UNIVERSITY OF RAJSHAHI
FACULTY OF ENGINEERING

DEPARTMENT OF APPLIED CHEMISTRY AND CHEMICAL ENGINEERING

Syllabus for B. Sc. Engineering

SESSION: 2013-2014

Part I Examination, 2014
Part II Examination, 2015
Part III Examination, 2016
Part IV Examination, 2017

The B.Sc. Engg. courses in Applied Chemistry and Chemical Engineering (total 4000 marks, 160 credits and 40 units) shall be divided into four parts, namely, Part-1, Part-II, Part-III and Part-IV and each part will be divided into Odd and Even semesters. The distribution of courses, marks, credits, units, number of classes per week in Year-Semester wise examinations shall be as follows:

PART-I ODD SEMESTER (2013-2014)

Course Code	Course Title	Unit	Mark	Credit	Contact Hour/ Week	Contact Period/ Week
ENG 1111	Technical and Communicative English	0.50	50	2	2	3
MATH 1121	Algebra (with Matrix) and Vector Analysis	0.75	75	3	3	4-5
PHY 1111	Mechanics, General Properties of Matter, Waves and Sound	0.75	75	3	3	4-5
CHEM 1121	Basic Inorganic Chemistry	0.75	75	3	3	4-5
ACCE 1111	Physical Chemistry-1	1.00	100	4	4	6
ACCE 1121	Chemical Engineering-I	0.75	75	3	3	4-5
ACCE 1132	Inorganic Qualitative Analysis (LAB)	0.50	50	2	4	6
	Industrial Tour *	0.00	00	0	-	1 d/y
	Total	5.00	500	20		

PART-I EVEN SEMESTER (2013-2014)

ECON 1211	Economics	0.50	50	2	2	3
MATH 1211	Differential and Integral Calculus	0.75	75	3	3	4-5
PHY 1221	Applied Electricity and Magnetism	0.75	75	3	3	4-5
STAT 1211	Statistics for Engineers	0.50	50	2	2	3
CHEM 1211	Basic Organic Chemistry	0.75	75	3	3	4-5
ACCE 1211	Chemical Technology-I	0.75	75	3	3	4-5
ACCE 1222	Organic Qualitative Analysis (LAB)	0.50	50	2	4	6
ACCE 1230	Board Viva Voce	0.50	50	2	-	-
	Total	5.00	500	20		

PART-II ODD SEMESTER (2014-2015)

Course Code	Course Title	Unit	Mark	Credit	Contact Hour/ Week	Contact Period/ Week
ACCO 2111	Industrial Management and Accountancy	0.50	50	2	2	3
MATH 2121	Differential Equations, Laplace Transform and Numerical Analysis	0.75	75	3	3	4-5
PHY 2111	Basic Electronics and Instrumentation	0.75	75	3	3	4-5
CHEM 2112	Organic Preparation (LAB)	0.25	25	1	2	3
ACCE 2111	Advanced Inorganic Chemistry	1.00	100	4	4	6
ACCE 2121	Physical Chemistry-2	1.00	100	4	4	6
ACCE 2132	Inorganic Quantitative Analysis (LAB)	0.50	50	2	4	6
ACCE 2142	Engineering Drawings and work shop (LAB)	0.25	25	1	2	3
	Industrial Tour	0.00	0	0	-	1 d/y
	Total	5.00	500	20		

PART-II EVEN SEMESTER (2014-2015)

CSE 2251	Computer Programming	0.75	75	3	3	4-5
CHEM 2212	Inorganic Preparations (LAB)	0.25	25	1	2	3
ACCE 2211	Advanced Organic Chemistry	1.00	100	4	4	6
ACCE 2221	Chemical Technology-II	1.00	100	4	4	6
ACCE 2231	Chemical Engineering-II	0.75	75	3	3	4-5
ACCE 2242	Physical Chemistry (LAB)	0.50	50	2	4	6
ACCE 2252	Industrial Preparations (LAB)	0.25	25	1	2	3
ACCE 2260	Board Viva Voce	0.50	50	2	-	-
	Total	5.00	500	20		

PART-III ODD SEMESTER (2015-2016)

Course Code	Course Title	Unit	Mark	Credit	Contact Hour/ Week	Contact Period/ Week
ACCE 3111	Chemical Engineering-III	1.00	100	4	4	6
ACCE 3121	Instrumental Analysis	1.00	100	4	4	6
ACCE 3131	Fuel Technology	0.75	75	3	3	4-5
ACCE 3141	General Pharmaceutical Chemistry	0.75	75	3	3	4-5
ACCE 3151	Corrosion Engineering-1	0.50	50	2	2	3
ACCE 3162	Chemical Engineering+Chemical Technology (LAB)	1.00	100	4	8	12
	Industrial Tour	0.00	00	-	-	1d/y
	Total	5.00	500	20		

PART-III EVEN SEMESTER (2015-2016)

ACCE 3211	Materials Engineering	1.00	100	4	4	6
ACCE 3221	Petrochemical Technology	0.75	75	3	3	4-5
ACCE 3231	Pyrometallurgy	0.75	75	3	3	4-5
ACCE 3241	Pharmaceutical Technology and Dispensing	0.50	50	2	2	3
ACCE 3251	Environmental Chemistry-I	0.50	50	2	2	3
ACCE 3262	Metallurgy+Pharmaceutical Chemistry (LAB)	1.00	100	4	8	12
ACCE 3270	Board Viva Voce	0.50	50	2	-	-
	Total	5.00	500	20		

* Non-credit industrial tour is compulsory for 1st, 2nd and 3rd year students in odd semesters.

PART-IV ODD SEMESTER (2016-2017)

Course Code	Course Title	Unit	Mark	Credit	Contact Hour/ Week	Contact Period/ Week
ACCE 4111	Polymer Science	1.00	100	4	4	6
ACCE 4121	Chemical Engineering-IV	0.75	75	3	3	4-5
ACCE 4131	Pharmaceutical Chemistry and Pharmaceutics	0.75	75	3	3	4-5
ACCE 4141	Electrometallgy	0.50	50	2	2	3
ACCE 4151	Industrial Hazards and Waste Management	0.50	50	2	2	3
ACCE 4162	Polymer Science & Pharmaceutical Chemistry (LAB)	1.00	100	4	8	12
ACCE 4172	Project Work	0.50	50	2	4	6
	Total	5.00	500	20		
PART-IV EVEN SEMESTER (2016-2017)						
ACCE 4211	Chemical Engineering-V	0.75	75	3	3	6
ACCE 4221	Hydrometallurgy	0.75	75	3	3	6
ACCE 4231	Textiles – Chemistry and Technology	0.50	50	2	2	4
ACCE 4241	Corrosion Engineering-II	0.50	50	2	2	4
ACCE 4251	Environmental. Chemistry-II	0.50	50	2	2	4
ACCE 4262	Corrosion + Chemical Engineering (LAB)	1.00	100	4	8	16
ACCE 4272	In-plant Training	0.50	50	2	1 month	*
ACCE 4280	Board Viva Voce	0.50	50	2	-	-
	Total	5.00	500	20		

* Contact periods per week in the last semester have been increased to isolate time for in-plant training.

Marks Distribution (Coursewise) : For a theoretical course, 10%, 20% and 70% marks are allotted for class attendance and participation, quizzes/class test, and semester final examination, respectively. For a practical examination (Laboratory/Field work), 10%, 30% and 60% marks are allotted for class attendance and participation, quizzes and viva voce and practical examination / design work / report, respectively. For a project work, 35%, 35% and 30% marks are alloted for supervision, external examination and presentation-oral examination, respectively. The basis for awarding marks for class participation and attendance will be as follows:

Attendance Marks: (≥90%)-10, (≥85-<90%)-9, (≥80-<85%)-8, (≥75-<80%)-7, (≥70-<75%)-6, (≥65-<70%)-5, (≥60-<65%)-4, (<60%)-0.

Grading System: A letter grade system shall be used to assess the performance of the students as follows :

Numerical grade (NG)	Letter Grade (LG)	Grade Point (GP/Unit)	Credit Point (CP/Unit)
80% and above	A^+	4.00	4
≥75% but <80%	A	3.75	4
≥70% but <75%	A^-	3.50	4
≥65% but <70%	B^+	3.25	4
≥60% but <65%	B	3.00	4
≥55% but <60%	B^-	2.75	4
≥50% but <55%	C^+	2.50	4
≥45% but <50%	C	2.25	4
≥40% but <45%	D	2.00	4
<40%	F	0.00	-

Course Duration : The maximum period of studies for B.Sc. Engg. degree under no circumstance shall exceed 6 academic years. Candidates failing to earn the required YGPA after completing regular examinations

and subsequently failed again after taking readmission in Part-I, Part-II or Part-III in the stipulated period shall be dropped out of the program.

Award of Degree : A student must earn a minimum of 150 credits and CGPA of 2.25 or higher for getting the B.Sc. Engg. degree. The B.Sc. Engg. (with Honours) will be awarded to a candidate if he earns credit of 160 and CGPA of 3.75 or higher.

Conduct of Examinations and Rules for Promotion : There shall be final examinations at the end of each semester. The results will be finalized at the end of even semester of an academic year. A student entering in an odd semester shall automatically move on to the even semester, unless the candidate was debarred from appearing at the final examinations at the end of the semesters.

The minimum passing grade in a theoretical course will be D and in a Laboratory course (Laboratory/Project/Field) and Viva Voce will be C. A student securing (i) a YGPA of 2.25 or higher, (ii) credit point loss in theoretical courses not more than 10 and (iii) not less than C grade in the laboratory courses and Viva Voce of two semesters shall be promoted to next higher class. There shall be no way to improve in Laboratory course and Viva Voce in the succeeding next year. A student failing to secure a minimum C grade in any of the Laboratory courses and Viva Voce in any semester shall fail that year.

Course improvement: A promoted student may appear for course improvement in the immediate next academic year for maximum 10 credit points to clear his/her F grade or to improve the grades on the courses in which less than B grade (including those of F grade) was obtained in Part-1, Part-2 and Part-3 examinations. In such case, the student his to give his/her choice of course/courses for course improvement in writing. If the student fails to clear his/her F grades in the first attempt, he/she shall got another (last) chance in the immediate next year to clear the F grades. In the case of student's failure to improve his/her course grade at the course improvement examination, the previous grade shall remain valid.

Class Text : For theoretical courses of less than or equal to 2 credits there shall be at least three class tests and at least four class tests for greater than 2 credits in a semester.

Course Exemption : Students who fail to be promoted to the next higher class shall be exempted from taking the Theoretical and Laboratory courses where they obtained grades equal to or better than

'B'. These grades would be counted towards calculating GPA in the next year.

Attendance : (i) <60% dis-collegiate (will not be allowed to appear at the examination.

(ii) 60-<70% non-collegiate (will be permitted to appear at the examination but have to pay requisite fine in addition to regular fees)

(iii) ≥70% collegiate (will appear at examination on paying the regular fees only)

Result Improvement : A candidate obtaining B.Sc. Engg within 4 or 5 academic years shall be allowed to improve his/her result, of maximum of 10 credit points (courses less than 'B' grade) of the Part-IV theoretical courses in the immediate next regular examinations and Board Viva-voce. If a candidate fails to improve CGPA with the block of new GP in total, the previous results shall remain valid.

ENG1111: Technical and Communicative English
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.5 Unit, 2 Credits, 2 Periods/Week, 33 Lectures, Duration of Exam: 2 Hours

Section-A

1. **Grammar**: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, wh & yes/ no questions, conditional sentences.
2. **Vocabulary**: Technical & scientific vocabulary, defining terms.
3. **Spoken English**: Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.

Section-B

4. **Reading**: Comprehension of technical & non-technical materials-skimming, scanning, inferring & responding to context.
5. **Technical Writing**: Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.
6. **Professional Communication**: Business commercial correspondence letter, job application, memos, quotations, tender notice, amplification, description, technical report writing, standard forms of term papers, thesis etc.

Books Recommended:

1. **A. J. Thomson & A. V. Martinet**: *A Practical English Grammar*.
2. **John M. Lennon**: *Technical Writing*.

3. **A. Ashley**: *Oxford Handbook of Commercial Correspondence*.
4. **J. Swales**: *Writing Scientific English*.
5. **Robert J. Dixson**: *Complete Course in English*.
6. **Rajendra Pal & J. S. Korlahalli**: *Essentials of Business Communications*.

MATH 1121: Algebra (with Matrix) and Vector Analysis
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 hours

Section-A

1. Fundamental theorem of algebra, relation between roots and coefficients, Descarts rule of signs, solution of cubic and biquadratic equations.
2. Complex numbers and their properties, De Moivre's theorem and its applications, functions of complex arguments, Gragory's series.
3. Summation of trigonometric series.
4. Hyperbolic functions.

Section-B

5. Types and kinds of matrices: Definitions and properties of different kinds of matrices, Adjoint, Inverse and rank of a matrix.
6. System of linear equations: Echelon, normal and canonical forms of matrices, Consistency, and solutions of homogenous and non-homogenous system of linear equations by matrix methods.
7. Vector addition, multiplication and differentiation vector, differential operators, grad, div and curl.
8. Vector integration, Green's theorem, Gauss's theorem and Stoke's theorem.

Books Recommended:

1. **Bernard and Child**: *Higher Algebra*.
2. **Hall and Knight**: *Higher Algebra*.
3. **Das and Mukherjee**: *Higher Trigonometry*.
4. **M. A. Sattar**: *Higher Trigonometry*.
5. **M. R. Spiezel**: *Vector Analysis*.
6. **F. Ayres**: *Matrices.*
7. **F. Ayres**: *Theory and Problems of Analysis*.

PHY 1111: Mechanics, General Properties of Matter, Waves and Sound
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section- A

1. **Rotational Motions:** Rotational variable; rotation with constant angular acceleration; relation between linear and angular kinematics, torque on a particle; angular momentum of a particle; kinetic energy of rotation and moment of inertia; combined translation and rotational motion of a rigid body; conservation of angular momentum.
2. **Oscillatory Motions:** Hooke's law and vibration; simple harmonic motion; combination of harmonic motions; damped harmonic motion.
3. **Surface Tension:** Surface tension as a molecular phenomenon; surface tension and surface energy; capillary rise or fall of liquids; pressure on a curved membrane due to surface tension.
4. **Elasticity:** Moduli of elasticity, Poisson's ratios; relations between elastic constants and their determination; cantilever.

Section B

5. **Fluid Dynamics:** Viscosity and coefficient of viscosity, Posseulle's equation; Bernoulli's theorem and its applications, Torricelli's theorem; venturimeter.
6. **Waves in Elastic Media:** Mechanical waves, types of waves, superposition principle, wave velocity; power and intensity in wave motion; interference of waves; complex waves; standing waves and resonance.
7. **Sound Waves:** Audible, ultrasonic and infrasonic waves, propagation and speed of longitudinal waves; vibrating systems and sources of sound; beats; Doppler effects.

Books Recommended:

1. **Ahmed & Nath**: *Mechanics and Properties of Matter.*
2. **Emran *et al.***: *General Properties of Matter*.
3. **Halliday & Resnick**: *Physics (Part-I & II).*
4. **Mathur**: *Elements of Properties of Matter*.
5. **Newman & Searle**: *General Properties of Matter*.
6. **Spiegel**: *Vector Analysis*.
7. **Symon**: *Mechanics*.

8. **Emran**: *Text Book of Sound.*
9. **Coulson**: *Waves*.
10. **Wood**: *Text Book of Sound*.

CHEM 1121: Basic Inorganic Chemistry
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section- A

1. **Atomic Structure:** Electromagnetic radiation, Rutherford's nuclear model of atoms, Bohr's model, quantum numbers, electronic configuration of elements & AUFBAU principle , Pauli's exclusion principle, Hund's rule of maximum multiplicity, elementary idea about wave mechanical model of an atom, shapes of s, p and d orbitals, defects of AUFBAU principle.
2. **Periodic Classification of Elements:** Periodic functions, ionization potential, electron affinity, electronegativity etc., position of hydrogen, lanthanides and actinides in the periodic table, properties of different types of elements in the light of electronic configuration.
3. **Group Chemistry of Elements:** Group chemistry with special reference to alkali metals, alkaline earth metals, inert gases, halogens, chalcogens etc.; transition elements

Section B

4. **Electronic Theory of Valencies:** Different types of bonds, ionic, covalent, co-ordinate and hydrogen bonds, hybridization of atomic orbitals, bonding in simple molecules like CH_4, C_2H_4, C_2H_2, NH_3, NH_4Cl, H_2O, $BeCl_2$, $AlCl_3$, BF_3, SO_3, C_6H_{12}, C_6H_6,. CO_2, PCl_3, PCl_5, SF_4, SF_6, SO_2, $SnCl_2$ etc, VSEPR theory, elementary idea about MOT
5. **Oxidation-reduction Reactions**: Definitions, oxidation state and number, balancing of oxidation - reduction equations, emf series.
6. **Principles Involved in Qualitative Inorganic Analysis**: Solubility, solubility product, common ion effect, theory of precipitation, group precipitations and analysis.

Books Recommended:

1. E. S. Gilreath : Fundemental Concepts in Inorganic Chemistry
2. S. Ahmed & L. Hossain : Snatak Ajoybo Rashayon
3. S. Z Haider : Modern Inorganic Chemistry
4. Companion : Chemical Bonding
5. A. I. Vogel : Qualitative Inorganic Analysis
6. T. Moeller : Inorganic Chemistry
7. R. D. Madan : Modern Inorganic Chemistry

ACCE 1111: Physical Chemistry-1
100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section- A

1. **Theory of Ideal Gases**: The combined gas law and the gas equation. Postulates of the kinetic molecular model theory. Root mean square velocity. Kinetic gas equation. Deduction of gas laws from the kinetic gas equation. The internal energy of an ideal gas. The mean free path. Transport properties of gases.
2. **Behavior of Real Gases**: Deviations from ideal behaviour. Causes of deviations. Modification of the ideal gas equation. Van dar Walls equation of state. The joule-Thompson effect. The van dar walls equation and the critical phenomenon.
3. **The Liquid State:** Liquids and the critical phenomena. Intermolecular forces. Structure of liquids. Vapor pressure. Trouton's law. Viscosity of liquids. Surface tension.
4. **Theory of Dilute Solutions:** Classification of solutions, Raoult's law, thermodynamic treatment of colligative properties of ideal solution, molecular weight determination from ebullioscopy, cryoscopy and osmometry, non ideal solutions.
5. **Chemical Equilibrium:** The law of mass action, dynamic nature and criteria of chemical equilibrium, thermodynamic derivation of equilibrium constant, determination of equilibrium constant, relationship between Kp and K_c, activity and activity coefficient, free energy and equilibrium constant, reaction isotherm, application of law of mass action to homogeneous and heterogeneous equilibrium, Le-Chatelier's principle.

Section- B

6. **Thermochemistry:** Laws of thermochemistry, Hess's law, Kirchoff's equation, heat of reaction, heat of formation: substance and ions in solution. heat of solution, heat of neutralization, heat of combustion, bond energies.
7. **The Solid State:** Types of solids: metallic, ionic, covalent and molecular solids. Properties of solids: polymorphism, enantiotropy, monotropy, dynamic allotropy and isomorphism. Crystal structure, Bragg's law, bond length, defects in solids.
8. **Thermodynamics:** First law, heat capacity, enthalpy, isothermal and adiabatic changes, thermodynamic reversibility, second law, Carnot's theorem, heat engines, entropy, free energy and work function, thermodynamic temperature scale, Gibbs-Helmholtz equation, Clausius-Clapeyron equation and its applications.

9. **Catalysis:** Characteristics of catalysts, types of catalysis, theories of catalysis, acid-base catalysis, enzyme catalysis, industrial catalysts and additives.

Books recommended:

1. S. Glasstone : A Text Book of Physical Chemistry
2. M.M.Haque & M.A.Nawab : Essentials of Physical Chemistry
3. P.C. Rakshit : Physical Chemistry
4. N. Kundu & S.K. Jain : Physical Chemistry
5. W.J. Moore : Physical Chemistry
6. Bahl and Tuli : Essentials of Physical Chemistry
7. Lewis and Glasstone : Elementary Physical Chemistry

Course Code No.: ACCE 1121
Course Title: Chemical Engineering-I (Chemical Engineering Fundamentals)
Full Marks: 75 [Exam. 70%, Quizzes/Class Tests 20%, Attendance 10%],
Unit: 0.75, Credit: 3, Duration of Examination: 4 Hours,
Periods/Weeks: 4-5, No. of Lectures: 50.

Section: A

1. **Origin and Development of Chemical Process Industries and Chemical Engineering**: Systematic analysis of chemical processes, theoretical basis of chemical industry with special reference to industrialization of Bangladesh.
2. **Introduction to Chemical Engineering Calculations**: Definition of units and dimensions, systems of dimensions and units.
3. **Process and Process Variables:** Temperature, pressure, composition and flow rates. Simple stoichiometric calculations, triangular diagram, graphical methods of addition and subtraction.
4. **Fundamentals of Material Balances:** Process classification, types of balances, principle and procedure of material balance.

Section: B

5. **Fluid Mechanics:** Introduction, general properties of fluid, fluid flow phenomena, viscosity, co-efficient of viscosity, effect of viscosity on fluid, types of fluid, fluid statics and its application. Fluid flow - basic equations for fluid flow, equation of continuity, Flow of fluid through narrow tube. Bernoulli's theorem and its applications, pressure concept, hydrostatic equilibria, Reynolds number.
6. **Measurement of Flowing Fluids:** Fluid flow measurement - Manometers, Orifice meter, Venturimeter, Rotameter, Pitot tube and weirs. Fittings and fittings materials. Pipes, pipe-standard and pipe materials, Valve and valve materials.
7. **Pumps, Fans and Blowers:** Pump head, pump efficiency, pump priming, power requirement, suction lift and cavitation, most important operating parameters of pumps, classification of pumps, and standard operating procedure (SOP) of pump. **Fans and Blowers:** Types and operations.
8. **Flow of Heat:** Mechanism of heat transfer, heat transfer co-efficients.

Books Recommended:

1. R. M. Felder and R. W. Rousseau - Elementary Principles of Chemical Processes.
2. Warren L. McCabe, Julian C. Smith and Peter Harriott - Unit Operations of Chemical Engineering.
3. W. L. Badger and J.T. Banchero - Introduction to Chemical Engineering
4. L. Bryce Andersen and Leonard Wenzel - Introduction to Chemical Engineering.
5. Wisler and J.G. Woodburn - Hydraulics.
6. Peery - Hand Book of Chemical Engineering.
7. S.K.Ghosal, S.K.Sanyal and S. Datta - Introduction to Chemical Engineering.
8. D.V. Himmelblau - Basic Principles and Calculations in Chemical Engineering.
9. Edwin Williams - Stoichiometry

ACCE 1132 : Inorganic Qualitative Analysis (LAB)
50 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.5 unit, 2 Credits, 6 Periods/Week

Systematic analysis of samples containing up to four radicals (at least two of which are cations) among the followings:

Ag^{+}, Pb^{2+}, Hg_2^{2+}, Cd^{2+}, Cu^{2+}, Bi^{3+}, Hg^{2+}, Fe^{3+}/ Fe^{2+}, Cr^{3+}, Al^{3+}, Mn^{2+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Ca^{2+}, Ba^{2+}, Sr^{2+}, Mg^{2+}, Na^{+}, NH_4^{+}, K^{+}, Cl^{-}, I^{-}, NO_3^{-}, $SO_4^{=}$, PO_4^{3-}, S^{2-}, SCN^{-} & $CO_3^{=}$

Books Recommended:

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

N.B. Students have to participate in 1 day's industrial tour of zero credit.

ECON 1211: Economics
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam. : 2 Hours

Section-A

1. **Basic Concepts of Economics:** Definition and subject matter of Economics; Microeconomics vs macroeconomics; Law of Economics; Central economic problems of every society; Different economic systems; Economics and Engineering.

2. **Theory of Demand, Supply and Consumer Behavior:** Law of Demand; Demand schedule and demand curve; Supply law, Supply schedule and supply curve; Shift in demand and supply; Equilibrium in the market; Elasticity of demand and supply
3. **Production and Costs and Theory of the Firm:** Meaning of production; Factors of production; Concepts of total, average and marginal costs, fixed and variable costs.
4. **Theory of the Firm:** Perfect competition and monopoly; Total, average and marginal revenue of a firm; Average and marginal revenue under perfect competition and monopoly; Firm's Equilibrium; Equilibrium of firm under perfect competition and monopoly.

Section-B

5. **The Input-Output Analysis:** Meaning of input-output analysis; Input-output analysis model; balance equation; coefficient matrix; Determination of final demand vector.
6. **Basic Concepts of Macroeconomics:** Growth; Unemployment; Inflation; Philips Curve, Business cycle; Circular flow of economics; Two, three and four sector economics.
7. **National Income accounting and determination:** Concepts of GNP, GDP and national income; Methods of national income accounting; Problems of national income accounting; Keynesian model of national income determination; The multiplier; Effect of fiscal policy in the Keynesian model.
8. **Budgets of Bangladesh:** The revenue at the capital budget; Income, expenditure of the government; direct and indirect taxes.
9. **Development Planning in Bangladesh:** Need for planning in Bangladesh; Various five year plans in Bangladesh; Development strategies in the five year plans of Bangladesh.

Books Recommended:

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

MATH 1211: Differential and Integral calculus
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 5 Periods/Week, Lectures: 55, Duration of Exam: 3 Hours

Section-A

1. **Functions:** Domain, Range, Inverse function and graphs of functions, Limits, Continuity, Indeterminate form.
2. **Ordinary Differentiation**: Differentiability, Differentiation, Successive differentiation and Leibnitz theorem.
3. a. **Expansions of functions**: Rolle's theorem, Mean value theorem, Taylor's and Maclaurin's formulae.
   b. **Maximum and minimum of functions of one variable**.
4. a**. Partial Differentiation**: Euler's theorem, Tangents and normal
   b. **Application of Derivatives**.

Section-B

5. **Indefinite Integrals**: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.
6. **Definite Integrals**: Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.
7. **Multiple Integrals**: Determination of lengths, Areas and Volumes.

Books Recommended:
Text Books:

1. **B. C. Das and B.N.Mukherjee**: *Differential Calculus.*
2. **B. C. Das and B.N. Mukherjee**: *Integral Calculus.*

Reference Books:

1. **F. Ayres**: *Calculus*.
2. **Edwards**: *Differential Calculus*.
3. **Williamson**: *Integral Calculus*.
4. **Muhammad and Bhattacherjee**: *Differential Calculus*.
5. **Muhammad and Bhattacherjee**: *Integral Calculus*.

PHY 1221: Applied Electricity and Magnetism
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 5 Periods/Week, Lectures: 55, Duration of Exam: 3 Hours

Section-A

1. **Electrostatics :** Electric dipole; electric field due to a dipole; dipole on external electric field; Gauss's Law and its applications.
2. **Capacitors:** Parallel plate capacitors with dielectric; dielectrics and Gauss's Law; susceptibility, permeability, and dielectric constant; energy stored in an electric field.
3. **Electric Current :** Electron theory of conductivity; conductor, semiconductors and insulators; superconductors, current and current density; Kirchhoffs Law and its applications.

Section B

4. **Electomagnetic Induction:** Faraday's experiment; Faraday's law; Ampere's law, motional e.m.f.; self and mutual inductance galvanometers-moving coil, ballistic and deadbeat types.
5. **Thermoelectricity : Thermal e.m.f;** Seebeck, Peltier and Thomson Effects; laws of addition of thermal e.m.f., thermoelectric power.
6. **DC and AC Circuits :** D.C. circuits with LR, RC, and LCR in series; A.C. circuits with LR, RC, LC, and LCR in series.

Books Recommended :

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

STAT 1211: Statistics for Engineers
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam. : 2 Hours

Section-A

1. **Analysis of statistical data:** Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.

2. **Probability:** Concept of probability, Sample Space, Events union and Intersection of Events. Probability of events, Loss of probability, Conditional probabilities. Bose Einstein Statistics. Bay's Theorem, Chebysec's Inequality and Practical examples.
3. **Random variables and probability Distribution:** Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions. Conditional Expectation and conditional variance. Moments and Cumulant generating functions. Characteristic function. Study of Binomial Poisson, Normal and Bivariate Normal distribution and Practical examples.

Section-B

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

Books Recommended:

Text Books:

1. P.G.Hoel. : Introductory Statistics
2. S.G. Gupta : Fundamentals of Statistics

Reference Books:

1. A.J.B.Anderson. : Interpreting Data.
2. H. Cramer : The Elements of Probability Theory.
3. D.V.Lindley : Introduction to Probability and Statistics
4. S.Lipschutz. : Probability
5. Mosteller, Rourke & Thomas : Probability with Statistical Applications;
6. F.L.Wolf. : Elements of Probability and Statistics
7. T.H. Wonnacot & R.J.Wonnacot : Introductory Statistics,
8. Yule & M.G.Kendall. : An Introduction to the Theory of Statistics

CHEM 1211 : Basic Organic Chemistry
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 5 Periods/Week, Lectures: 50, Duration of Exam: 3 Hours

Section-A

1. **Fundamental Concept of Organic Chemistry**: Purification and analysis of organic compounds. Electronic theory of valency and its application to organic chemistry, tetravalency of carbon, hybridization, shapes and geometry of organic molecules, atomic orbital theory of bonding, nature of covalent bond, localized and delocalized covalent bond, concept of resonance, inductive effect, bond energy, bond length and bond angle.
2. **Aliphatic hydrocarbons :** Alkanes (Paraffins) : Structure, Nomenclature, Preparations and reactions, Photo-chemical reactions. Conformations of ethane and butane.
   Alkenes: Structure, Nomenclature, Preparations and reactions, Preparations, Reactions, mechanism of addition to double bonds. Markownikoff and anti-Markownikoff addition, Peroxide effect, Oxidation and reduction of olefins.
   Alkynes : Structure, Nomenclature, Preparations, Reactions and acidity of alkynes.
   Alkylhalides : Nomenclature, Preparation, Reactions of halides.
3. **Alcohols and ethers** : Nomenclature, Classification, Preparation, Association of alcohols, Distinction between different types of alcohols. Ethers and epoxides : Nomenclature, Preparation and reactions, host guest interaction,
4. **Aldehydes and Ketones :** Nomenclature, General methods of preparation and reactions, nucleophilic addition to carbonyl compounds.
5. **Carboxylic acids :** Nomenclature, Role of resonance effect, inductive effect, acidity, general methods of preparations, reactions, Derivatives of carboxylic acids, esters, anhydrides, acylhalides, amides etc. Dicarboxylic acids and their derivatives.

Section-B

6. **Nitrogen and sulphur containing compounds :** Amines, different types of amines, Nomenclature, structure, basicities, preparations, Separation, properties, and reactions, nitro, cyano compounds and compounds containing sulphur atom.
7. **Aromatic Chemistry:** Structure of benzene and related compounds, aromaticity, mechanism of orientation, substitution, resonance, mono and polyfunctional derivatives of benzene, phenols, polynuclear hydrocarbons, naphthalenes and phenanthrenes.
8. **Alicyclic Compounds:** General methods of preparation and properties, ring expansion and contraction, stability of ring, ease of ring formation, conformation and chemical reactivity of cyclohexane and its derivatives.

9. **Synthetic Methods and their Applications in Organic Chemistry:** Grignard synthesis, acetoacetic and malonic ester synthesis and synthesis involving diazonium salts.

Books Recommended:

1. I. L. Finar : Organic Chemistry, Vol. I
2. B. S. Bahl and Arun Bahl : Advanced Organic Chemistry
3. M. Ahmed and A. Jabber : Organic Chemistry
4. R. T. Morison & R. N. Boyd : Organic Chemistry
5. S. Pine : Organic Chemistry

ACCE 1211 : Chemical Technology-I
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 4-5 Periods/Week, Lectures: 50, Duration of Exam.: 3 Hours

Section-A

1. **Introduction to Chemical Technology and Chemical Process Industries:** History of development of science and technology, modern concepts, general and special chemical technology, the structure of chemical industry, development to chemical process industries, project planning and implementation.
2. **Sugar and Starch Industries:** Sugar from different sources, manufacture and refining of cane sugar, milling operation and control of evaporator, vacuum pan and centrifugal operation, utilization of by-products of sugar industry, sugar specialities, routine analysis in sugar industry, recovery of starch from different sources and prospects of sugar industry in Bangladesh.
3. **Pulp and Paper Industries**: Sources of cellulosic raw materials, constituents associated with cellulose, manufacture of different types of pulp and paper, recovery of chemicals from waste cooking liquors, de-inking of waste paper, routine analysis in pulp and paper industry, pulp and paper industries in Bangladesh.
4. **Fermentation Industry:** Chemistry and mechanism of enzyme actions, manufacture of industrial alcohol, absolute alcohol, butyl alcohol, acetone, vinegar and acetic acid by fermentation processes, production of pickles and cheese by micro-biological methods, alcoholic beverages - beer, wine and liquors.

Section-B

5. **Leather:** Classification of hides and skins, structure of animal skins, pretannage process, tanning processes – vegetable tanning and chrome tanning, finishing of leather, commercial aspects of leather, pollution problems from leather industry, leather industry in Bangladesh.

6. **Preservation of Foods:** Types of food, principles of food preservation, methods of food preservation, causes of food deterioration, food preservation by dehydration, low temperatures, high temperature, fermentation, preservatives and irradiation with special reference to the preservation of fish, fruits, vegetables, meat and poultry products, food plant sanitation.
7. **Agricultural Chemicals:** Plants nutrients, nutrient functions, types of fertilizers, source of fertilizers, chemistry and preparation of ammonium nitrate, potassium nitrate, urea, superphosphate, tripple super phosphate (TSP), pollution caused by fertilizers, insecticides, pesticides, herbicides, biodegradation of pesticides, pesticides pollution.

Books Recommended:

1. N. Shreve : Chemical Process Industries
2. Jacob : Food and Food Products
3. Furnas : Rogers Industrial Chemistry
4. R. K. Das : Industrial Chemistry
5. Sharma : Industrial Chemistry
6. Casey : Pulp and Paper
7. Reigels : Handbook of Industrial Chemistry
8. Bailey's : Industrial Oil and Fat Products
9. Fisher : Paint and Varnish Technology
10. Frazier and Westhoff : Food Microbiology
11. Desrosier & Desrosier : Technology of Food Preservation
12. P. Honig : Principles of Sugar Technology
13. G. N. Pandy : A Textbook of Chemical Technology

ACCE 1222 : Organic Qualitative Analysis (LAB)
50 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.5 Unit, 2 Credits, 6 Periods/Week

(a) Detection of elements and determination of functional groups of organic samples.
(b) Determination of physical constants such as m.p and b.p.
(c) Identification of unknown organic compounds.
(d) Preparation of a suitable derivative of the sample under identification and determination of the m.p./ b.p of the derivative.

Books Recommended:

1. A. I. Vogel : A Textbook of Practical Organic Chemistry
2. Curtin, Shriner and Fusion : Systematic Organic Analysis
3. Clarke : Practical Organic Chemistry

ACCE 1230: Board Viva Voce
50 Marks, 0.5 Unit, 2 Credits.
Students have to appear before the examination committee for Viva Voce on both theoretical and practical courses

ACCO 2111: Industrial Management & Accountancy
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam. : 2 Hours

Section-A

1. **Industry:** Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry; Business: Meaning & Objectives of Business, Types of Business: Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.
2. **Fundamentals of Management**: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Scientific Management and Core Management skills.
3. **Factory Location and Plant Layout**: Factors Determining Location of Factory, Steps in Location, Factors Influencing Layout, Types of Layout, Problems of Layout.
4. **Work-Environment and Plant Utility**: Meaning, Importance, Factors Affecting Work Environment, Plant Utility, Lighting, Ventilation, Air-conditioning, Sanitation and Noise Control.
5. **Sole Proprietorships**: Features, Advantages, Disadvantages of Sole Proprietorship, Sustainability of Sole proprietorships.
6. **Man Power Planning & Motivation**: Need, Objectives, Manpower Planning Process, Recruitment, Selection and Training, Issue in Managing People, Maslow's Need Hierarchy, Social Needs and Productivity, Hygiene and Motivators.
7. **Conflict & Union Management Perspective**: Meaning, Process of Conflict, Types of Conflict, Industrial Conflict Resolution Methods, Negotiation Skills, Growth of Trade Unions, Functions, Structure, Leadership and Management in the Trade Union, Collective Bargaining.

Section-B

8. **Accountings**: History, Scope and Nature of Accounting, Purpose of Accounting, Information and Uses

9. **Transaction**: Meaning and Features, Accounting Equation, Meaning and Classification of Account, Double entry System, Rules for Determining Debit and Credit, Accounting cycle.
10. **Journal, Ledger and Trial Balance**: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems.
11. **Work Sheet**: Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.
12. **Cost Terms Concepts and Classification**: Meaning of Cost, Manufacturing and Non Manufacturing Costs, Period and Product Costs, Variable and Fixed Costs, Direct and Indirect Costs, Differential, Opportunity and Sunk Costs, Schedule of Cost of Goods Manufactured, Schedule of Cost of Goods Sold and Income Statement.
13. **Cost :** Volume-Profit Relationship: Contribution Margin and Ratio, Break-even Analysis, CVP relationship in Graphical Form and Target Net Profit Analysis.

Books Recommended:

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

MATH 2121: Differential Equation, Laplace Transform and Numerical Analysis
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 5 Periods/Week, Lectures: 55, Duration of Exam.: 3 Hours

Section-A (Differential Equations)

1. Solution of first order and first degree differential equations.
2. Singular solutions, orthogonal and oblique trajectories.
3. Solutions of higher order linear differential equations.
4. Series solution of linear differential equations.

Section-B

5. **Laplace Transform :** Definition, Laplace transforms of some elementary functions. Sufficient conditions for existence of Laplace

transforms. Inverse Laplace transforms. Laplace transforms of derivatives. The unit step function. Periodic function. Some special theorems on Laplace Transforms. Partial fraction. Solutions of differential equations by Laplace transforms. Evaluation of improper integrals. Fourier transforms.

6. **Numerical Analysis Interpolation**: Simple difference, Newton's formulae for forward and backward interpolation. Divided differences. Tables of divided differences. Relation between divided differences. Tables of divided differences. Relation between divided differences and simple differences. Newton's general interpolation formula. Lagrange's interpolation formula. Inverse interpolation by Lagrange's formula and by successive approximations. Numerical differentiation of Newton's forward and backward formula. Numerical integration. General quadrature formula for equidistant ordinates. Trapezoidal rule. Simpson's rule. Weddle's rule. Calculation of errors. Relative study of three rules. Gauss's quadrature formula. Legendre polynomials. Newton's Cotes formula. Principles of least squares. Curve fitting. Solution of algebraic and transcendental equations by graphical method. Regula-Falsi method. Newton-raphson method, Geometrical significance. Convergence of iteration and Newton-Raphson method., Geometrical significance. Convergence of iteration and Newton-Raphson methods. Newton-Raphson method and iteration method for the solution of simultaneous equations. Solution of ordinary first order differential equations by Picard's and Euler's method. Rung-Kutta's for solving differential equation.

Books Recommended:

Text Books:

1. **S. L. Ross**: Introduction of Ordinary Differential Equations.

Reference Books:

1. F. Ayres: *Theory and problems of Matrices*.
2. **F. Ayres**: *Differential Equations*.
3. **B. D. Sharma**: *Differential Equations*.
4. **L. Pipes**: App. *Mathe. For Engineers and Physicist*.
5. **I. S. Sokolnikoff & R.M.Redheffer**: *Math. For Physics and Modern Physics*.

PHY 2111: Basic Electronics and Instrumentation
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 5 Periods/Week, Lectures: 55, Duration of Exam: 3 Hours

Section-A

1. **Semiconductor Diodes**: p-type and n-type Semiconductors; pn Junction and Its Volt-Ampere Characteristics; Special Diodes: LED and Zener; Rectifiers and Power supplies.
2. **a) Bipolar Junction Transistors**: PNP and NPN Transistors: Construction and Operations, DC characteristics of CE, CB and CC configurations. **b) Logic Gates and Boolean algebra**: Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR and Ex-NOR operations and their truth tables; Laws of Boolean algebra, De-Morgan's theorems.
3. **Feedback and Oscillators Circuits**: Feedback: Principles, Positive and Negative Feedbacks; Oscillators: Condition for Sustained Oscillation; Phase-Shift, Hartley and Colpitt's Oscillators.

Section B

4. **a) Number Systems**: Decimal, Binary, Octal and Binary codes.**b) Logic Gates and Boolean algebra**: Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR and Ex-NOR operations and their truth tables; Laws of Boolean algebra, De-Morgan's theorems.
5. **Flip-Flops**: RS, D, T and JK Flip-Flops.
6. **Instrumentations**: Oscilloscope, pH-meter, Spectrophotometer, GM and Scintillation counters; Concept of computer on-line measurements.

Books Recommended

1. **Grob, B.:** *Basic Electronics*
2. **Gupta, SL and Kumar, V.:** *Handbook of Electronics*
3. **Boylestad, RL and Nashelsky, L:** *Electronic Devices and Circuit Theory*
4. **Mehta, VK.:** *Principles of Electronics*
5. **Malvino, AP:** *Electronic Principles*
6. **Tocci, RJ.:** *Digital Systems*
7. **Souhney, AK:** *A Course in Electrical Measurements & Electronics*

CHEM 2112 : Organic Preparations (LAB)

25 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.25 Unit, 1 Credit, 3 Periods/Week

Preparations of some important organic compounds; such as acetyl salicylic acid (aspirin), acetanilide, salicylic acid, benzoic acid etc.

Book Recommended:

1. A. I. Vogel : A Text Book of Practical Organic Chemistry
2. Raj K. Bansal : Laboratory manual in Organic Chemistry.

ACCE 2111 : Advanced Inorganic Chemistry

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Co-ordination Compounds:** Warner's theory and Sidgwick's electronic theory of co-ordination compounds and their limitations, nomenclature of complexes: chelates and their classifications, inner complexes, valence bond and crystal field theory of complex compounds, different types of isomerism, stereoisomerism in four and six coordinated complexes, stability of complexes and application of complexes.
2. **Nuclear and Radiochemistry:** Atomic nucleus, mass defect, packing fraction, binding energy, potential barrier, different types of nuclear reactions, acceleration of charge particles, fission and fusion reactions, nuclear forces and stability, elementary idea about isotopes, isobars and isotones, separation of isotopes, natural and artificial radioactivity, equation of radioactive decay & growth, statistics, concept of complex nucleus, uses of radio-isotopes.
3. **Principles of Colorimetric and Spectrophotometric Methods of Analysis:** Concept of chromophors, Red shift and blue shift, hyperchromic effect & hypochromic effect. Beer-Lambert's law, photoelectric colorimeters, determination of unknown concentration of a solution.

Section-B

4. **Complexometric Titrations:** EDTA complexes, effect of pH upon complex formation with EDTA, end point detection by pM indicators, different types of EDTA titration, titration in a mixture.
5. **Aqueous Equilibria:** Dissociation of water, meaning of the terms Kw, pKw, pH and pOH, strong acids & bases. Weak acids & bases, pH for all weak, strong acid & base solutions, relation between K_a and K_b, acid-base properties of salt solutions.

6. **Modern Theories of Acids and Bases:** Classical theory, Bronsted-Lowry, Lewis and other modern theories, solvent ion concept etc., strengths of acids and bases, acid-base character and chemical structure.
7. **Principle of Inorganic Quantitative Analysis**: Primary standard substances, different types of quantitative analysis, classification of volumetric methods: acid-base, redox and precipitation titrations; Karl Fischer method, indicators for titration, titration in nonaqueous media; titration curves.

Books Recommended :

1. Basalo & Johnson : Co-ordinaion Chemistry
2. G. R. Choppin : Nuclear Chemistry and Radioactivity
3. A. I. Vogel : A Test Book of Quantitative Inorganic Analysis
4. Y. Lyalikov : Physico-chemical Analysis
5. S. M. Khopkar : Basic Concepts of Analytical Chemistry
6. Pauling : College Chemistry
7. Finston and Richtman : A New View of Current Acid - Base Theories
8. Sayenuddin Ahmed : Ajoybo Rashayan
9. E.S. Gilreath : Fundamental Concepts in Inorganic Chemistry

ACCE 2121 : Physical Chemistry-II

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Chemical Kinetics:** Order and molecularity of reactions, rate equations for zero, first, second and third order reactions, determination of order and rate constant, theories of reaction rates, temperature dependence of reaction rates, chain reactions, reaction in solutions, kinetics in chemical engineering, kinetic models for non-elementary reactions.

2. **Electrochemistry:** Conductance, Faraday's laws of electrolysis, the conductance of electrolytic solution, cell constant, equivalent and molar conductance, equivalent conductance and concentration, Kohlrausch's law of independent migration of ions, conductivity and mobility of ions. abnormal mobilities of hydrogen and hydroxyl ions, transport number, applications of conductance measurement.

3. **Electrochemical Cells:** Electrode reactions and concept of half cells, reversible and irreversible cells, the origin of emf, measurement of emf, the standard cell, relation between electrical and chemical energy, types of single electrodes, single and standard electrode potentials, redox potential, concentration cells, liquid junction potential, accumulators, applications of emf measurement.

4. **Surface and Colloid Chemistry:** Adsorption, types of adsorption, adsorption isotherms, Freundlich, BET and Langmuir adsorption isotherms, adsorption at the free surface of a liquid, Gibbs adsorption equation, surface area of adsorbents, temperature dependence of surface reactions, adsorption from solutions, applications of adsorption.
   Colloid Preparation, purification, classification and properties of colloids, origin of electrical charge on colloidal particles, gel and emulsions, synergesis and thioxotropy, soaps and surface active agents.

Section-B

5. **Photochemistry:** Electromagnetic radiation, energy content of a photon, Laws of photochemistry. Primary processes in photochemical reactions, fluorescence, phosphorescence and chemiluminescence, mechanism of photochemical reactions.

6. **Phase Equilibrium:** Definition of terms, the phase rule, one component systems: water, CO_2; two component systems : liquid-liquid equilibrium in partially miscible liquid pairs, liquid-vapour equilibrium, zeotropic and azeotropic mixtures, principle of fractional distillation; solid-liquid equilibrium : eutectic point, congruent and incongruent melting point; humidity, efflorescence and deliquescence.

7. **Ionic Equilibria:** True and potential electrolytes, dissociation of weak electrolytes, Ostwald's dilution law, ionisation of water, the pH scale. Henderson equation, buffer solutions and buffer action, determination of pH, hydrogen gas electrode, glass electrode.

8. **Radiation Chemistry:** Primary effects due to charged particles, linear energy transfer, Bremsstrahlung, passage of neutrons through matter, interaction of gamma radiation with matter, absorption coefficients. Absorption in water, units of radiation energy, radiolysis of water, the hydrated electron.

Books Recommended:

As in course ACCE 1111 and

1. S. Glasstone : An Introduction to Electrochemistry

ACCE-2132 : Inorganic Quantitative Analysis (LAB)
50 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.5 Unit, 2 Credits, 6 Periods/Week

a) Acid-base titrations
b) Oxidation-reduction titrations
c) Precipitation titration
d) Complexometric titrations
e) Gravimetric analysis.

Books Recommended:

1. A. I. Vogel : A Text Book on Inorganic Quantitative Analysis

ACCE 2142 : Engineering Drawings (LAB)
25 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.25 Unit, 1 Credits, 3 Periods/Week

N.B. Students have to participate in 1 day's industrial tour of zero credit.

CSE 2251 : Computer Programming

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance] 0.75 Unit, 3 Credits, 4-5 Periods/Week, Lectures: 50, Duration of Exam: 3 Hours

Section-A

1. **Introduction :** Programming languages, basic concepts of compiler, interpreter, algorithm and flowchart.
2. **Variables, Constants, Operators and Expressions :** Program structure in C, Program creating, compiling, debugging and running, Basic I/O functions, Identifiers and keywords, Simple data types, variables, constants, operators, Bitwise operators, comments.
3. Program Control Statements : True and False in C, C Statements, Conditional Statements, if switch, Loops : for, while, do/while, break, exitO, continue, Labels and goto.
4. **Arrays :** Single-Dimensions arrays, passing single-dimension arrays to functions, tow-dimensional arrays, multidimensional arrays, arrays and pointers, allocated arrays, array initialization.

Section-B

5. **Functions :** The return Statement, scope rules of functions, function arguments, arguments to mainO, Function returning noninteger values, using function prototypes, returning pointers, classic versus modern parameter declarations, recursion, pointers to functions, implementation issues.
6. **Pointers :** Pointers are addresses, pointer variables, the pointer operators, pointer expressions, dynamic allocation functions, pointers and arrays, pointers to pointers, initializing pointers.
7. Structure, Unions and User-Defined Variables : Structures, arrays of structures, passing structures to functions, structure pointers, arrays and structures within structures, Bit-fields, Union, Enumerations, Using sizeof to Ensure Portability, typedef.
8. **Input, Output and Disk Files :** Streams and Files, Standard Input and Output, I/O System : Conceptual vs. Actual console I/O, Formatted Console I/O, Formatted Output-printf, Variable length Argument List, C File system, Random Access Files and lseekO

Books Recommended

1. Kernighan and Ritchie : The C Programming Language, Prentice Hall
2. Gotfreid : Programming with C, Schaum's Outline Series, Tata McGraw Hill
3. D.E. Knuth : The Art of Computer Programming, Addison-Wesley Professional
4. E. Balagurusamy : Programming with ANSIC, Tata McGraw Hill
5. H. Schildt : Teach yourself C, McGraw-Hill Publishers.

CHEM 2212 : Inorganic Preparations (LAB)

25 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.25Unit, 1 Credit, 3 Periods/Week

1. Preparations of sodium thiosulphate, amine-complex of some metal ions, potash alum etc.
2. Preparation of ferrous sulphate crystal from ferric chloride solution
3. Preparation of potassium permanganate solution from waste dry cell

ACCE 2211 : Advanced Organic Chemistry

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Heterocyclic Compounds:** Chemistry of furan, thiophene, pyrrole, pyridine, thiazole, quinoline, isoquinoline and compounds containing more than one heteroatoms.
2. **Chemistry of Carbohydrates:** Classification and characteristic properties, structures and conformations of glucose and fructose, structures and configurations of monosaccharides, epimerization and mutarotation, disaccharides and polysaccharides.
3. **Amino Acids, Polypeptides 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.

4. **Stereochemistry:** Types of isomerism, asymmetric carbon atom, optical isomerism, specific and molecular rotation, optically active compounds containing one and more than one asymmetric carbon atoms, R and S configurations, geometrical isomerism; Nature, configuration and properties.

Section-B

5. **Organic Reactions and their Mechanisms:** Some typical organic reactions with reference to their mechanisms and applications: Friedel - Crafts reaction, Wolffkishner reduction, Clemmensen reduction, Oppenauer oxidation, Meerwein-Ponndorf-Verley reduction, Aldol condensation, Diels-Alder reaction, Perkin reaction, Wittig reaction, Knoevenagel and Cannizzaro reactions.
6. **Alkaloids :** Occurrance, general methods employed for the extraction, isolation and characterization of alkaloids. Structure elucidation of some important alkaloids.
7. **Dyes:** Colour and constitution, definition, classification, basic idea of dye formation, properties, some typical dye preparations and uses :
8. **Substitution Reactions:** Bimolecular and unimolecular substitution reactions, their mechanism and stereochemistry, factors affecting S_N^1 and S_N^2 reactions.

Books Recommended:

1. R. T. Morision & R. N. Boyd : Organic Chemistry
2. I.L. Finar : Organic Chemistry Vol. I & II
3. B. S. Bahl & Arun Bhal : Advanced Organic Chemistry
4. L. Fieser and M. Fieser : Organic Chemistry
5. Alexander : Ionic Organic Reactions
6. Gilman : Advanced Organic Chemistry
7. Gram and Hammond : Organic Chemistry
8. Wheland : Advanced Organic Chemistry
9. E.L. Eliel : Stereochemistry of Carbon Compound
10. W. Pigman : Carbohydrates
11. P. Sykes : A Guide to Mechanism in Organic Chemistry
12. E.S. Gould : Organic Reaction Mechanism
13. Jerry March : Advanced Organic Chemistry Reaction, Mechanisms and Structure.
14. Raj K. Bansal : Organic Reaction Mechanisms.

ACCE 2221 : Chemical Technology-II

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Mineral Acids:** Sources of sulphur, mining of sulphur – Sicilian and Frasch processes, manufacture of sulphuric acid – chamber and contact processes, oleum, uses, production of hydrochloric acid nitric acid, properties and uses.
2. **Alkali, Chlorine and Allied Chemicals:** Sodium chloride as raw material, manufacture of soda ash, caustic soda, chlorine, hypochlorites and bleaching powder.
3. **Coating Technology:** Paint, varnish and lacquer, constituents and their functions, factor influencing satisfactory performance of surface coating, properties of pigments, bindners and volatile solvents, pigments of different colours, paint application, causes of paint failure, emulsion paints, manufacture of paint, varnish and lacquer, heat resistant and acid proof paints, enamels and japans.
4. **Perfume and Flavouring Industries** : Constituents of perfumes, vehicles or solvent, the fixative and odoriferous elements, synthetics and semisynthetics used in perfumes and flavours, perfume and flavour essence formulations, industrial applications of perfumery, the flavouring industry, natural fruit concentrates, vanila chocolates and cocoa.

Section-B

5. **Ceramic Industries:** Types of ceramic products, basic raw materials, whitewares, manufacture of porcelain, types of clay, preparation, firing, different stages of firing, chemical conversion including basic ceramic chemistry, different types of kiln, temperature recording in the kiln, heavy clay products, manufature of refractories, varieties of refractories, specialized ceramic products, enamels and enameled metal, ceramic industries of Bangladesh.
6. **Soaps and Detergents:** Sources of oils, fats and waxes, saponification number, acid value and iodine value, surface active materials and principles of detergency, manufacture of different types of soap, recovery of glycerine, typical soaps, classification of detergents, industrial process for the manufacture of alkyl-aryl sulphonate, synthetic glycerine from petroleum.
7. **Glass Industries:** History and development of glass industries, Raw materials, composition, properties, and uses of different types of glasses, manufacture of glass, special glasses. Glass industries of Bangladesh.
8. **Cement Industries:** Raw materials, composition, properties and uses of different types of cements, manufacture of cement by different methods, setting and hardening of cement, testing of cement. Limes – classification, manufacture and properties, cement industries of Bangladesh.

9. **Water Conditioning and Waste Water Treatments**: Water in nature, water conditioning, methods of water conditioning, water purification, municipal water conditioning, industrial water conditioning, sewage and industrial waste water treatment, water for industrial purposes, industrial wastes & treatment processes and water analysis.

Books Recommended:

As in course ACCE 1211

Course Code No.: ACCE 2231
Course Title: Chemical Engineering-II
Full Marks: 75 [Exam. 70%, Quizzes/Class Tests 20%, Attendance 10%],
Unit: 0.75, Credit: 3,
Duration of Examination: 4 Hours,
Periods/Weeks: 4-5, No. of Lectures: 50.

Section – A

1. **Material Balance:** Material balance calculation of unit operations.
2. **Mass Balance on Reactive System:** Definition of terms - limiting and excess reactant, yield, conversion, recycle, bypass, purge, mass balance involving combustion of solid, liquid and gases, mass balance in industrial reactions.
3. **Single Phase System and Multiphase System:**
4. **Computer-Aided Balance Calculations:** Degree of freedom analysis, sequential modular simulation, equation – based simulation, commercial simulation package problems.

Section – B

5. **Energy Balance:** Concepts and units, heat capacity, Calculation of enthalpy changes, Enthalpy changes for phase transitions, the general energy balance, reversible processes and the mechanical energy balances, energy balances with chemical reaction, heat of solution and mixing, enthalpy-composition diagram.
6. **Balance on Reactive processes.**
7. **Balance on Non-reactive process.**
8. **Unsteady-state Energy Balance :**

ACCE 2252: Industrial Preparations (LAB)

25 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 0.25 Unit, 1 Credit, 3 Periods/Week

Preparations of some compounds of industrial importance.

ACCE 2260 Board Viva Voce
50 Marks, 0.5 unit, 2 Credits.
Students have to appear before the examination committee for Viva Voce on both theoretical and practical courses

Course Code No.: ACCE 3111

Course Title: Chemical Engineering-III (Unit Operations)
Full Marks: 100 [Exam. 70%, Quizzes/Class Tests 20%, Attendance 10%],
Unit: 1.0, Credit: 4,
Duration of Examination: 4 Hours,
Periods/Weeks : 06, No. of Lectures: 66.

Section-A

1. **Principle of Heat Flow in Fluid:** Heat exchanger, condensers, rate of heat transfer, over-all heat transfer co-efficient, boiling of liquids, condensation of vapour.
2. **Evaporator:** Types of evaporator, principle and operation of single effect, double effect and multiple effect evaporators, evaporator capacity – heat and material balances, condensate removal, entrainment separator, choice of steam pressure, steam-film coefficient, scale formation and prevention.
3. **Steam Boiler:** Introduction, essential of a good steam, selection of a steam boiler, classifications of steam boilers, boiler mounting and boiler accessories – feed pump, superheater, economizers, air preheater, performance of steam boilers, boiler draught.
4. **Crystallization:** Crystal forms and crystal habit, classification of crystallizers, theory of crystallization, nucleation, rate of crystal growth, vacuum-crystallizer theory, caking of crystals and its prevention, material and energy balance of a crystallizer, calculation of yield.

Section-B

5. **Drying, Humidifiers and Air Conditions:** Types of dryer and their applications, theory of drying, rate of drying curves, moisture content and mechanism of moisture movement, types of drying material, dryer calculation and dryer control. Definition of humidity and humid heat, humidity chart, wet bulb temperature, humidifiers and dehumidifiers.
6. **Fluid Solid Separation:** Sedimentation, Kynch theory, design of continuous settlers, separation of sizes by free settling, classification of filters, theory of filtration, construction and operation procedure of filters.
7. **Mixing of Solids, Liquids and Pastes:** Agitation of liquids, circulation, velocities and power consumption in agitated vessels. Dispersion operations.
8. **Size Reduction, Screen Analysis, Handling and Storage of Solid Materials:** Methods and equipments for size reduction. Screening - industrial screens, screen analysis. Types of conveyors, construction and operation of belt conveyors, fluidisation and pneumatic conveyors, dust separation, storage of solid materials, silos and beans.

Books Recommended:

1. W. L. Badger and J.T. Banchero - Introduction to Chemical Engineering.
2. B. F. Dodge - Chemical Engineering Thermodynamics.
3. R. E. Treybal - Mass Transfer Operations
4. A. S. Foust et al - Principles of Unit Operation.
5. V.P. Vasandan and D.S.Kumar - Heat Engineering
6. Mc Cabe, J.C. Smith and Harriot - Unit Operations of Chemical Engineering.
7. M. Rhodes - Principles of Powder Technology

ACCE 3121: Instrumental Analysis

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Spectroscopic Analysis:** Theoretical principles for visible, UV & IR spectroscopic analyses; instrumentation of the visible, UV & IR spectrophotometers and their measurement principles. Application of spectrophotometric methods for qualitative and quantitative analyses.
2. **Atomic Absorption and Flame Emission Spectroscopies:** Theoretical principles, instrumentation, measurement techniques and applications of atomic absorption and flame emission spectrophotometers.
3. **X-ray Diffraction:** Properties of X-rays; diffraction; the Bragg law; diffraction directions; diffraction method; scattering of X-rays; experimental methods; determination of crystal structure.
4. **Electrochemical Methods:** Potential sweep techniques; cyclic voltammetry; potentiometric titration; amperometric titration; A.C. techniques.

Section-B

5. **Chromatographic Techniques:** Principles of chromatographic analysis**;** thin layer chromatography and ion exchange chromatography. High performance liquid chromatography (HPLC): normal phase, reversed phase, ion exchanges and ion pairing techniques. Applications of HPLC in analysis of drugs and industrial products.
6. **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, heat flux, DSC; power compensated DSC; applications of TGA; DTA and DSC.
7. **Mass Spectroscopy:** Basic Principle, instrumentation, general techniques and applications. Different types of mass spectrometers.
8. **Nuclear Magnetic Resonance (NMR) Spectroscopy:** Theoretical principles, instrumentation and measurement techniques; scopes and applications of FT-NMR.

Books Recommended:

1.	G. W. Ewing	: Instrumental Methods of Chemical Analysis
2.	F. J. Welcher (edited)	: Standard Methods of Chemical Analysis
3.	G.D. Christain	: Analytical Chemistry
4.	G.L. Kehl	: The Principles of Metallographic Laboratory Practice
5.	Wendlandt:	: Thermal Analysis
6.	E. L. Charsley (edited)	: Thermal Analysis- Techniques and Applications
7.	B .K. Sharma	: Instrumental Methods of Chemical Analysis
8.	R. M. Verma	: Analytical Chemistry
9.	Ghatwal and Anand	: Instrumental Methods of Chemical Analysis
10.	G.H. Jeffery, J Bassett, J. Mendham & R.C. Denny	: Vogel's Text Book on Inorganic Quantitative Analysis
11.	H.A. Flaschka, A.J. Barnard and P.E. Sturrock	: Quantitative Analytical Chemistry
12.	A.J. Bard & L.R. Faulkner	: Electrochemical Methods
13.	C.M.A. Brett & A.M.O.Brett	: Electrochemistry
14.	B. D. Cuttlity	: Elements of X-ray Diffraction
15.	R. Greef, R. Peat, L.M. Peter, D. Pletcher and J. Robinson	: Instrumental Methods in Electrochemistry

ACCE 3131 : Fuel Technology
75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section A

1. **Basic Concept of Fuel:** Definition of fuel, essential requirements of fuels, classification of fuels, 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, sulfur, oxygen and ash content on calorific value in 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:** Origin, occurrence, composition and classification of crude oils, 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 and asphalts.

4. **Petroleum Products and Their Aspects:** Octane and cetane number of liquid fuels, detonation of fuels, antiknock compounds or 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.

Section B

5. **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, necessities of natural gas purification, methods of natural gas purification, 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.
6. **Coal:** Origin, formation and composition of coal, chemical definition of coal, classification of coal chemical 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.
7. **Coal Processing:** 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, anthraene etc) from coal tar, coke oven gas, hydrogenation of coal. Manufacture of water gas and producer gas.

Books Recommended:

1. Goldstein : The Petroleum Chemical Industry
2. Hrdu and Williams : Petrochemical Industries
3. Flix : Chemistry of Petroleum Derivatives
4. Kalichevsky : Chemical Refining of Petroleum
5. N. Shreve's : Chemical Process Industries
6. Sukumar Maiti : Introduction to Petrochemicals
7. N. N. Lebedev : Chemistry and Technology of Basic Organic and Petrochemical Synthesis (Vol. 1 & 2)
8. H.S. Bell : American Petroleum Refining
9. B.K. Bhaskara Rao : Modern Petroleum Refining Process
10. B.G. Deshpande : The World of Petroleum
11. W. L. Nelson : Petroleum Refining Engineering

12. Jams H. Gray & G.E. : Petroleum Refining and Economics
Glemn E. Handwerk
13. Moor : Coal
14. W. Francia : Coal
15. Lawry : Chemistry of Coal Utilization
16. Huntington : Natural Gas and Natural Gasoline
17. Badrul Imam : Bangladeshe Tel Shambabona O Haripur Tel Bitorka

ACCE 3141 : General Pharmaceutical Chemistry

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section-A

1. **The Occurrence of Impurities in Medicinal Chemicals and Substances Used in Pharmacy:** Standard criteria of impurity of pharmaceutical chemicals, principles underlying qualitative and quantitative pharmaceutical analysis. Pharmacopoeia and their importance in regulating the standards of medicinal chemicals.
2. **Preparation, Properties, Actions and Uses of the Following Compounds**: Aluminium hydroxide, barium hydroxide, magnesium hydroxide, magnesium sulphate, magnesium trisilicate, ferrous sulphate, ferrous gluconate, p-amino salicylic acid, paracetamol and barium sulphate.
3. **Crude Drugs:** 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 followings : Nux Vomica, Cinchona, Belladonna, Opium and Ephedra species.
4. **Definition and Classification of Glycosides, Vitamins and Hormones:**. Isolation, chemistry, industrial production plant (equipments, flow sheet etc.) and medicinal importance of the following: Ascorbic acid, thiamine and riboflavin. Biochemistry and mode of action of vitamins, hormones and glycosides.

Section-B

5. Study of chemistry including general biological action of important synthetic drug viz. sulphadrugs, antimalerials etc., chemotherapy of important drugs in current use.
6. **Enzymes:** Definition, classification, properties, biological roles and factors affecting enzyme activity; specificity and mechanism of enzyme action; use of enzyme as therapeutic agent, diagnostic kit and clinical diagnosis; inhibitors and

activators of enzyme; synthesis and mode of action of important inhibitor and activator drugs in current use.

7. Concept of antagonist, agonist and inverse agonist from pharmacological point of view. Synthesis, action, uses and mode of action of some antagonist and agonist drug commonly available in the market.
8. **Methods of Sterilizations:** Microbial assays, sterility test and pyrogen testing.

Books Recommended:

1. A. Burger : Medicinal Chemistry
2. Rogers : A Text Book of Inorganic Pharmaceutical Chemistry
3. Bently : Chemistry of Morphine Alkaloids
4. Chopra and others : Chopra's Indigenous Drugs of India
5. Henry : Plant Alkaloids
6. R. Fleck : May's Chemistry of Synthetic Drugs
7. Fruton and Simmonds : General Biochemistry
8. Flowry : Antibiotics
9. I. L. Finar : Organic Chemistry, Vol. II.
10. Rogenburg : Chemistry and Physiology of Vitamins
11. Dyke : The Vitamins
12. E.W. Martin : Husa's Pharmaceutical Dispensing
13. Remington (edited) : Remington's Pharmaceutical Sciences
14. USP (edited) : The United States Pharmacopeia
15. BPC (edited) : The British Pharmaceutical Codex
16. BP (edited) : The British Pharmacopoeia
17. White, Handler & Smith : Principles of Biochemistry
18. Chettan : Practical Pharmaceutical Chemistry

ACCE 3151 Corrosion Engineering-I

50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **General Ideas:** Definition of corrosion; importance and economic aspects of corrosion study; classification of corrosion processes; corrosion cells and corrosion damages; mechanism of corrosion; thermodynamics of corrosion; potential-pH diagrams of iron-water, aluminum-water and chromium-water systems.
2. **Electrochemistry and Electrode Electrolyte Interface:** Electrical double layer; rate of charge-transfer reactions under zero field and electric field; electronation and de-electronation reaction; equilibrium exchange current density; non - equilibrium drift current density; over potential; Butler-Volmer equation for high-field and low-field approximations, and for a multistep reaction.
3. **Kinetic Aspects of Corrosion:** Polarization and corrosion rate; measurement of polarization; calculation of IR drop; causes of polarization;

hydrogen over voltage; polarization diagrams of corroding metals; influence of polarization on corrosion rate; measurement of corrosion rate from polarization data; Tafel extrapolation; linear polarization; AC impedance technique.

Section-B

4. **Passivity:** Characteristics of passivation and the Flade potential; behaviours of passivators; anodic protection and transpassivity; theories of passivity; growth of passive film with time; action of chloride ion and passive-active cells; critical pitting potential; passivity in alloys; effects of cathodic polarization and catalysis.
5. **Different Forms of Corrosion:** Theories; mechanism and preventions of corrosion; stress-corrosion cracking; crevice corrosion; stray current corrosion; pitting corrosion; microbial corrosion; intergranular corrosion and galvanic corrosion.
6. **Dry Corrosion:** Introduction, parameters of metal oxidation reaction, film continuity and Pilling-Bedworth ratios, mechanism of oxidation, remedial measures, catastrophic oxidation, internal oxidation, oxidation of alloys.

Books Recommended:

1. H. H. Uhlig : Corrosion and Corrosion control
2. U. R. Evans : An Introduction to Metallic Corrosion
3. M. G. Fontana : Corrosion Engineering.
4. S. N. Banerjee : An Introduction to Science of Corrosion and its Inhibition.
5. E. C. Potter : Electrochemistry
6. K. J. Vetter : Electrochemical kinetics
7. J. O. M. Bockris & A. K. N. Reddy : Modern Electrochemistry
8. C. C. Nathan : Corrosion Inhibitors
9. B.G. Baker : Surface Analysis by Electron Spectroscopy.
10. K.R. Trethewey & J. Chamberlain : Corrosion

ACCE 3162 : Chemical Engineering and Chemical Technology (LAB)
100 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 1 Unit, 4 Credits, 12 Periods/Week

(i) Chemical Engineering –I

1. Measurement of fluid flow.
2. Fabrication of power supply unit.
3. Construction of control chart.
4. Measurement and control of temperature, pressure, viscosity, pH, electrical conductivity.
5. Determination of drying rate of granular solid in a tray dryer.
6. Separation and purification of metallic ions by ion exchange and solvent extraction methods.

(ii) Chemical Technology

1. Analysis of cane sugar for invert sugar sucrose and ash.
2. Analysis and identification of fats, oil and waxes.
   a) Physical test: Solidifying point (Tilor), raneidity (Kriestest refractive index, colour matching (by tintometer)
   b) Chemical analysis: Determination of saponification value, acid value, iodine value, determination of water soluble, water insoluble and volatile fatty acids (Reichert, Mitchist, Polenski and Krishner values).
3. Analysis of fertilizers for phosphorous, potassium, ammoniacal nitrogen and percentage of urea, preparation of bordux mixture.
4. Refining and bleaching of oil samples, preparations of laundry and toilet soaps, liquid soap and vanishing cream, rouges and eye cosmetics.
5. Preparation of thickened linseed oils.
6. Analysis of cements for CaO, MgO, FeS, Al_2O_2 and SiO_2.
7. Preparation of water glass
8. Preparation of caustic soda

STUDENTS HAVE TO PARTICIPATE IN 1 DAY'S INDUSTRIAL TOUR OF ZERO CREDIT.

ACCE 3211 : Materials Engineering

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Introduction to Materials:** Classification of materials; structure-property relations and processing of materials; mechanical properties-stress-strain behaviour; anelasticity; elastic properties of materials; tensile properties; elastic recovery during plastic deformation; hardness. thermal characteristics; response to electric fields and chemical bond in solid materials.
2. **The Structure of Crystalline Solids:** Introduction; types of solids; polycrystalline aggregates; structure of atoms; space lattice/crystal lattice; unit cell and its lattice parameters; crystal systems; Bravais lattices; crystal structure of metals (B.C.C., F.C.C. & H.C.P); crystal symmetry; co-ordination number; atomic radii; number of atoms per unit cell; atomic packing factor; structure of some important solids, crystallographic planes and directions; interplanar spacing for cubic crystal; methods to determine crystal structures; polymorphism and allotrophy; solid solutions in metals and compounds; imperfection in crystals; noncrystalline materials.
3. **Failure:** Introduction; fundamental of fracture; ductile fracture; brittle fracture; principles of fracture mechanics; impact fracture testing; cyclic stresses; the S-N curves; crack initiation and propagation; factors that affect fatigue life; generalised creep behaviour; alloys of high temperature use.
4. **Electrical and Magnetic Properties of Materials:** Charge carriers and conductivity; insulators; scmiconductors; intrinsic and extrinsic semiconductors; classification of semiconductors on the basis of Fermi level;

ferroelectricity; basic properties of ferromagnetic and ferrimagnetic materials; hysteresis loops; requirements for permanent and soft magnetic materials; applications of magnetic materials.

Section-B

5. **Ceramic Materials:** Introduction; types of ceramic materials; properties of ceramics: thermal, optical, plastic deformation, electrical conductivity, dielectric, magnetic, piezoelectric, mechanical, etc.; comparison of ceramic and non-ceramic phases; ceramic crystals: AX type, A_mX_p type, $A_mB_nX_p$ type structure; classification of technical ceramics; processing of ceramics: material preparation, powder pressing, extrusion, soft plastic forming, slip casting, drying, firing; glazing of ceramics, binary and ternary phase diagram of ceramic phases; application of ceramics.
6. **Composite Materials:** Classification of composite materials; fabricating reinforced and hybrid composites; structural composites; concrete; concrete-polymer composites and fibre-reinforced cement.
7. **Nanomaterials:** Introduction; properties of metal nanoclusters, semiconducting nano particles, rare gas and molecular clusters; methods of synthesis of nano particles. Carbon molecules; clusters carbon nanotubes applications of carbon nanotubes.
8. **Refractory Materials:** Introduction, application and classification of refractories; properties of refractory materials: refractoriness, thermal expansion, elastic and plastic deformation, density and strength; production of chromate, magnesite, dolomite refractories; castable and fused refractory; super refractory; application of refractory.

Books Recommended:

1. L. H. Van Vlack : Elements of Materials Science and Engineering
2. R. E. Smallman : Modern Physical Metallurgy
3. B. D. Cullity : Elements of X-ray Diffraction
4. O. P. Khanna : A Text Book of Material Science
5. R. B. Gupta : Materials Science
6. V. Raghavan : Physical Metallurgy
7. W. K. Callister : Materials Science and Engineering – An Introduction.
8. J.C. Anderson, K. D. Leaver, R. D. Rawling & J. M. Alexander : Materials Science
9. R. E. Smallman and R.J. Bishop : Metals and Materials.
10. W.D. Kingery : Introduction to Ceramics
11. P.P. Bundnikov : The Technology of Ceramics and Refractories
12. C.P. Poole and F. J. Owens : : Introduction to nano technology.

ACCE 3221: Petrochemical Technology

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section-A

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.
3. **Aromatics from Petroleum:** Production of aromatics and their separation, productions of BTX, carbon monoxide and synthesis gas from hydrocarbons.
4. **Catalysts for Petrochemicals Processes:** Catalysts for petroleum refining, catalysts for petrochemicals industry, recent advances in industrial catalysis, role of polymers in catalysis. Future of petrochemicals – energy crisis and petrochemicals industry, energy crisis and industrial fuels and trends in petrochemical industry.

Section-B

5. **Plastic Industry:** Classification of plastics, thermoplastic plastic and thermosetting plastics, properties and uses of plastics, raw materials for plastics, manufacture of phenol-formaldehyde resins (Bakelite), melamine-formaldehyde resins, polyethylene, polypropylene, polyvinyl chloride and polystyrene.
6. **Plastic Processing Technology:** Plastics, elastomerics and fibres, compounding, processing techniques – molding, extrusion, thermoforming, foaming, reinforcing, fibre spinning and others, multipolymer systems and composites, plasticizers and other additives.
7. **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.
8. **Adhesives:** Animal glue, starch adhesives, synthetic adhesives, and cellulose and silicate adhesives.

Books Recommended:

1. N. N. Lebedev : Chemistry and Technology of Basic Organic and Petrochemical Synthesis (Vol. 1 & 2)
2. Sukumar Maiti : Introduction to Petrochemicals
3. Kalichevsky : Chemical Refining of Petrochemicals

4. Flix : Chemistry of Petroleum Derivatives
5. Hrdu and Williams : Petrochemical Industries
6. Huntington : Natural Gas and Natural Gasoline
7. N. Shreve's : Chemical Process Industries
8. P. Ghosh : Polymer Science and Technology of Plastics and Rubbers
9. H.M. Langton : Synthesis Resins and Allied Plastics
10. Sharma : Industrial Chemistry
11. Goldstein : The Petroleum Chemical Industry

ACCE 3231: Pyrometallurgy

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.75 Unit, 3 Credits, 4-5 Periods/Week, Lectures: 50, Duration of Exam: 3 Hours

Section-A

1. **Metallic Minerals and Their Occurrences**: Ore dressing; comminution; sorting and grading; concentration processes; thermal methods of ore preparation - calcination, roasting and sintering.
2. **General Pyrometallurgical Principles:** Ellingham diagram; thermodynamics of reduction of metallic oxides by CO; metallothermic reduction; vacuuo - thermic reduction; matte–smelting; principle of roasting of sulphides into oxides and sulphates.
.3. **Phase Diagrams:** General principles of the phase diagrams of alloys and solid solutions and intermetallic compounds. Study of the Fe-C, Cu-Zn, Al-Cu, Al-Si and Cu-Sn systems.

4. **Extraction:** Principles and general methods of extraction of copper, nickel, lead, tin and zinc.

Section-B

5. **Production of Pig Iron:** Raw materials; blast furnace; production pig iron in blast furnace; chemical reactions taking place in blast furnace; factors affecting the reducibility of iron ores; blast furnace by products and their uses.
6. **Steel Making and Alloys of Steels:** The converter process; nitrogen in the Bessemer steel; the use of oxygen in Bessemer converter; the open hearth process; the use of oxygen in open hearth process; classification and uses of steel; steel making in electrical furnaces; duplex steel making processes; deoxidation and alloying additions; production of steel ingots; plain carbon steels, low alloy steels; high alloy steels; tool and die steels.
7. **Corrosion and Scale Resistant Alloys:** General, iron-chromium alloys, iron-chromium-carbon alloys: iron-nickel alloys, iron-chromium-nickel-carbon alloys, classification, low-alloy, corrosion –resistant steel, chromium steels; 18-8 chromium-nickel steel; light-chromium, high-nickel steel, carbide precipitation; stabilization, application of 18-8 stainless steel.

Books Recommended:

1. A. R. Bailey : A Text Book of Metallurgy
2. J. Newton : Extractive Metallurgy
3. Rhines : Phase Diagrams in Metallurgy
4. Ward : Physical Chemistry of Iron and Steel making
5. R. B. Leighou : Chemistry of Engineering Materials
6. Brick and Philip : Structure and Properties of Alloys
7. Volsky and Sergievskaya : Theory of Metallurgical Process
8. D .S. Clark & W. R. Varney : Physical Metallurgy for Engineers.

ACCE 3241 : Pharmaceutical Technology and Dispensing

50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.5 Unit, 2 Credits, 3 Periods/Week, 33 Lectures, Duration of Exam: 2 Hours

Section-A

1. **Unit Process and Unit Operation in Pharmaceutical Chemistry:** Design, construction and safety measures of pharmaceutical manufacturing plant, principles involved and technique employed in drying, granulation, mixing, clarification, filtration, milling, distillation, control of humidity, refrigeration, air conditioning, piping and storage.
2. **Ointments:** Definition and classification, factors affecting skin absorption, ointment bases, preparation of ointments including dermatological preparations. Ophthalmic ointments.
3. **Emulsions:** Definition and classification, determination of types of emulsion, theory of emulsions, emulsification and emulsifying agents, HLB system, types of emulsifying agents, stability of emulsion, sedimentation or creaming, emulsion stability testing , preparing equipments, industrial manufacture of emulsions, packing and storage.
4. **Aerosols:** Definition and principles, preparation of aerosols, pharmaceutical application, aerosols for typical use, sterile filling, equipments and quality control.

Section-B

5. **Parenteral Products :** Types of parenteral products, advantages and disadvantages, vehicles for parenteral products, containers for parenteral products, closures, cleaning, equipment and preparation of parenteral products including clarification, filling, sterilization, sealing and capping, control requirements for parenteral products, pyrogen tests, sterility tests, inspection for foreign particles,

inspection for leakage, identity, labeling, storage, administration of parenteral products.

6. **Internal and External liquids:** Definitions, flavors, palatability, vehicles for internal and external liquids, preparation of different types of syrups, elixers, compounding of internal and external liquids, liquids manufacturing, the hydrophilic-lipophilic systems.
7. **Capsules:** Definition and administration, hard and soft capsules, dispensing of capsules, prescriptions for hard capsules, enteric coated capsules, use of talets in capsules, machinery used for making hard cpsules and soft capsules and quality control of capsules.
8. Hospital Pharmacy : Professional aspects, literature, service aspects, the hospital pharmacy and radiopharmaceuticals.

Books Recommended

As in courses ACCE 3141 and ACCE 4131

ACCE 3251 : Environmental Chemistry-1
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **The Environment:** Environmental segments. Earth's atmosphere and its composition. Atmospheric regions, atmosphere of the outer regions. Chemical and photochemical reactions in the atmosphere. The astrosphere and related aspects. Evolution of the atmosphere.

2. **Human Impact on Environment**: Depletion of ozone layer, Green house effect, acid rain, ocean acidification and photochemical smog Remedial measures and prevention. Scope of the environmental chemistry.
3. **Pollutants in the Environment:** Definition and classification, occupational pollution. Metals in the environments. Environment and eco-factors. Ecological pyramids. Biological magnification, Biogeochemical cycles in the environment.

Section -B

4. **Chemistry of Air Environment:** Air pollution and its causes; adverse effects of air pollutants, effect of individual pollutants on man, animal, vegetables and materials, pollution from petroleum refining, smelting of non-ferrous ores, manufacture of iron and steel, paint and varnish, chemical works and other industrial processes. . Scope of the environmental chemistry
5. **Air Pollution Control:** . Types and Classification of pollutants. Prevention and remedial measures.
6. **Environmental Sampling and Measurements:** Factors affecting sampling schedules and locations, selection of materials and methods, measurement of

source concentration, ambient concentration, various methods for the determination of major pollutants.

Books Recommended:

1. W. Strauss & S. J. Mainwaring : Air Pollution
2. M. Lippmann & S. Schlesinger : Chemical Contamination in the Human Environment
3. J. Moreton & N. A. R. Falla : Analysis of Airborne Pollutants in Working Atmosphere
4. R A Horne : The Chemistry of Our Environment
5. A. S. Stoker : Air and Water Pollution
6. S.C. Bhatia : Environmental Chemistry
7. V. Arena : Ionizing Radiation and Life
8. H. Dertinger & H. Jung : Molecular Radiation Biology
9. A..K. De : Environmental Chemistry
10. H. Kaur and B.K. Sharma : Environmental Chemistry
11. S.E. Manahan : Environmental Chemistry
12. S.S. Dara : A textbook of Environmental Chemistry and Pollution Control
13. G.M. Masters : Introduction to Environmental Engineering and Science

ACCE 3262 : Metallurgy and Pharmaceutical Chemistry (LAB)
100 Marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 1.00 unit, 4 Credits, 12 Periods/Week

(i) Metallurgy

1. Use of chemical (volumetric), spectrophotometric, atomic absorption spectrophotometric and flame photometric techniques in metallurgical analyses.
2. Analyses of commercially available cast iron, various types of steel and stainless steel, and other ferrous and non ferrous alloys.
3. Analyses of available ores, slags and scraps.

(ii) Pharmaceutical Technology

1. Synthesis and preparation of compounds of medicinal importance e.g. aluminium hydroxide, sulphanilamide, magnesium hydroxide, p-aminobenzoic acid, etc.
2. Volumetric estimation of active constituents in pharmaceutical preparations in current use.
3. Pharmaceutical analysis involving use of gas liquid chromatography, fluorimeters, electrophoresis and partition chromatography.
4. Formation and compounding of the following: Syrups, tablets, ointments, exlixers, tinctures, emulsions and aerosols.
5. Qualitative test of amino acids, carbohydrates and proteins.

ACCE 3270 Board Viva Voce
50 Marks, 0.5 Unit, 2 Credits.
Students have to appear before the examination committee for Viva Voce on both theoretical and practical courses

ACCE 4111 : Polymer Science

100 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 1 Unit, 4 Credits, 6 Periods/Week, 66 Lectures, Duration of Exam: 3 Hours

Section A

1. **Basic Concept of Polymers:** Classification of polymers, natural and synthetic polymers, organic and inorganic polymers, distinction between simple molecules and polymers, linear, branched and crosslinked polymers, chemical and geometrical structure of polymer molecules, crystallinity in polymers, glass transition temperature (T_g), important uses of high polymers.
2. **Polymerization:** Types of polymerization – step reaction (condensation), radical chain (addition) and ionic chain polymerizations, mechanism and kinetics of polymerizations: initiator and initiation, propagation and termination, polymerization techniques, miscellaneous polymerization reactions.
3. **Copolymerization:** Copolymerization, free radical copolymerization, ionic copolymerization, copolycondensation, monomer reactivity ratio, types of copolymerization, block & 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, methods for determination of molecular weight of high polymers, significance of molecular weight and molecular weight distribution curves.

Section B

5. **Polymerization with Complex Co-ordination Catalysts:** Heterogeneous and homogeneous Ziegler-Natta polymerizations, Ziegler-Natta copolymerization, metal oxide catalysts, catalysts, Metathesis polymerization.
6. **Natural Polymers: Cellulose** – Sources and isolation, fibre structure – cellulose molecule, supermolecular structure and ultrastructure, cellulose allomorphs and their interconversion, mercerization of cellulose, cellulose derivatives, degradation reactions of cellulose, vegetable fibres. **Protein polymers** – silk and wool, composition and structure of mulberry silk, properties of silk.
7. **Inorganic Polymers:** Inorganic polymers, homopolymers and heteropolymers, silicon polymers – polysilane polymers, preparation and chemical modification of polysilane polymers, properties and uses,

polysiloxane and polysilicate polymers, polyphosphazene polymers, coordination polymers and sol-gel.

8. **Dyeing of Polymers:** Dyes and dyeing, modern concepts of dyeing, dye-fibre bondings, mechanism and kinetics of dyeing, factors affecting dyeing, dye intermediates, preparation of some important dyes and dye intermediates.

Book Recommended:

1. G. Odian : Principles of Polymerization
2. Gowariker, Viswanathan & Sreedhur : Polymer Science
3. C. E. H. Bawn : The Chemistry of High Polymers
4. J. L. Koening : Chemical Microstructure of Polymer Chain
5. R. H Peters : Textile Chemistry (Vol. 1, 2 & 3)
6. E. Sjostrom : Wood chemistry fundamentals and applications
7. M. Lewin and I. S. Goldstein : Wood Structure and Composition
8. P. Ghosh : Polymer Science & Technology of Plastics and Rubber
9. F. W. Billmeyer : Text Book of Polymer Science
10. P. Flory : Principles of Polymer Chemistry
11. G.S. Misra : Introduction to polymer chemistry
12. Cockett & Hilton : Dyeing of Cellulosic fibres and Related Processes
13. F. Sadov, Korchagim and Matetsky : Chemical Technology of Fibrous Materials
14. E.R. Trotman : Dyeing and Chemical Technology of Textile Fibres
15. M. P. Stevens : Polymer Chemistry: an Introduction

Course Code No.: ACCE 4121
Course Title: Chemical Engineering-IV (Mass Transfer Operation and Utility Appliances)
Full Marks: 100 [Exam. 70%, Quizzes/Class Tests 20%, Attendance 10%],
Unit: 1.0, Credit: 4, Duration of Examination: 4 Hours,
Periods/Weeks: 06, No. of Lectures: 66.

Section-A

1. **Equipment for Gas-Liquid Operations:** Stage efficiency, agitated vessel, tray towers, shell and trays, trays spacing, towers diameter, bubble cap trays, tray efficiency, point efficiency, Murphree tray efficiency, liquid dispersed equipment, venturi scrubbers, wetted wall towers, packed towers, packing materials.
2. **Gas Absorption:** Equilibrium solubility of gases in liquids, ideal liquid solutions, non ideal liquid solutions, material balances, minimum liquid-gas ratio for absorbers, counter current multistage operation.

3. **Liquid Extraction:** Fields of usefulness, single stage equipment, multistage equipment, liquid equilibria, choice of solvent, stage wise contact, stage calculation.
4. **Refrigerator:** Application of refrigeration in chemical industries, refrigerating capacity, compression refrigeration, comparison of refrigerants, absorption refrigeration.

Section-B

1 **Mass Transfer:** General principle of diffusional processes, molecular and eddy diffusion, transfer of material between phases.

2. **Distillation:** Boiling point diagram and equilibrium diagram, method of distillation , types of fractionating column, heat and material balance of fractionating column, number of plate calculation, location of feed plate, reflux ratio, entrainment.
3. **Compressor:** Compression and expansion of fluids; Compression equipment, work of single-stage compressor, effect of clearance stage compression. Joule-Thomson or throttling expansion.
4. **Adsorption:** Types of adsorption, nature of adsorbents, adsorption equilibria, adsorption isotherm, the Freundlich equation, application of adsorption as a unit operation.

Books Recommended:

1. Van Winkle – Distillation.
2. Robinson and Gilliland - Elements of Fractional Distillation.
3. W. L. Badger and J. T. Banchero - Introduction to Chemical Engineering.
4. B. F. Dodge - Chemical Engineering Thermodynamics.
5. R. E. Treybal - Mass Transfer Operations
6. A. S. Foust et al. - Principles of Unit Operation.
7. V.P. Vasandan & D. S. Kumar - Heat Engineering.
8. McCabe, J. C. Smith and Harriot - Unit Operations of Chemical Engineering
9. J. M. Smith, H. C. Von Ness and M. M. Abbott - Introduction of Chemical Engineering Thermodynamics.

ACCE 4131: Pharmaceutical Chemistry and Pharmaceutics

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 4-5 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Alkaloids:** General method employed in their isolation, purification and identification; Chemistry of the principal alkaloids of ergot, tobacco, pepper, rawolfia and pomegranate.
2. Chemistry of glycosides with emphasis on cardiac glycosides of digitalis.
3. **Antibiotics:** Production, chemistry, actions and uses of different penicillins, streptomycin, chloramphenicol and tetracycline.

4. **Vitamins:** History, occurrence, classification and chemistry of vitamins A, D, E and K.

Section-B

5. **Hormones:** Chemistry and physiological functions of the following: (a) Thyroid hormone (b) Insulin (C) Progesterone (d) Testosterone (e) Adrenaline (f) Cortisone (g) Estrone and (h) Synthetic sex hormones.
6. **Tablet Making:** Weights and measures; formulation and compounding of tablets by (i) wet & (ii) dry granulation methods; slugging and capping of tablets; disintegration test for compressed tablets; essential qualities of a good tablet; advantages and disadvantages of tablets as medicinal dosage form.
7. **Drugs:** Stability and preservation of drugs.
8. Drug incompatibilities, contra indication and adverse effects, types of incompatibilities, drug interaction, Over-Counter-Medicines, Examples of drug interactions warnings.

Books Recommended:

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

ACCE 4141: Electrometallurgy
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **Principles of. Electrodeposition :** Faraday's law of electrolysis, current and energy efficiency of electrolysis, principles of electrodeposition of metals and alloys, throwing power and its measurement, mechanism of electro - deposition, composition of cathode, film structures of electrodeposits, effects of operating conditions, bath composition and properties and basis metal upon the nature of deposits, characterization of the deposits such as thickness measurements, surface analysis, protection against corrosion, adhesion, wear resistance, etc.

2 **Batteries:** Primary cells - Leclanche cells; flat type of dry Leclanche cell; magnesium dry cell; air-depolarized cell; various oxide-depolarized cells; chloride - depolarized cells. Secondary cells - general consideration of performance; lead - acid accumulator - constraction, capacity, factors aftecting capacity, efficiency; alkaline cell - construction, cell reactions, capacity efficiency, uses; silver - zinc accumulator - cell reaction, performace.

3. **Fuel Cells:** Thermodynamic efficiency of fuel cell; electromotive force fuel cells; rates of electrode processes; low temperature cells, medium and high temperature cells; air depolarized and other cells: fuel cell operation; application, economics and future of fuel cells.

Section-B

4. **Electrolysis of Fused Salts:** General principles, scopes and applications. Electrolysis of Al, Mg, Na and Zn.

5. **Electrowining and Electrorefining :** General principles and applications of electrowinning and electrorefining. Electrowinning of Cu, Zn, Co and Ni. Electrorefining of Cu, Ni, and Al; treatment of anode mud.

6. **Electroplating:** Electroplating of Cu, Ni, Cr, and brass.

Books Recommended

1. Greef, Peat, Peter, Pletcher & Robinson	Instrumental Methods in Electrochemistry.
2. E. C. Potter :	Electrochemistry
3. L. Mantell :	Industrial Electrochemistry
4. Bockris & Reddy	Modern Electrochemistry
5. Blum & Hogaboom	Principles of Electroplating and Electroforming.
6. F. A. Lowenheim :	Modern Electroplating
7. G. W. Vinal :	Primary Batteries
8. G. W. Vinal :	Storage Batteries.
9. Angus Mc Dougall :	Fuel cells

ACCE 4151 : Industrial Hazards and Waste Management
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 3 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **Chemical Hazards and Risk Characterization:** Types of hazards. Industrial pollutants in the environment. Hazard identification and classification. Occupational exposure and control. Legislative acfivities regarding chemical hazards. Pollution hazards in chemical industries. Loss prevention and risk analysis. Preliminary hazard analysis (PHA). Hazard evaluation and process safety management. Safety symbols. Chronic daily intake (CDI), Bioconcentration factor (BCF), Risk assessment for chloroform in drinking water.
2. **Control of Chemical Plant Hazards:** Industrial plant lay out. Ventilation and lighting. Pressure vessels Safe storage, handling and transportation. Electrical systems. Fire hazards and prevention,controls for health Hazards. Personal protective devices. Laboratory safety. Maintenance procedure. Emergency procedure and mutual aid. Handling and management of Chemicals in the BCIC factories.
3. **Current Industrial Environmental Status:** Concept of threshold limit values. Sampling procedure, formulation of guidelines and discharge standards of various industries, permit systems for discharges/emissions. Environmental management plan (EPM). Objectives and Components of EMP. Matrix of EMP and its implementation. Pollution control laws and acts. Case studies with few chemical industries.

Section-B

4. **Industrial Wastes and Treatment Processes:** Characteristics and types of industrial effluents and wastes. Principles of industrial waste treatment. General methods of treatment: Preliminary, primary secondary and tertiary

treatment of industrial wastes. Treatment of wastes or effluents with organic and inorganic impurities. Removal of phosphorus and nitrogen from wastewaters. Suspended solids removal. Ultimate disposal.

5. **Hazardous Waste Managent :** Origin and amounts of hazardous wastes. Types of hazardous wastes. Biomedical wastes. Hazardous wastes in the geosphere, hydrosphere, atmosphere and biosphere. Management of hazardous wastes. Off side hazardous waste disposal. Codisposal. Security landfill. Characteristics of solid waste: Methods of solid waste treatment. Microbiology involved in solid waste disposal. Radioactive waste disposal. Converting radiowaste into solid form and its management. Hazardous substances and health.
6. **Conservation and Re-use of Industrial Wastes:** Construction materials from waste. Utilization of agricultural wastes: medicines, liquid fuels. Urban waste and bagasse for electricity. Biomass into rural power. Rubber from old tyres. Oil from plastic waste, acacia. Particle board and Silica from rice husk. Jute wastes into paper and board Plastic for heat and electricity generation. Paints from potatoes. Wealth from flyash. Converting garbage into fuel, fertilizers and power. Wastewater reuse.

Books recommended:

1. S.E. Manahan : Hazardous Waste: Chemistry, Toxicology and Treatment
2. S.E. Manahan : Environmental Chemistry.
3. C. Baird : Environmental Chemistry.
4. B.K. Sharma and H. Kaur : Environmental Chemistry.
5. T. Sawyer and E. Martell : Industrial Environmental Chemistry.
6. J.M. Dallavalle : The Industrial Environment & its Control.
7. E. Jogensen : Industrial Waste Water Management.
8. R.K. Sapru : Environmental Planning & Management.
9. D. Jacob : The Analytical Chemistry of Industrial Poisons, Hazards and Solvents.
10. S.M. Mosters : Introduction to Environmental Engineering and Science.
11. Metcalf and Eddy : Wastewater Engineering.

ACCE 4162 : Polymer Science & Pharmaceutical Chemistry (LAB)

100 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 1 Unit, 4 Credits, 12 Periods/Week

(i) Pharmaceutical Chemistry and Pharmaceutics

1. Preparation of inorganic & organic compounds of medicinal importance: Aspirin, phenacetin, sulphaguanidine, magnesium trisilicate, magnesium sulphate and paracetamol.

2. Assay of sulphadrugs, antibiotics, vitamins, calcium gluconates, piperazine citrate, and disodium hydrogen citrate.
3. Determination of active constituents of important drugs and pharmaceutical preparations
4. Estimation of urine: Estimation of main constituents of urine; determination of abnormal constituents of urine.
5. Sterilization process and sterility test, pyrogen testing, alkalinity test for glass containers.
6. Determination of total-nitrogen, protein-nitrogen and non-protein nitrogen in a supplied sample by Micro-Kjeldahl method.
7. Identification of amino acids in a protein by paper chromatography and thin-layer chromatography.
8. Estimation of amino acids in a protein by spectrophotometric method.

(ii) Polymer Science

1) Estimation of cellulose, hemicellulose and lignin in a sample of jute fibre and baggage.
2) Characterization of cellulose samples by determination of (i) copper number, (ii) methoxy content and (iii) solution viscosity
3) Determination of molecular weight of high polymers by viscosity and osmotic pressure measurements.
4) Determination of water repellency and tensile strength of jute and cotton fibres.
5) Preparation of synthetic polymers.
6) Casting of cellulose acetate film.
7) Proximate and ultimate analyses of coal, low temperature carbonization of coal, ignition temperature of coal and coke.
8) Determination of octane number and cetane number of liquid fuels; carbon residue test, cloud and pour point, aniline point, diesel index, flash fire points, viscosity indices, boiling points range,
9) Calorific values of solids, liquids and gaseous fuels; composition of gaseous fuels.

ACCE 4172 : Project work
50 Marks [35% supervision, 35% External Examiner, 30.% Presentation- Oral Examination], 0.05 Unit, 2 Credits, 6 Periods/Week

On choosing a teacher of ACCE as supervisor (to be approved by the Academic Committee), each student will select a problem in any field of Applied Chemistry, Chemical Engineering or Chemical Technology. The problem must require experimental work to write up a report to be submitted to the Examination Committee.

Course Code No.: ACCE 4211

Course Title: Chemical Engineering-V (Reaction Engineering, Plant Design and Process Control)

Full Marks: 100 [Exam. 70%, Quizzes/Class Tests 20%, Attendance 10%],
Unit: 1.0, Credit: 4, Duration of Examination: 4 Hours,
Periods/Weeks: 06, No. of Lectures: 66.

Section - A

1. **Reactor:** Classification of reactors, single ideal reactors, ideal batch reactors, space time and space velocity, steady-state mixed flow reactor, steady-state plug flow reactor.
2. **Chemical Reactor Design:** Homogenous reactions, interpretation of kinetic data, kinetic models for homogeneous reactions, testing of kinetic model.
3. **Catalysis and Catalytic Reactors:** Catalysis, steps in a catalytic reaction, synthesizing a rate law, mechanism and rate-limiting step, heterogeneous data analysis for reactor design, catalyst deactivation.
4. **Non-ideal flow :** Residence time distribution of fluid in vessels, conversion directly from tracer information, models for non-ideal flow, dispersion model, tamks in series model, multiparameter model.

Section - B

5. **General Design Consideration:** Plant location, plant layout, flow diagram, plant operation, utilities, structural design.
6. **Plant Economics:** Plant depreciation, profitability, alternative investments and replacements, optimum design and design strategies.
7. **Design and Cost Analysis:** Design and cost analysis of mass transfer equipment, heat transfer equipment and chemical reactor.
8. **Pilot Plants, Models and Scale-up:** Importance of pilot plant study and models, principle of similarity, dimensional analysis, similarity criteria, extrapolation, scale up of heat transfer and mixing equipment, packed towers and chemical reactors.

Books Recommended:

1. M.S. Peters Timmerhaus - Plant Design and Economics for Chemical Engineering
2. R. E. Johnston - Pilot Plant Models and Scale-up Methods in Chemical Engineering
3. O. LevenSpiel - Chemical Reaction Engineering
4. A.K.M. Abdul Quader - Design and Building of Process Plants.
5. Denbigh – Chemical Reactor Theory
6. A.E. Fribance - Industrial Instrumentation Fundamentals.
7. H.E. Schweyer - Process Engineering Economics.
8. Coughanowr & Koppel - Process Systems Analysis and Control.
9. Orman H. Ceaglske - Automatic Process Control for Chemical Engineers.

ACCE 4221: Hydrometallurgy

75 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance], 0.75 Unit, 3 Credits, 6 Periods/Week, 50 Lectures, Duration of Exam: 3 Hours

Section-A

1. **Leaching:** General principles; leaching agents; methods and equipments; leaching of metals; leaching of oxides: bauxite, uranium ores and manganese dioxide.
2. **Cyanidation of Gold and Silver:** Theories and mechanisms of dissolution of gold and silver in cyanide solutions; effects of various parameters on the cyanidation of gold and silver; recovery of Au and Ag from cyanide leach solutions.
3. **Leaching of Sulphides:** Acid, alkali, and alkali cyanides; theories and mechanisms; bacterial leaching.
4. **Solvent Extraction:** Definitions; extractants; diluents; modifiers; theory and mechanism of extraction and stripping; nature of organic and aqueous phases; engineering aspects of solvent extraction.

Section-B

5. **Ion-exchange:** General principles; ion-exchange materials; characteristics of ion-exchange materials; ion-exchange properties in aqueous media; ion-exchange properties in non-aqueous media; recovery from leach solutions and metal separations: lanthanides, uranium and thorium.
6. **Precipitation of Metals by Hydrogen Reduction:** Theory of metal precipitation ; thermodynamics; kinetics; mechanism of precipitation and role of additives; application to recovery and separation of copper, cobalt and nickel and separation of copper from zinc.
7. **Extraction of Metals :** Extractions of Al, U, Th, Ni, Cu, Co and Zn by hydrometallurgical processes; production of semi-conductor metals like Si, Ga, Ge, Tc,Cd etc.
8. **Preparation of Metallic** Compounds of Commercial Importance from Metallic Ores: $Al_2(SO_4)_3$, $Al(OH)_3$ $NiSO_4$, Mo-compounds, Pt-compounds, TiO_2, Cr_2O_3 ZrO_2 $K_2Cr_2O_7$ and recovery of Sn, Pb, Zn, Ni, V, Ag etc from metallic wastes.

Book Recommended:

1. F. Habashi : Principles of Extractive Metallurgy
2. A.R. Burkin : The chemistry of Hydrometallurgical Processes.
3. N. Shrieve : Chemical Process Industries
4. Kirk & Olhmes : Encylopaedia of Chemical Technology
5. Kunin : Ion-Exchange
6. G.H. Morrison & H. Freiser : Solvent Extraction in Analytical Chemistry

7. V.V. Fomin : Chemistry of Extraction Process
8. S. Venkatachalam : Hydrometallurgy

ACCE 4231: Textiles - Chemistry and Technology
50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance] 0.5 Unit, 2 Credits, 4 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **Textile Fibres:** Specific Features of Textile Fibres, classification, chemical constitutions of some important fibres, physical properties, chemical properties – moisture relations and chemical relations.
2. **Yarn and Fabric Manufacture:** Spinning – preparatory processes, carding, combing, drawing and spinning; fabric manufacture – preparatory processes, weaving, woven fabrics, knitted fabrics, lace fabrics and felts.
3. **Textile Fibres**: Classification, cellulosic fibres – cotton and rayon, protein fibres – silk and wool, polyamides, polyesters and acrylic fibres.

Section-B

4. **Chemical Finishing of Textiles:** Introduction, creping, softening, starch finishes, weighting, anti-shrink cotton, synthetic resins, waterproofing, mothproofing, fireproofing and mildew- and rot- proofing.
5. **Testing and Identification of Textile Fibres and Dyed Materials:** Testing of textile fibres - Objective of testing fibres, non-technical tests, technical tests and chemical tests, testing of dyed materials – determination of fastnesses and identification of dyes.
6. **Environmental Impact of the Textile Industry:** Introduction, environment – local, regional and global, environmental impacts of the textile industry, and approaching the problems, health safety aspects of dyeing industry.

Books Recommended:

1. J. T. Marsh : Textile Science
2. J. T. Marsh : An Introduction to Textile Finishing
3. H.L. Needle : Textile Fibres, Finishes and Processes
4. E.P.J Gohl and Vilensky : Textile Science
5. V.A. Shenai : Technology of Textile Processing (Vol. I to X)
6. Sadov, Korchagim, Matetsky : A Chemical Technology of Fibrous Materials
7. E.R. Trotman. : Dyeing and Chemical Technology of Textile Fibres
8. R. H. Peters : Textile Chemistry (Vol. 1, 2 & 3)
9. J. F. Booth : Principles of Textile Testing
10. Bernard P. Corbman : Textiles: Fiber to Fabric
11. D.G.Duff & R.S.Sinclair : Giles's Laboratory Course in Dyeing
12. Man-made Fibres : R. W. Moncrief Kent's and Riegel Handbook of Industrial Chemistry and Biotechnology

ACCE 4241 Corrosion Engineering-II

50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 4 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1. **Corrosion Prevention:** Materials selection; alteration of environment; design; cathodic and anodic protection, coatings and electroplating.
2. **Corrosion Testing:** Physico-chemical methods; electrochemical methods; factors involving reproducibility; advantages and disadvantages of diffirent corrosion testing methods; corrosion inspection and monitoring, corrosion rate expressions; general ideas of corroded surface analysis by X-ray, EDAX, XPS, AES and ESCA.
3. **Treatment of Water and Steam Systems:** Deaeration and deactivation; hot- and cold-water treatment; boiler-water treatment for corrosion control, mechanisms.

Section-B

4. **Corrosion Under Various Environments:** Corrosion in mineral acids, organic acids, alkalies, sea water and fresh water; atmospheric corrosion and underground corrosion.
5. **Corrosion in Other Environments:** Corrosion in human body, automobile corrosion, dew point corrosion, corrosion under insulation, corrosion in sewage and plant-waste treatment and in pollution control, corrosion of metals by halogens and corrosion of electronic equipment
6. **Corrosion in Industries:** Corrosion in; gas turbine blades; chemical industries; petroleum industry; building industry and fertilizer industry; and pulp and paper industries.

Books Recommended:

Same as in course ACCE 3151 Corrosion Engineering-I

ACCE 4251 : Environmental Chemistry-II

50 Marks [70% Exam, 20% Quizzes/Class Tests, 10% Attendance]
0.5 Unit, 2 Credits, 4 Periods/Week, Lectures: 33, Duration of Exam: 2 Hours

Section-A

1 **Chemistry of Water Environment:** Water pollution and its causes, adverse effects of water pollutants. Pollution from industrial, agricultural, domestic and other sources. Water pollution and wild life. Aquifers, hydraulic gradient,,

Groundwater flow: Darcy's law. Microbial systems in water, eutrophication, salinity.

2. **Prevention and Control of Water Pollution:** Mrehods of control. General options: Trickling filter, Electrodialysis, Reverse osmosis.
3. **Environmental Toxicology:** Chemicals in the internal environment, uptake, translocation, metabolism and excretion of plants and animals, chemical localization and its consequences toxicity of heavy metals, toxicity of food additives and drugs, pesticides, germicides, toxic substances released by microorganisms, atmospheric toxicants, assessment of environmental risk.

Section-B

4. **Environmental Radioactivity:** Sources of radionuclides in the environment. effect of radiation on environment, effects of ionizing radiation on man, Radiation damage to DNA, transmission of radioactive fall out in food chain of man, The risks and benefits of radiation. Preventive measures from radiation. Radioactivity atlas with special reference to Bangladesh. Indoor radon level and radiation hormesis.
5. **Environmental Problems in Bangladesh** : Environmental degradation from industries, factories, and agricultural fields. Domestic wastes and disposals, weather change, water supply and sanitation. Water quality management in rivers.
6. **Environmental monitoring and Impact assessment** : Necessity, monitoring systems, physicochemical monitoring. Bangladesh Standards for drinking water, irrigation water, industrial effluent and ambient air. Definitions and essentials of Environmental Impact Assessment.

Books Recommended:

1. J.N. Duffus : Environmental Toxicology
2. R A Home : The Chemistry of Our Environment
3. De Bruin : Biochemical Toxicology and Environmental Agents
4. A.S. Stoker : Air and Water Pollution
5. S.C. Bhatia : Environmental Chemistry
6. V. Arena : Ionizing Radiation and Life
7. H. Dertinger & H. Jung : Molecular Radiation Biology
8. A.K. Dc : Environmental Chemistry
9. H. Kaur and B.K. Sharma : Environmental Chemistry.

ACCE 4262 : Corrosion and Chemical Engineering (LAB)

100 marks [60% Practical/Report, 30% Quizzes and Viva Voce, 10% Attendance], 1 Unit, 4 Credits, 16 Periods/Week

(i) Chemical Engineering-II

1. Use of Micro computers in material balance calculation.

2. Measurement of viscosity of liquids, fluid flow.
3. Measurement of specific heat and heat capacities of liquids.
4. Measurement of overall heat transfer coefficient.
5. Mass and energy balance for an open evaporator.
6. Crystallization of sugar from sugar cane juice in a batch crystallizer
7. Calculation of HETS value of a column (packed)
8. Construction of Boiling point diagram
9. Determination of particle size by standard screen.
10. Determination of particle size by Anderson sedimentation pipette
11. Construction of Binodal curve for ternary system.
12. Computer aided material and energy balance calculation.
13. Determine reaction rates, space time and space velocity of an esterification reaction using a steady-state mixed flow reactor.
14. Determine reaction rate of a liquid phase homogeneous reaction using a steady-state plug flow reactor.

(ii) Corrosion

1. Plating of iron and steel by Ni, Cu, Sn, brass and bronze, and determination of the plating quality by measuring layer thickness.
2. (i) Measurement of the corrosion rates of base metals galvanically coupled with different area ratios of the noble metals.
   (ii) Determination of the corrosion rates of carbon steels, galvanised steels and aluminum and nickel in various aggressive media.
3. High temperature oxidations of metals and alloys and their effects on corrosion

ACCE 4272 : In-plant Training

50 Marks [10% participation, 30% quizzes/Viva Voce, 60% report (30% by one examiner and 30% by other examiner), 0.50 Unit, 2 Credits, 1 month's training duration

Each student have to submit a report on the training to the examination commettee

ACCE 4280 Board Viva Voce

50 Marks, 0.5 Unit, 2 Credits.

Students have to appear before the examination committee for Viva Voce on both theoretical and practical courses