Outcomes (ILOs): After studying this course students will be able to-

Determine the Reichert-Meissl value, Polenske value, and Peroxide value of oil/fat sample to in order to make a statement on the quality of oil/fat.

Analyze the cane sugar and glucose by diversified methods.

Analyze a few industrial products.

Conduct qualitative research.

Course Content

1. Determination of Iodine value of fat/oil sample.
2. Determination of Saponification value of fat/oil sample.
3. Determination of Acid value of fat/oil sample.
4. Analysis of commercially available cast iron, various types of steel and stainless steel and other ferrous and non-ferrous alloys.
5. Analyses of available ores, slags and scraps.
6. Analysis of soap sample for Total alkali and acid.
7. Analysis of soap sample for Moisture content.
8. Analysis of soap sample for filling matter.
9. Determination of Ester value of fat/oil sample.
10. Analysis of industrial raw materials.

(a) Iron Ore (b) Scrap iron (c) Gypsum (d) Bauxite (e) Sulphur (f) Fuel Oil, (g) Natural gas (h) Coal, (i) Oilseeds (j) Cellulosic raw material (k) Lime & Limestone (l) Sea- salt (m) Sand (n) Water

11. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. Practical Organic Chemistry : Clarke
4. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
5. Procedure Supplied from the Dept. of ACCE.

Course No.: ACCE-311

Lab-IX: Chemical Process Technology-II

Credit: 2	Marks: 50
Exam.-2024 & 2025	Time: 6 Hours

Rationale: To provide the student with an understanding of the fundamental chemical processes that are central to important industrial products.

Objectives of the Course: Students will gain hands-on experience with study design, laboratory measurements, monitoring equipment and sophisticated instrumentation. Students will sample both in the laboratory and the ambient environment as part of this experiential course to gain practical experience at chemical technologies.

Intended Learning Outcomes (ILOs): Upon successful completion of the course, the students will be able to-

Understand laboratory techniques and instrumentation used in testing air quality, water quality, sugar, fats and oils and industrial products.

Develop sampling plans and approaches to study design.

Conduct research in a laboratory setting.

Course Content

1. Determination of the amount of reducing sugar.
2. Determination of temporary and permanent Hardness of water sample.
3. Analysis of fat/oil sample for Reichert-Meissl value.
4. Analysis of fat/oil sample for Polenske value.
5. Estimation of cane sugar and glucose by (i) Fehling solution method, (ii) Benedict method and estimation of sugar in molasses and (iii) Iodometric method.
6. Analysis of cane sugar for invert sugar sucrose and ash.
7. Determination of Peroxide value of fat/oil sample.
8. Analysis of Industrial products.
(a) Soap and detergents (b) Fertilizers (c) Bleaching powder (d) Acids and alkalis (e) Carbon disulphide (f) Refined vegetable oils (g) Hydrogenated fats (h) Animal fats and oils (i) Milk and milk products (j) Sugar, Honey and confectionary materials (k) Glass.
9. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. Practical Organic Chemistry : Clarke
4. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
5. Procedure Supplied from the dept of ACCE.

Course No.: ACCE-312
Lab-X: Environmental Technology –I

Credit: 2 Exam.-2024 & 2025	Marks: 50 Time: 6 Hours
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Rationale: To provide the student with an understanding of the fundamental chemical processes that are central to important environmental problems. This course will also provide a scientific foundation for decision-making processes to protect public health and the environment from the adverse effects of chemicals.

Objectives of the Course : tudents will gain hands-on experience with design, laboratory measurements, monitoring equipment and sophisticated instrumentation. Students will do sampling both at the laboratory and the ambient environment as part of this experiential course to gain practical experience of different environmental measurements.

Intended Learning Outcomes (ILOs): Upon successful completion of the course, the students will be able to-

Understand laboratory techniques and instrumentation used in testing water quality, fish, fruit and vegetables and industrial products.

Develop sampling plans and approaches to study design.

Conduct research in a laboratory setting.

Gain experience transforming data from the instrument.

Course Content

1. Determination of DO in the water sample.
2. Determination of BOD of wastewater sample.
3. Determination of COD of wastewater sample.
4. Determination of TDS and TSS of a waste water sample.
5. Determination of Turbidity of a water sample.
6. Determination of iron in a water sample by Spectrophotometric method
7. Determination of pH, EC of a water sample.
8. Determination of acidity and alkalinity of a water sample.
9. Analysis of Oil and Grease in wastewater sample.
10. Analysis of water for chlorine, organic matter, nitrate, nitrite, ammonium ion.

11. Analysis of water for phosphate and sulphate ion.
12. Determination of Formalin in contaminated samples (Fish, Fruits and vegetables).
13. Determination of pollutants in different industrial samples.
14. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
4. Procedure Supplied from the Dept. Of ACCE

Lab-XI: Scientific Communication: Written, Oral and Visual

Course No.: ACCE-313

Lab-XI: Scientific Communication: Written, Oral and Visual

Credit: 2

Exam.-2024 & 2025

Marks: 50

Time: 4 Hours

Rationale: This course is developed to ACCE students' communication skills using different scientific presentation formats (i.e., written, oral, poster). Not only will this course help students in their course work during their graduate studies but also as they transition to their professional lives: communicating at scientific meetings, grant writing, writing manuscripts for professional journals, drafting resumes, interviewing, and sharing techniques with colleagues.

Objectives of the Course: To develop students oral, visual and written scientific communication skills and to familiarize students with research resources. Students may use their own research topic, including work on a thesis or dissertation, or help will be provided in selecting one.

Intended Learning Outcomes (ILOs): By the end of this course, each student will be able to:

Perform effective literature reviews and accurately cite relevant literature.

Perform critiques of written, oral and visual materials.

Incorporate suggestions and criticisms from critiques into their own work.

Develop written and oral communications/presentations describing and interpreting statistical analyses for different types of audiences.

Course Content

1. Attendance and Participation (20 points): Students are expected to attend class and come prepared to participate in discussions and activities.

2. Written Communication: E-mail, Resume/CV, Report, Journal Article, Review Article, Book writing. Writing communication component (45 points).

- One-two paragraph summary of project: 5 points.
- References for project: 5 points.
- Abstract: 5 points.
- Two-three-page project description (initial): 5 points.
- Peer critiques: 5 points.
- Project description revision: 15 points.
- Sketch: 5 points

3. Oral Communication: Lecture, Meeting, Presentation, Interview.

Oral communication component (15 points).

- Oral presentation: 10 points.
- Peer critiques: 5 points.

4. Visual Communication: Poster Session, Lecture, Presentation

Visual communication component (20 points).

- Poster presentation: 10 points.
- Peer critiques: 5 points.
- Seminar critique: 5 points.

Books recommended:

1. Science Communication: A Contemporary Definition
By- T. W. Burns, D. J. O'Connor, S. M. Stockmayer
2. How to Compose, Write and Publish a Scientific or Professional Communication. By- Boranic M. Acta Inform Med.

doi: 10.5455/aim.2016.24.416-418. PMID: 28077907; PMCID: PMC5203754.

3. Hoogenboom BJ, Manske RC. How to write scientific article. *International Journal of Sports Physical Therapy*. 2012; 7(5): 512-7.
4. How to write article. URL: <http://www.columbia.edu/cu/biology/ug/research/paper.html>
5. How to write article. URL: <http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWsections.html>
6. How to write article. <http://www.owl.net.rice.edu/~bios311/bios311/sciarticle.html>

Syllabus for Fourth Year B. Sc. (Honours) Examination, 2025 & 2026

Course No.: ACCE-401 Chemical Engineering-IV

Credit: 3 Exam.-2025 & 2026	Marks: 75 Time: 4 Hours
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Rationale: Chemical engineering is a continuously evolving discipline linked to a variety of industries. Chemical engineers lead the design of large-scale facilities in the chemical, petrochemical, and industrial biotechnology sectors. This course enables students to perform basic design calculations and analysis of typical industrial processes involving particulate matters.

Objectives of the Course: The objectives of the course are to:
Provide students with advanced technical skills in chemical engineering.
Enable students to solve problems within an engineering type of environment.
Provide training in research.

Intended Learning Outcomes (ILOs):

Upon completion of this course students will gain
An advanced knowledge of fundamental areas of chemical engineering.
An understanding of how discoveries and other ideas can be exploited effectively, including new company spin-outs, re-organisation of existing company structures.
Produce workable solutions to engineering problems.

Course Content

1. Equilibrium Stage Operations: Principles of stage processes, calculation of stages by graphical methods and other short cut methods using Fenske, Underwood, Colburn and Gilliland correlation, binary distillation, x-y diagrams, multicomponent distillation-phase equilibria and concept of key components, pinch point etc., calculation of multicomponent system, design calculations, theoretical analysis.

Azeotropic and extractive distillation, distillation equipments, plate and packed towers, design procedures.

2. Multistage Counter Current Gas Absorption: Calculation of theoretical stages in absorption column, graphical design procedure, multicomponent absorber and stripper, absorption in single equilibrium stage, continuous differential-contact packed column design.

3. Design of Fluid Flow Equipment: Centrifugal, reciprocating and rotary pumps, compressors, liquid, gas and slurry pipelines, thrust nozzle, different types of valves, fittings, storage tanks, thickener, venturi scrubber.

4. Industrial Catalysis: Surface chemistry & catalysis, solid-liquid interface, solid-gas interface, surface area of solids, adsorption of gases and vapours on solids, Langmuir adsorption isotherm–BET and related isotherms, thermodynamics of adsorption, kinetics of adsorption and desorption, poly-functional catalysis, electrocatalysis, catalysis by metal complexes, deactivation of catalysts, regeneration of deactivated catalysts, catalyst preparation methods, design of industrial catalysts.

5. Design of Heterogeneous Reactors: Introduction to catalytic and non-catalytic reactions; steps in a catalytic reaction; adsorption isotherms, surface reaction and desorption; classical ward and testing of models; determination of a rate law; model of reaction and rate-limiting step; experimental reactors and treatment of data; design of Heterogeneous Reactors moving bed, packed bed and fluidized bed reactors and reactors for uncatalized heterogeneous reactions.

Books recommended:

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| 1. Introduction to Chemical Engineering | : W.L. Badger & J.T. Banchero |
| 2. Elementary Principles of Chemical Processes | : R.M. Felder & R.W. Rousseau |
| 3. Unit Operations of Chemical Engineering | : W.L. McCabe, J.C. Smith & P. Harriot |
| 4. Introduction to Chemical Engineering | : L.B. Andersen & L. Wenzel |

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| 5. | Handbook of Chemical Engineering | : Peery Robert H |
| 6. | Introduction to Chemical Engineering | : S.K. Ghosal, S.K. Sanyal & S. Dutta |
| 7. | Mass Transfer Operations | : R.E. Treybal |
| 8. | Chemical Engineering Thermodynamics | : B.F. Dodge |
| 9. | Principles of Unit Operations | : A.S. Foust et al |
| 10. | Separation Process Principles | : Seader J.D. & Henley E.J |
| 11. | Multi-component Distillation | C. D. Holland |
| 12. | Distillation. | :M. Van Vincle |
| 13. | Design of Equilibrium Stage Processes | :B.D. Smith |
| 14. | Chemical Reaction Engineering | : Levenspiel Octave |
| 15. | Fluid Mechanics with Engineering Applications | : Franzini Daugherty |
| 16. | Fluid Mechanics | : F. M. White |
| 17. | Handbook of Chemical Engineering. Calculation | : Chohey N.P |
| 18. | Conceptual Design of Chemical Process | : Douglas |
| 19. | Plant Design and Economics for Chemical Engineering | : Peters and Timerhaus |
| 20. | Systematic Method for Chemical Process Design | : Beigler, L. T |
| 21. | Industrial Catalysis and Separations: Innovations for Process Intensification | : K. V. Raghavan, B. M. Reddy |
| 22. | Industrial Catalysis: A Practical Approach | : Jens Hagen |
| 23. | Handbook of Industrial Catalysts | : Lloyd, Lawrie |

Course No.: ACCE-402
Pharmaceutical Process and Technology-II

Credit: 3
Exam.-2025 & 2026

Marks: 75
Time: 4 Hours

Rationale: The course deals with the chemistry, preparation, made of action, structural activity and pharmaceutical uses of some essential pharmaceutical products like vitamin, antibiotic, hormone and so on. It will also help to know the stability of emulsion and the quality control tests of emulsion and aerosol.

Objectives of this Course:

To understand the chemistry, biochemistry and properties of important components of the pharmaceuticals industry.

To enable students to perceive the detailed activities of vitamins, antibiotics and hormones.

To gain insights on all the preparation techniques, uses and stability of pharmaceutical products.

To develop the knowledge of the filling, packaging, storage and quality control of products.

Intended Learning Outcomes (ILOs): Upon completion of this course students will be able to-

Elaborate opportunities with techniques to handle pharmaceutical products.

Get a clear conception about maintaining the standard quality of the pharmaceutical industries.

Course Content

1. Vitamins: History, occurrence, classification and chemistry of vitamins A, B, C, D, E and K. Biochemistry and mode of action of vitamins.

2. Antibiotics: Production, chemistry, actions and uses of different penicillin's, streptomycin, chloramphenicol and tetracycline.

3. Hormones: Chemistry and physiological functions of the thyroid hormone, insulin, progesterone, testosterone, adrenaline, cortisone, estrone and synthetic sex hormones.

4.Ointments: Definition and classification, factors affecting skin absorption, ointment bases, preparation of ointments including dermatological preparations, ophthalmic ointments.

5. Emulsion: Definition and classification, determination of types of emulsion, the theory of emulsion, emulsification and emulsifying agents, HLB system, types of emulsifying agents, stability of emulsion, sedimentation or creaming, emulsion stability testing preparing equipment, industrial manufacture of emulsion, packing and storage.

6. Drugs: (i) General methods for extraction, isolation and identification of active principles of crude drugs: Definition and classification of alkaloids, industrial production plant (equipments, flow-sheet etc.), chemistry including physical, chemical and physiological properties of the principal constituents of the Nux Vomica, Cinchona, Belladonna, Opium and Ephedra species.

(ii) Stability and preservation of drugs. Study of chemistry including general biological action of important synthetic drugs: sulpha drugs,

antimalarials, analgesics, antidiabetics, antipyretics, cardiovascular, antihistamine etc. Chemotherapy of important drugs in current use.

Books recommended:

1. Medicinal Chemistry : A. Burger
2. A Text Book of Pharmaceutical Chemistry : Driver
3. A Text Book of Inorganic Pharmaceutical Chemistry : Rogers
4. Modern Methods of Plant Analysis : PACCEh and Tracy
5. Plant Alkaloids : Henry
6. May's Chemistry of Synthetic Drugs : R. Fleck
7. General Biochemistry : Fruton and Simmonds
8. Antibiotics : Flowry
9. Organic Chemistry (Vol. I & II) : I.L. Finar
10. Chemistry and Physiology of Vitamins : Rosenbudrg
11. The Vitamins : Dyke
12. Husa's Pharmaceutical Dispensing : E.W. Martin
13. Principles of Biochemistry : White, Handler & Smith
14. Tablet Making : A.E. Fribance
15. Process Engineering Economics : A.I. Little

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| 16. Hormones | : Pincus |
| 17. Remington's Pharmaceutical Sciences | : Remington |
| 18. Chopra's Indigenous Drugs of India | : Chopra et al |

Course No.: ACCE-403 Petrochemical Technology

Credit: 3	Marks: 75
Exam.-2025 & 2026	Time: 4 Hours

Rationale: Petrochemical Engineers have made important contributions to society over many years in terms of products and processes. A large number of industries depend on the synthesis and processing of chemicals and materials. Hence, the breadth and versatility of this course will continue to open many new opportunities.

Objectives of the Course: This course will help

To provide a broad education on petrochemical technology including the basic concept of petrochemicals and their production process.

To gain knowledge in rubber processing technology.

Contribute to society in terms of the energy crisis.

Intended Learning Outcomes (ILOs): Upon completion of this course, students will have the-

The basic concept of petrochemicals.

Knowledge to describe rubber plants, extraction and refining of rubber

Ability to identify, formulate, and solving engineering problems related to petrochemical and rubber industry.

Course Content

1. Basic Concept of Petrochemicals: History and development of petrochemical industry, classification of petrochemicals-first, second and third-generation petrochemicals, prospect of petrochemical industries in Bangladesh, raw materials of petrochemicals: gaseous raw materials-natural gas, refinery gas, liquefied petroleum gas, liquid raw materials-naphtha, solvent extracts and distillates, solid raw materials- petroleum wax and petroleum cokes.

2. Chemistry and Production Technology of

Petrochemicals: Phenol, vinyl chloride, acrylonitrile, styrene, acetylene and ethylene from hydrocarbons. Production of aromatics and their separation, productions of BTX, carbon monoxide and synthesis gas from hydrocarbons.

3. Catalysts for Petrochemicals Processes: Catalysts for petroleum refining, catalysts for petrochemicals industry, recent advances in industrial catalysts, the role of polymers in catalysts. Future of petrochemicals- energy crisis and petrochemicals industry, energy crisis and industrial fuels and trends in petrochemical industry.

4. Rubber Materials and Processing Technology: Classification of rubber, refining of crude rubber, synthetic rubber, manufacture of styrene-butadiene rubber, butyl rubber, silicone rubber, neoprene rubber, rubber compounding and rubber reclaiming, properties and uses of rubber, sponge and foam rubbers.

Books recommended:

1. The Petroleum Chemical Industry : Goldstein
2. Petrochemical Industries : Hrdy and Williams
3. Chemistry of Petroleum Derivatives : Flix
4. Chemical Refining of Petrochemicals : Kalichevsky
5. Chemical Process Industries : R.N. Shreve
6. Introduction to Petrochemicals : Sukumar Maiti
7. Chemistry and Technology of Basic Organic and Petrochemical Synthesis (Vol. 1 & 2) : N.N. Lebedev
8. Industrial Chemistry : B.K. Sharma
9. Natural Gas and Natural Gasoline : Huntington
10. Polymer Science and Technology of Plastics and Rubbers : P. Ghosh
11. Synthesis Resins and Allied Plastics : H.M. Langton

Course No.: ACCE-404

Instrumental Analysis

Credit: 3
Exam.-2025 & 2026

Marks: 75
Time: 4 Hours

Rationale: Chemists are able to design specific synthetic routes to produce compounds from starting materials. However, how do the chemists actually know what structures the compounds that they are wishing to make actually have? Instrumental analysis is helpful to analyze that.

Objectives of the course: The course will cover and act as a support to understand the UV, IR, FTIR Raman, Mass, AAS, NMR, thermal and X-Ray related topics.

Intended Learning Outcomes (ILOs): Upon completion of this course, students will be able to understand the theoretical principles, characteristics, instrumentation, determination and application of spectrophotometric methods for qualitative and quantitative analyses like UV, IR, FTIR Raman, Mass, AAS, NMR, thermal and X-Ray related topics.

Course Content

1. Spectroscopic Analysis: (a) UV- Vis Spectroscopy: Beer-Lambert's law, determination of unknown concentration of a solution, principles, types of electronic transitions, instrumentation and applications. **(B) IR Spectroscopy:** Principles, types of electronic transitions, instrumentation of the IR spectrophotometers and their measurement principles, applications.

2. Atomic Absorption and Flame Emission Spectroscopy: Atomic absorption spectrometry, AAS: absorption of characteristic radiation, instrumentation; sample vaporization, qualitative measurements, Applications. Flame emission spectrometry, FES, flame characteristics, flame processes quantitative measurements, interference, Applications.

3. Mass Spectrometry: Introduction, Basic principle, instrumentation, determination of molecular formula. Mc Lafferty rearrangement, meta-stable ions, fragmentation process, interpretation of mass spectra.

4. Nuclear Magnetic Resonance (NMR) Spectroscopy:

Theory, instrumentation, relaxation process, Information from NMR spectra, chemical shift, factors influencing chemical shifts, spin-spin coupling, spin-spin splitting patterns, factors affecting spin-spin coupling, shift reagents, spin de-coupling, chemical shifts in case of proton exchange reaction, restricted rotation etc. Applications of NMR spectroscopy.

5. Thermal Analysis: Principles for the thermo-gravimetric analysis (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC), DTA and TGA curves, factors affecting TGA and DTA results, applications of TGA, DTA and DSC.

6. X-ray Diffraction and X-ray Fluorescence: Properties of X-rays, diffraction, the Bragg law, diffraction directions, diffraction method, scattering of X-rays, experimental methods, determination of crystal structure, X-ray fluorescence.

Books recommended:

1. Instrumental Methods of Chemical Analysis : G.W. Ewing
2. Standard Methods of Chemical Analysis : F.J. Welcher (edited)
3. Analytical Chemistry : G.D. Christian
4. Analytical Chemistry : R.M. Verma
5. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
6. Quantitative Analytical Chemistry : H.A. Flaschka, A.J. Barnard & P.E. Sturrock
7. The Principles of Metallographic Laboratory Practice : G.L. Kehl
8. Thermal Analysis : Wendlandt
9. Thermal Analysis- Techniques and Applications : E.L. Charsley (edited)
10. Instrumental Methods of Chemical Analysis : B.K. Sharma
11. Instrumental Methods of Chemical Analysis : Ghatwal and Anand
12. রাসায়নিক বর্ণালীমিতি ও কোয়ান্টাম মেকানিক্স : জেড. এ. চৌধুরী
13. Electrochemical Methods : A.J. Bard & L.R. Faulkner
14. Electrochemistry : C.M.A. Brett & A.M.O.

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| 15. Elements of X-ray Diffraction | Brett
: B.D. Cuttlity |
| 16. Instrumental Methods in
Electrochemistry | : R. Greef, R. Peat, L.M.
Peter, D. Pletcher & J.
Robinson |

Course No.: ACCE-405 Research Methodology

Credit: 3

Exam.-2025 & 2026

Marks: 75

Time: 4 Hours

Rationale: Research is for everybody who is willing to learn and enhance their knowledge. Research is a careful and detailed study of a particular problem or concern, using scientific methods. An in-depth analysis of information creates space for generating new questions, concepts and understandings.

Objectives of the Course:

Expansion of Knowledge Base:

One of the greatest benefits of research is to learn and gain a deeper understanding. The deeper you dig into a topic, the more well-versed you are.

Keeping up to date: Research encourages you to discover the most recent information available. Updated information prevents you from falling behind and helps you present accurate information.

Intended Learning Outcomes (ILOs):

In general, research objectives describe what we expect to achieve by a project.

Formulate hypotheses which could be tested in another piece of research.

Formulate Research Aims and Objectives.

Course Content

1. Introduction: Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Defining the Research

Problem, What is a Research Problem? Selecting the Problem, Technique Involved in Defining a Problem..

2. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs.

3. Sampling Design: Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe, Complex Random Sampling Designs.

4. Measurement and Scaling Techniques: Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools, Scaling, Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Technique.

5. Methods of Data Collection: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

6. Processing and Analysis of Data: Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation..

7. Statistics in Research: What is a Hypothesis? Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, Flow Diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means, Hypothesis Testing for Differences between Means, Hypothesis Testing for Comparing Two Related Samples, Chi-square Test, Analysis of Variance (ANOVA) and Covariance, Multivariate Analysis Techniques.

8. **Interpretation and Research Writing:** Meaning of Interpretation, Why Interpretation? Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing , Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Scientific Writing (Research Report/original research manuscript/review manuscript) Precautions for Writing Research Reports, Research issues (ethical issues, intellectual honesty, intellectual property rights) The Computer: Its Role in Research..

Books recommended:

1. Research Methodology: A Step-by- Step Guide for Beginners Fourth Edition : Ranjit Kumar
2. Research Methodology: Methods and Techniques : C.R Kothari
3. Research Methodology: An Introduction : Wayne Goddard, Stuart Melville

Course No.: ACCE-406
Materials Science and Engineering

Credit: 3

Exam.-2025 & 2026

Marks: 75

Time: 4 Hours

Rationale: This course is designed to give students ideas on mechanical, physical, and chemical properties of engineering materials, such as metals, ceramics, polymers, nanomaterials, and composites and biomaterials.

Objectives of the Course: To predict and control material properties through an understanding of atomic, molecular, crystalline, and microscopic structures of engineering materials.

To be an essential member of an engineering team responsible for the synthesis and processing of advanced materials for manufacturing.

To make capable a graduate's may work in areas as diverse as automobile, aerospace, biomedical, or microelectronics manufacturing.

Intended Learning Outcomes (ILOs): After studying this course, students should be able to-

Know the mechanical, physical, and chemical properties of engineering materials.
Understand the atomic, crystalline, and microscopic structures of engineering materials, product development, synthesis, and processing operations.

Course Content

1. Engineering Materials: Materials classification, engineering requirements of materials, advanced materials and modern materials. Properties of Engineering Materials: Mechanical properties, factors affecting mechanical properties, physical, thermal, electrical, optical, magnetic and chemical properties of materials. Factors affecting the selection of materials for engineering purposes, materials selection and design considerations.

2. Fundamentals of Structures of Crystalline Solids: Crystal structures, unit cells, crystal system, crystallographic points, directions and planes, single crystal, polycrystalline materials, anisotropy, non-crystalline solids. Metallic crystal structures (face-centred, body-centred, hexagonal close-packed and closed-packed crystal structures), crystal structures of closed pack anions, Imperfections in solids (vacancies and self-interstitials), impurities in solids, imperfections in ceramics, interfacial defects, polymer defects.

3. Deformation of Materials: Introduction, elastic deformation, plastic deformation, deformation of single crystal, mechanism of plastic deformation, deformation by twinning, deformation of polycrystalline materials, stress-strain curve for polycrystalline materials, yield point phenomenon, Cottrell theory of sharp yield point, work (or strain) hardening, elastic after effect, bauschinger effect, season cracking, preferred orientation, recovery, recrystallization, and grain growth, grain size control.

4. Biomaterials: Definition, biomechanism, classification of biomaterials, manufacture of biochemical products, applications of biomaterials in the medical field.

5.Composite

Materials:Classification of composite materials, fabricating reinforced and hybrid composites, structural composites, concrete, concrete-polymer composites and fibre-reinforced cement.

Books recommended:

1. A Text Book of Material Sciences and Metallurgy : O.P. Khanna
2. Materials Science and Engineering: An Introduction : William D. Callister, Jr.
3. Materials Science : V. Rajendran and A. Marikani
4. Polymer Science and Technology : P. Ghosh
5. Introduction to Material Sciences : Beker and Peterlin
6. Material Sciences : G.K. Narula, K.S. Narula and V.K. Gupta
7. Elements of Material Science and Engineering : L. H. Van Black
8. Foundations of Materials Science and Engineering : W.F. Smith
9. A Text Book of Chemistry of Engineering Material : Salger and Paul
10. Shilpa Rashayun : Nurul H. Bhuyan
11. Chemistry of Engineering Materials : Robert B. Leighou
12. Introduction of Science and Engineering of Materials : William, D. C., Rethwisch, D.G.
13. The Science and Engineering of Materials : Askeland, D., Fulay, P. P., Wright, W. J.

Course No.: ACCE-407 Biomedical Engineering

Credit: 3
Exam.-2025 & 2026

Marks: 75
Time: 4 Hours

Rationale: This course is designed to give ideas on biochemical engineering related to the biochemical process in living things, sterilization, enzymes and biomaterials.

Objectives of the Course: To give ideas on the basic concept of biochemical engineering.

To give information on the detailed explanation of enzymes.

To provide broad education regarding bio-reactors.

To gain knowledge in biomaterial education.

Intended Learning Outcomes (ILOs): After studying this course, students should be able to-

Know the basic concept of biochemical engineering.

Describe biochemical reactors.

Understand enzyme action, mechanism, preparation, purification and technology.

Gain knowledge of the chemistry of biomaterials.

Know the haematological and biochemical analysis of bio-species.

Course Content

1. Introduction to Biochemical Engineering: Comparison of a chemical and biochemical process. Microbiology: general idea on structure of cells (prokaryotes and eukaryotes) and cell theory. Classification of microorganisms (protist kingdom) and their morphological characteristics e.g. Bacteria, blue; green algae, actinomycetes, fungi (mold, yeasts), protozoa (primitive animals) and algae (primitive plants).

Biochemistry: the study of structure, properties and functions of important cell chemical like lipids (fatty acids, fat, vitamins steroids, phospholipids) and carbohydrates, proteins and nucleic acids. Molecular genetics: Concept and definition, process of gene expression; DNA replication and mutation,

recombinant DNA technology, prospects of genetic engineering. Overview of biotechnology, concept of bioinformatics.

2. **Sterilization:** Media and air, methods. Stoichiometry of growth and product formation. Fermentation: energy-balance, mixing in fermenters, the role of shear in stirred fermenters, role of diffusion in bioprocessing, oxygen uptake in cell cultures, oxygen transfer in fermenters, cell disruption.

3. **Enzyme:** Classification, comparison of enzymes with synthetic catalysts, the kinetics of enzyme catalyzed reactions- Michealis- Menten equation for single substrate reaction; concept of substrate and substrate enzyme complex. Evaluation of kinetic parameters in M-M equation. Substrate inhibition and activation. Feedback inhibition. Competitive and non-competitive inhibition. Enzyme activation and inhibition. (No derivation). Study of parameters affecting enzymatic activity like pH, temperature and mechanical forces. Production and purification of enzymes. Immobilization of enzymes (physical and chemical methods). Applications of enzymes as catalysts. Industrial, medical and analytical applications of immobilized enzymes; bioenergetics; energy through EMP pathway and TCA cycle on glucose molecule. Importance of NAD and ATP.

4. **Design and Analysis of Biological Reactors:** Ideal reactors and non-ideal reactors, sterilization reactors, multiphase reactors; packed type, bubble column, fluidized bed, fixed bed, (general description). Fermentation technology; design and operation of typical aseptic aerobic fermentation process. Different configuration for fermenters. Product recovery operations filtration, centrifugation, extraction, sorption, precipitation, chromatography and membrane process. Bio-chemical industry; flow diagrams and descriptions for production of fine chemicals like enzymes, proteins, antibodies, steroids.

5. **Haematological and Biochemical Analysis of Bio-species:** General concepts of Haematological and biochemical analysis of bio-species.

Books Recommended:

1. Bailey & Ollis, Biochemical Engineering Fundamentals, McGraw Hill
2. M.L. Shuler and F. Kargi, Bioprocess Engineering, Prentice-Hall of India.
3. Pauline Doran, Bioprocess Engineering Principles, Elsevier
4. Perry R.H. & Chilton H.C.(Eds.), Chemical Engineer Handbook, McGraw Hill
5. Biochemical Engineering by A. Aiba, E. Humphrey & N.R Milli
6. Bioprocess Engineering- Basic concept by M.L. Shuler and Kargi
7. Biochemical Engineering by J.M.Lee
8. Biochemical Engineering by H.W. Blanch and D.S. Clark

Course No.: ACCE-408
Corrosion Engineering

Credit: 3	Marks: 75
Exam.-2025 & 2026	Time: 4 Hours

Rationale: This course is designed to cover the corrosion principle, forms of corrosion, corrosion damage, and their prevention techniques. This will also cover the corrosion testing and corrosion in industries.

Objectives of the Course: To provide students with comprehensive knowledge about corrosion/materials degradation and preventive methodologies.

Intended Learning Outcomes (ILOs): Upon completion of the course, students will be able to-
Possess state-of-the-art knowledge and skills in the area of metal corrosion and protection technology.

Think critically and holistically in dealing with real corrosion problems, and generate practical solutions.

Course Content

1. Corrosion Principles: Definition, classification, corrosion damage, corrosion rate expressions. Electrochemical aspects: Electrochemical Reactions, polarization, passivity. Environmental effects: Effect of oxygen

and oxidizers, the effect of velocity, effect of temperature, effect of corrosive concentration, effect of galvanic coupling. Metallurgical and other aspects: Metallic Properties, economic considerations, importance of inspection, study sequence.

2. Different Forms of Corrosion: Uniform attack, galvanic or two-metal corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching, Erosion corrosion, fretting corrosion, stress corrosion, hydrogen damage.

3. Corrosion in Industries: Underground corrosion, marine corrosion, corrosion in boiler plant, chemical industries, petroleum industry, fertilizer industries.

4. Corrosion Prevention: Materials selection, alteration of the environment, design, cathodic and anodic protection, coatings.

5. Corrosion Testing: Introduction, classification, purpose, materials and specimens, surface preparation, measuring and weighing, exposure techniques, duration planned-interval tests, aeration, cleaning specimens after exposure, temperature, standard expressions for corrosion rate, galvanic corrosion, high temperatures and pressures, different corrosion tests.

Books recommended:

1. Manufacturing Process and Materials for Engineers : L.E. Doyle and C.A. Keyser
2. Chemistry of Engineering Materials : Robert B. Leighou
3. A Text Book of Material Sciences and Metallurgy : O.P. Khanna
4. Physical Metallurgy and Engineers : D.S. Clark and W.R. Varney
5. An Introduction to Science of Corrosion and its Inhibition : S. N. Banerjee
6. Corrosion Engineering : S. N. Banerjee
7. Corrosion Engineering : G. Fontana
8. Introduction to Corrosion Engineering and its Prevention : Uligue

Course No.: ACCE-409
Lab-XII: Chemical Engineering-III

Credit: 2
Exam.-2024 & 2025

Marks: 50
Time: 6 Hours

Rationale: This course advances students' learning and experience in experimental aspects of a number of areas of chemical engineering. Both fundamental aspects, such as kinetics and reaction engineering, process control, heat and mass transfer and fluid flow as well as more applied topics will be covered. The course will not only serve to reinforce fundamental principles of chemical engineering, but also to the application of the technology.

Objectives of the Course: The course emphasises and reinforces topics and principles introduced in lectures through experiential learning in the laboratory and with practical work in general. In successfully completing the course students will develop the ability to critique experimental data and techniques.

Intended Learning Outcomes (ILOs): On successful completion of the course students will be able to:

Demonstrate an understanding of the fundamental principles underlying chemical engineering through practical experimentation.

Show an understanding of the issues related to experimental aspects of chemical engineering

Exhibit expertise relevant to the practice of engineering

Bring a problem-solving mindset to any challenge in the workplace

Demonstrate some understanding of the professional obligations related to the discipline of engineering, with a special emphasis of the development of safe working practices during laboratory exercises

Course Content

1. Analysis of swelling ratio (%), percentage porosity (%) and density of a porous polymeric materials.
2. Determination of Cooper (Cu) in water by flameatomic absorption spectroscopic (AAS) technique
3. Boiling and condensation studies

4. Fluidized bed polymer coating.
5. Silicon wafer oxidation.
6. Photocatalytic water purification

Books Recommended:

1. *Chemical Engineering*, Volume 6, : Sinnott. R.K, Coulson & Richardson's
3rd Edn Butterworth Heinemann, New Delhi, 1999
2. Perry's, "*Chemical Engineers Handbook*," 7th Edn. : Perry. R.H., et al.
3. Modern Lab Experiments for : David F. Ollis and H. Henry Lamb
Chemical Engineering

Course No.: ACCE-410

Lab-XIII: Chemical Process Technology -III

Credit: 3

Exam.-2025 & 2026

Marks: 75

Time: 9 Hours

Rationale: This course covers the analysis of pulp, pharmaceutical, fats/oils sample. It will also help to enrich students' practical knowledge relevant to different chemical process industries.

Objectives of the Course: To give a clear concept for the analysis of the industrial product.

Intended Learning Outcomes (ILOs): Upon completion of the course, students will be able to-

Gain knowledge of GLP.

Choose and handling different instruments.

Know various experimental calculation methods.

Analyze pharmaceutical, pulp, fats/oils, stainless steel sample.

Course Content

1. Estimation of the amount of calcium gluconate in the given sample.
2. Estimation of the alpha-cellulose content and moisture content of the given pulp sample.
3. Analysis of fat/oil sample for Reichert-Meissl value.
4. Analysis of fat/oil sample for Polenske value.
5. Estimation of Nickel in the given stainless steel sample.
6. Determination of neutralization power of antacid tablets.
7. Analysis of sawdust: Estimation of total cellulose.
8. Determination of the effect of Polymeric additives on index viscosity.
9. Synthesis of Alkyl Benzene.
10. Synthesis of Nitro Benzene.
11. Determination Flash and fire point of fuels.
12. Determination calorific value of fuels.
13. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. Practical Organic Chemistry : Clarke
4. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
5. Procedure Supplied from Dept.

Course No.: ACCE-411

Lab-XIV: Pharmaceutical Process and Technology

Credit: 2

Exam.-2025 & 2026

Marks: 50

Time: 6 Hours

Rationale: This course is mainly focused on chemical process technologies. Lab-XI, chemical process technologies-IV will enrich student's practical knowledge relevant to different chemical process industry.

Objectives of this Course: The objectives of this course are

To give a clear concept about titrimetric method, conduction titration, potentiometric titration.

To serve knowledge about different equipment like spectrophotometer, chromatographic equipment, venturi meter, orifice meter, Reynolds apparatus etc.

To give a clear concept and practical ideas of different unit operation units like crystallizer, evaporators, spray dryer and heat exchanger etc.

Intended Learning Outcomes (ILOs): Students are expected to have gained knowledge to

Choose and handle appropriate equipment for titration, extraction, adsorption, corrosion rate etc.

Conduct laboratory safety issues and various experimental calculating methods.

Draw various process units and construct graphical representation.

Course Content

1. Estimate the amount of aspirin in the given sample.
2. Estimate the amount of paracetamol in the given sample.
3. Estimate the amount of cholesterol in the given sample.
4. Construct the drying rate curve of the supplied sample and find the critical moisture content from the graph.
5. Drawing a circulating magma crystallizer/standard vertical type evaporator/spray dryer/rotary dryer/ heat interchangers.
6. Determine the corrosion rate of mild steel in xM HCl solution and in xM HCl solution containing y% Cu^{2+} .
7. Determination of total nitrogen, protein nitrogen and non-protein nitrogen in a supplied sample by Micro-Kjeldahl method.
8. Estimation of amino acids in a protein by spectroscopic method.
9. Measurement of cell constant: (a) Conductometric titrations (b) Potentiometric titrations
10. Determination of Pharmaceutical products using Chromatographic methods.
11. Polycondensation of adipic acid with ethylene glycol.
12. Polycondensation of phthalic anhydride with glycerine.
13. Calibration of Venturi-meter.
14. Calibration of Orifice-meter.
15. Study of various types of flows using Reynolds apparatus.

16. Experiments on liquid-liquid extraction.
17. Experiments on adsorption isotherm curve.
18. Estimate the amount of vitamin C in the given sample.
19. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. Practical Organic Chemistry : Clarke
4. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
5. Procedure Supplied from the Dept. Of ACCE

Course No.: ACCE-412
Lab-XV: Environmental Technology -II

Credit: 2 Exam.-2025 & 2026	Marks: 50 Time: 6 Hours
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Rationale: To provide the student with an understanding of the fundamental chemical processes that are central to the analysis of air, water, soil, vegetables, fruits and fish. This course will also provide scientific foundation for decision-making processes to protect public health and the environment from the adverse effects of chemicals.

Objectives of the Course: Students will gain hands-on training in laboratory measurements, monitoring sophisticated/modern instruments. Students will do sampling both at the laboratory and field as part of this experiential course to gain practical experience of different environmental measurements of air, water and soil.

Intended Learning Outcomes (ILOs): Upon successful completion of the course, the students will be able to-

- Understand laboratory techniques and instrumentation used in testing water quality, fish, fruit and vegetables and industrial products.
- Develop sampling plans and approaches to design a project.
- Conduct research in a laboratory.
- Gain experience transforming data from instrument.

Course Content

1. Analysis of water for chlorine, organic matter, nitrate, nitrite, ammonium ion.
2. Analysis of water for phosphate and sulphate ion.
3. Determination of trace elements (Pb, Hg, Fe, Cd) in water sample.
4. Determination of Arsenic in water sample.
5. Determination of Formalin in contaminated samples (Fish, Fruits and vegetables).
6. Determination of pollutants in different industrial samples.
7. Determination of SO₂ and CO₂ in the air of urban and rural area.
8. Determination of total acid in air of the urban and rural area.
9. Determination of particulate matter per unit volume of air in the urban and rural area.
10. Determination of dust falls per unit area of urban and rural.
11. Determination of moisture content, water holding capacity and pH of soil.
12. Sampling of bacteria from air, water and soil.
13. Determination of organic and inorganic components of airborne particulate matter.
14. Determination of toxic metals in biological samples.
15. Determination of total solid in water sample.
16. Determination of CO₂ in a water sample.
17. Some other experiments as designed by the course teacher(s).

Books recommended:

1. Applied Chemistry Theory and Practice : Vermani and Narula
2. A Text Book of Inorganic Quantitative Analysis : A.I. Vogel
3. বিশ্লেষণীয় ও ব্যবহারিক রসায়ন : হাজারী, দাস ও দে
4. Manual of Methods of analysis of Foods and Water. : Food Saifty and Standards, India-2016
5. Procedure Supplied from Dept.

Course No.: ACCE-413 In-Plant Training

Credit: 3 Exam.-2025 & 2026	Marks: 75 Time: 9 Hours
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Rationale: This course focuses on training in a specific training institute/specialized laboratory/industry.

Objectives of this Course : Handling various sophisticated instrument at the training institute/specialized laboratory/industry.
To give a clear concept of different operations.
To know the real situation of training institute/specialized laboratory/industry.

Intended Learning Outcomes (ILOs) : Upon successful completion of the course, the students will be able to-
Design and implement a new project.
Think critically that how someone could establish a new industry or laboratory.
Learn effectively how to write a scientific training report

Course Content

All students will have to perform In-plant training. In-plant training will be organized to a training Institute/different industries for practical training. It will be done as individual/group wise which is organized by concerned teachers. Participation is compulsory for each student and they will submit a report and give a viva-voce/a power point presentation. The report and viva-voce/presentation will be examined by the internal examiners.

Course No.: ACCE-414 Project

Credit: 2
Exam.-2025 & 2026

Marks: 50
Time: 6 Hours

Rationale: This course focuses on a piece of project work.

Objectives of this Course: Handling various sophisticated instrument in industries or laboratory.

To give clear concept of different operations.

To know to design and implement new project.

Intended Learning Outcomes (ILOs): Upon successful completion of the course, the students will be able to-

Write a proposal for project work.

Design and implement a new project.

Write a project report and scientific article

Effectively communicate ideas orally from the project work.

Course Content

All students will have to perform project work. Project work will be based upon different industries or laboratory-work. It will be performed as group work or as an individual which would be organized by concerned teachers. Participation is compulsory for each student and they will submit a report and give a viva-voce/a power point presentation. The report and viva-voce/presentation will be examined by the internal examiners.



Faculty of Science
Ordinance
For
THE DEGREE OF BACHELOR OF SCIENCE WITH
HONOURS
SESSION 2009-2010

UNIVERSITY OF CHITTAGONG
FACULTY OF SCIENCE
ORDINANCE FOR THE DEGREE OF BACHELOR OF
SCIENCE WITH HONOURS
WITH EFFECT FROM THE SESSION 2009-2010

1. DURATION OF THE PROGRAMME OF STUDY

The programme of study for the Degree of Bachelor of Science with Honours will extend over a period of 4 (four) academic years and will be completed by a student in not more than 6 (six) academic years.

2. SUBJECTS

There will be the following subjects in the Faculty of Science of this University; i. Physics; ii. Chemistry; iii. Mathematics; iv. Statistics; v. Applied Chemistry and Chemical Engineering, and any other subject/s as may be approved by the University authority from time to time.

3. QUALIFICATION FOR ADMISSION

Students passing the Higher Secondary Certificate (H.S.C.) examination in science from an Education Board of Bangladesh or a recognized equivalent examination from home or abroad may be admitted to the programme of Bachelor of Science with Honours in any of the above mentioned subjects in this University on such terms and conditions as may be determined by the University authority from time to time.

4. REGISTRATION

- i. A candidate will attain studentship of the University on admission to a programme as per rules. S/he will be required to be registered with the University through such processes and on payment of such fees as determined by the University authority from time to time.
- ii. A student will never take admission in more than one subject other than certificate/diploma courses. If it is so reported/found, his/her studentship and examinations, if appeared/passed, will be immediately cancelled.

5. COURSE IDENTIFICATION SYSTEM

Each course will be designated by three to five letters for the subject/discipline as decided by the concerned department and a three-digit number for the course of which the first digit will correspond to the year, for example, **CHEM.-101** for the first course of 1st year in **Chemistry**, **STAT-405** for the fifth course of 4th year

in **Statistics** and so on. **English** course will be denoted by **ENG - 001**.

6. MARKS AND CORRESPONDING CREDITS

Theoretical/practical courses/viva-voce of 25, 50, 75 and 100 marks are equivalent to 1, 2, 3 and 4 credits, respectively.

7. NATURE OF COURSES AND DISTRIBUTION OF MARKS

- i. The B.Sc. (Hons.) degree programme will be an integrated one consisting of major and related courses, carrying a total of 4000 marks as distributed below (year-wise):

Year	Major Theoretical + Practical	Related Theoretical + Practical + Industrial Tour/Project	Credits	Ses sional	Viva - voce	Credits	Total Marks	Total Credits
First	450	350	32	75	75	03+03	950	38
Second	450	350	32	75	75	03+03	950	38
Third	850	--	34	75	75	03+03	1000	40
Fourth	950	--	38	75	75	03+03	1100	44
Total	2700	700	136	300	300	24	4000	160

***Practical and Industrial Tour/Project can be considered separate courses.**

- ii. The related courses will be formed at least two subjects other than the major subject as decided by the Academic Committee of the concerned Department. The Committee of Courses and Studies of the Department will prepare the syllabus. In preparing the syllabus of the related courses, the teachers of the relevant subjects should be invited as an associate member in the meeting of the committee of courses.
- iii. Sessional means tutorial, class test, term paper, field works, field tour, study tour etc.
- iv. 25-35% of the total of theoretical and practical marks will be allotted for practical in all subjects, other than Mathematics.
- v. 5-10% of the total of theoretical and practical marks will be allotted for practical in Mathematics.
- vi. 20% of the practical marks will be awarded on the basis of class performance, during the whole course of study evaluated by the course teacher/s and the rest 80% on the basis of performance in the annual examination.
- vii. Project works, if applicable, will be started at the beginning of the 4th year class.

8 ENGLISH COURSE

Apart from the credit courses mentioned above a student will take one English course of 100 marks in the first year and s/he will be allowed to sit for this examination with the first year examination. If s/he fails to do that, s/he will be allowed to appear at the examination with the immediate next batch, only once. Points secured in this course in excess of 12.00 will be added in calculating his CGPA. Minimum pass mark for English is 25. **Students securing marks between 25 and below 65 will be awarded 'Pass'. The F grade will be awarded to the students scoring less than 25 marks. If a student fails to appear even in the second time, "Incomplete" will be written in her/his transcript as shown in the following table:**

Numerical Grade	Letter Grade
65% and above	B+ and above
25% to less than 65%	Pass
Less than 25%	F
Not appeared in the examination	Incomplete

9. CLASS HOURS (45 MINUTES EACH)

Theoretical and practical courses will be so designed as to be completed in minimum of the following class hours:

- a. Theoretical course of 25 marks (1 credit) in 15 class hours, 50 marks (2 credits) in 30 class hours, 75 marks (3 credits) in 45 class hours and 100 marks (4 credits) in 60 class hours.
- b. Practical course of 25 marks (1 credit) in 8 x 3 class hours, 50 marks (2 credits) in 15 x 3 class hours, 75 marks (3 credits) in 25 x 3 class hours and 100 marks (4 credits) in 30 x 3 class hours.

10. DURATION OF EXAMINATION

Examination will be held on academic year (annual) basis. Time allotted for examination will be as follows:

- a. Theoretical courses: 2 hours for 25 marks, 3 hours for 50 marks, 4 hours for 75 - 100 marks.
- b. Practical courses: 4 hours for 25 marks, 6 hours for 50 marks, 9 hours for 75 marks and 12 hours for 100 marks.

11. MEDIUM OF INSTRUCTION AND EXAMINATION

The medium of instruction and answer in the examination scripts will be either English or Bengali. Mixing of English and Bengali in the answer script of any course will not be ptable, except for scientific/technical terms.

12. ELIGIBILITY TO APPEAR AT THE EXAMINATIONS

- i. In order to be eligible for appearing at the examination, a candidate will be required to attend on an average not less than **70%** of the

lectures. The Academic Committee of the Department may recommend marginal cases of shortage of attendance (not below **50%**) on special ground with documentary evidences. In this case, the candidate will have to pay the requisite non-collegiate fee as determined by the University Authority as per **General Rules and Regulations No. 1(ix)**.

- ii. The course teacher must submit the class attendance register and report to the Chairman of the Department before processing the examination entry forms. The Department will verify the eligibility of the candidates and send the entry forms to the Provost of the concerned hall for necessary action.
- iii. The Provost of the concerned hall will make necessary verification of the forms and send forward to the Comptroller of Accounts for necessary action.
- iv. The Controller of Examinations will issue admit card only to the eligible candidates as per rules and send these to the concerned Department and the Chairman will distribute the same to the candidates. If the examination entry forms remain incomplete, admit cards will not be issued. Each student will mention his/her registration/ID number with session and previous examination roll/ID number in the entry form, if any.

13. GRADING SYSTEM

Letter grades and corresponding grade points will be awarded as follows:

Numerical Grade	Letter Grade	Grade Point
80 % and above	A+	4.0
75% to less than 80%	A	3.75
70 % to less than 75 %	A–	3.50
65% to less than 70%	B+	3.25

60 % to less than 65 %	B	3.00
55 % to less than 60 %	C+	2.75
50 % to less than 55%	C	2.50
45 % to less than 50 %	D	2.25
40 % to less than 45%	F	2.00
Less than 40 %	X	0.00
Incomplete/Absent		X

14. **PASS MARKS**

Course Marks	100	75	50	25
Pass Marks	40	30	20	10

15. **GPA/CGPA CALCULATION**

- i. No credits are granted for grade less than D. Calculation of GPA and CGPA (Cumulative Grade point Average) is Shown in **appendix-A**. To calculate CGPA, no grades from any source other than that of the prescribed credits will be considered.
- ii. In the Academic Transcript/Grade sheet, only Letter Grade (LG), corresponding Grade Points (GP), Points Secured (PS) and finally GPA, CGPA, not the numerical marks, will be shown.
- iii. 0.05 points secured will be added to the total points secured of candidates who will study Military Science and score 70% or above at the time of calculating CGPA.

16. **PROMOTION TO HIGHER CLASS (FROM 1ST YEAR TO 4TH YEAR)**

A student is required to fulfill the following conditions for promotion to the next higher class:

- i. A student must earn at least GPA 1.75 without sessional and viva-voce at his/her respective examination of the year, failing which s/he will be declared to be failed in the respective examination.
- ii. In such case, a student will be allowed to improve his/her GPA of the 1st/2nd/3rd year by appearing at the examination of the immediate next batch only.
- iii. Promotion to 2nd/3rd/4th year after the respective examination will be given effect on the basis of the results published by the Controller of Examinations.

17. VIVA-VOCE

- i. A regular student must appear at the viva-voce of the 1st/2nd/3rd/4th year examination. At the end of each examination, the Examination Committee will hold a viva-voce. The viva-voce marks will not be taken into consideration for the determination of yearly GPA. All marks of 4 viva-voce examinations will be added up to determine LG, GP and PS and to calculate CGPA.
- ii. If a student fails to appear at the viva-voce, the Examination Committee may recommend him/her for appearing at the **viva-voce within 30 days** from the date of preceding regular viva-voce of the respective examination and also before the publication of result of the respective examination. However, the candidate will have to take permission from the Vice-chancellor producing necessary documents. In this case, s/he will have to bear all expenses to conduct the viva-voce as fixed by the University Authorities.
If a student does not avail the above clause i. and ii. i.e. does not appear at the annual viva-voce, s/he will be declared to have failed in the respective examination.
- iii.

18. SESSIONAL

- i. A regular student must complete his/her sessional of the 1st, 2nd, 3rd and 4th year. The sessional marks will not be taken into

consideration for the determination of yearly GPA. All marks of 4 yearly sessional will be added up to determine LG, GP and PS and to calculate CGPA.

ii.

If a student fails to appear at her/his sessional of the 1st/2nd/3rd/4th year, s/he will be declared to have failed in the respective examination.

19. IMPROVEMENT OF GRADES

- i. A general students earning C, D and F grade in any course in the 1st, 2nd and 3rd year examination may also choose to improve their grade/s by appearing at the annual examination of the same course only with the immediate next batch. If such a student fails to improve his/her grade/s, the previous grade/s of the same course will remain valid.
- ii. If a student appears at the Improvement Examination of any course/s as mentioned in the clause i. above and whatever the score s/he earns, a letter grade **not above B** (even the score above B is earned) will be written in the Tabulation Sheet and Grade sheet. The word **“Improved”** will be written to the right column of the Transcript corresponding to the improved course/s.
- iii. No improvement will be allowed in English course, sessional and viva-voce.
- iv. For improvement of his/her grade in a particular course, the student will apply to the Chairman of the Department at least 4 weeks before the start of the next annual examination.
- v. The Chairman of the department will prepare the list/s of candidates for the regular, irregular and improvement categories and send one copy of each to the office of the Controller of examinations after the last date of filling up the examination entry forms.

20. DEGREE REQUIREMENTS

For the degree of Bachelor of Science with Honours, a student will require to fulfill the following conditions:

- i. A student must earn a minimum CGPA 2.25 and s/he must earn GPA 1.75 in 1st, 2nd, 3rd and 4th year examinations separately.
- ii. A student must earn a minimum GPA 2.00 in consolidated sessional, failing which s/he will be declared failed in the programme.
- iii. A student must earn a minimum GPA 2.00 in consolidated viva voce, failing which s/he will be declared failed in the programme.
- iv. A student earning CGPA 4.00 will be awarded B. Sc. (Hons.) degree with **Distinction** and citation so made in the **academic transcript**.
- v. A student who will earn CGPA 2.00 to less than 2.25 after completion of 4-year course will be awarded **B.Sc. Pass Degree** without any class but s/he must earn GPA 1.75 in 1st/2nd/3rd and 4th year examination, GP 2.00 in consolidated sessional and GP 2.00 in consolidated viva-voce separately. **The student with a Pass Degree will not be eligible for admission into Masters Programme.**

21. FAILED STUDENT

- i. If a student fails to earn required GPA for promotion mentioned in clause 16i. of the 1st/2nd/3rd year examination, s/he will be treated as a failed student .
The failed student will be allowed to appear in the failed course/s with the batch that immediately follows as an irregular candidate, failing which s/he will be dropped out of the programme.
The failed students can also appear at the improvement examination in the courses earning C and D along with the failed course/s only once. In this case if s/he improves grade/s a letter grade not above B will be written in the Tabulation sheet and Grade Sheet for the improvement courses (originally earning C or D).
- ii. If a student fails to appear at the 1st/2nd/3rd/4th year examination after depositing examination fees, s/he will be treated as a failed student. The failed student will be allowed to appear at the

examination with the batch that immediately follows as an irregular candidate, failing which s/he will be dropped out of the programme.

- iii.** If a failed student earns required GPA for promotion as an irregular candidate in the 1st/2nd/3rd year examination, s/he not be allowed to appear in the course/s s/he scored C, D or F grade to improve his/her GPA under any consideration.
- iv.** If a student fails to appear at the viva-voce of the 1st/2nd/3rd/4th year examination as per clause 17, s/he will be treated as a failed student. In such a case, s/he will be allowed to appear at the viva-voce with the batch that immediately follows as an irregular candidate, failing which s/he will be dropped out of the programme.
- v.** If a student fails to appear at the sessional of the 1st/2nd/3rd/4th year examination as per clause 18, s/he will be treated as a failed student. In such a case, s/he will be allowed to appear at the sessional with the batch that immediately follows as an irregular candidate with permission of Academic Committee of the Department, failing which s/he will be dropped out of the programme
- vi.** The failed student will appear at the 1st/2nd/3rd/4th year examination as an irregular candidate, generally as per syllabus in force without any re-admission. If any drastic changes in the syllabus are made, the irregular candidate will appear at the examination in his/her original syllabus on the recommendation of the Academic Committee of the department.
- vii.** After completing 1st/2nd/3rd year examination as irregular candidate, the above categories of students will have to be admitted provisionally to the next higher class within the date fixed by the Academic Committee of the concerned department. If the student fails at the respective examination, his/her provisional admission will automatically be cancelled.
- viii.** If a student fails to appear at the examination twice in a particular year or more than twice in the entire programme, s/he will be dropped out of the programme.

- ix. A student failing to earn minimum GPA 1.75 in 4th year examination will be treated as a failed student. Such a student is allowed to improve his/her GPA by appearing in 4th year course/s at the examination with the immediate next batch only as an irregular candidate, but it must be within six consecutive academic years from the session of his/her first admission. Failing which s/he will be dropped out of the programme.
- x. A student failing to earn required GP in consolidated sessional during finalization of 4-year results will have to appear at four courses (total marks 300) of comprehensive examinations each of 75 marks with the immediate next batch only once as an irregular candidate, but it must be within six consecutive academic years from the session of his/her first admission. Course-1, 2, 3 and 4
- xi. comprises of first, second, third and fourth year syllabi respectively.
A student who fails to earn required GP in consolidated viva-voce during finalization of 4-year results will have to appear at a viva-voce examination of 300 marks with the immediate next batch only as an irregular candidate. But it must be within six consecutive academic year from the session of his/her first admission

22. RE-ADMISSION

- i. If a student fails to appear at the 1st/2nd/3rd/4th year examination due to shortage of required percentage of class attendance or any other reason, s/he will have to get himself/herself re-admitted as an irregular student with the batch that immediately follows on recommendation of and within the date fixed by the Academic Committee of the department. S/he must have to fulfill the requisite class attendance for appearing at the examination as an irregular candidate.
The student will be allowed to appear at the respective examination only once with the batch that immediately follows as an irregular candidate, failing which s/he will be dropped out of the programme. If a re-admitted student earns required GPA for promotion as an irregular candidate in the 1st/2nd/3rd/4th year examination, s/he will not be allowed to appear in the course/s s/he scored C, D, or F grade to improve GPA under any consideration.

- ii. Re-admission will not be allowed in the first year, if the percentage of class attendance of the student is below 30%, then his/her studentship will be treated as cancelled, i.e. s/he will be dropped out of the programme.
- iii. A student may be allowed re-admission for not more than once in a particular year and not more than twice in the entire programme.

23. IMPROVEMENT OF RESULTS

A student may improve his/her CGPA after the degree is awarded by appearing only once in 4th year course/s earning C, D or F grade at the examination with the immediate next batch but it must be within six consecutive years from the session of his/her first admission. If a student improves his/her CGPA, the word **'Improvement'** and **'the year'** of improvement examination should be mentioned in his/her **academic transcript** and **certificate**.

A student willing to cancel his/her improved CGPA and have the previous results reinstated will apply in this respect to the Controller of Examinations through the Chairman of the Department and the Provosts of the concerned hall with necessary fees prescribed by the University Authority from time to time.

24. FORMATION OF THE EXAMINATION COMMITTEE

There will be separate Examination Committees for each of the 1st, 2nd, 3rd and 4th year examinations as follows:

- i. The 1st and 2nd year Examination Committees, each will consist of
 - one Chairman, two Internal Members of the major subject, two members of the related subjects and one External Member (from another Public University). **The members on the related course/s will moderate question papers only of related course/s and not conduct viva-voce.**

- ii. The 3rd and 4th year Examination Committees, each will consist of - one Chairman, three Internal Members and one External Member (from another Public University).

25. GENERAL RULES AND REGULATION

- i. Functions of the Academic Committee/Chairman/Director of the Departments/Institutes/RCMPS will be according to **“General rules and regulations No. 1”**
- ii. Functions of the Examination Committee will be according to **“General rules and regulations No. 2.”**
- iii. Functions of the Chairman of the Examination Committee will be according to **“General rules and regulations No. 3.**
- iv. Functions of the course teacher/examiner will be according to **“General rules and regulations No. 4.**
- v. Functions of the tabulators for finalization of the results will be according to **“General rules and regulations No. 5.**
- vi. Functions of the Controller of Examinations regarding examinations and publication of results will be according to **“General rules and regulations No. 6.**

26. COLLECTION OF TUITION FEES

The Comptroller of Accounts will make arrangement to collect tuition and session fees of respective session from a student who will be promoted to 2nd/3rd/4th year, within two months after publication of result of 1st/2nd/3rd year examinations. If s/he fails to deposit fees within the time, s/he may be given another 30 days to deposit the same with late fine fixed by the University Authority, failing which his/her name will be struck off the University Register. i.e. s/he will be dropped out of the programme.

27. ADMISSION OF THE EXPELLED STUDENT

- i. If a student adopts unfair means in 1st/2nd/3rd/4th year examination, and s/he is penalized with cancellation of result of his/her respective

year, then his/her results of the previous year/s, if any, will remain valid.

- ii. If a student of 1st/2nd/3rd/4th year is expelled from the university for any reason as the case may be, s/he will have to get himself/herself re-admitted to the subsequent 1st/2nd/3rd/4th year respectively for once only. Generally, the syllabus in force for the examination concerned will be applicable for such a student. If any drastic changes in the syllabus are made, s/he will have to appear at the examination with his/her original syllabus on the recommendation of the Academic Committee of the Department.
- iii. The expelled period will not be counted for calculating maximum available period (6 years) in clause 1.

28. ACADEMIC CALENDAR

Academic Committee of the concerned Department will prepare an Academic Calendar showing the beginning of each academic year, date for commencement and suspension of classes, commencement of each examination. Classes will be suspended at least 30 days before the commencement of each examination. There should be a gap of at least 30 days from the date of publication of results of a particular year (e.g. 2nd year 2002) and date of commencement of the next examination of next session (e.g. 2nd year 2003).

29. REVIEW OF THE ORDINANCE

The ordinance may be reviewed by the Academic Council on recommendation of the Faculty through Ordinance Committee.

30. EFFECT OF THE ORDINANCE

This ordinance will be effective from the academic session 2009-2010.

As per recommendation of 221st Extraordinary meeting of the Academic Council vide resolution no-1 (Kha) held on 24-07-2010 & approved by 467th meeting of the Syndicate vide resolution no. 6 held on 09-08-2010 and later on amended and revised as per the Syndicate empowerment).

Dated, August, 28, 2010
Chittagong University
Chittagong

Professor Dr. Muhammad Shah Alam
Register (In-charge)
University of Chittagong
Chittagong, Bangladesh.